



**DEPARTMENT OF WATER AND SANITATION
REPUBLIC OF SOUTH AFRICA**

BID W11237

CLOSING DATE AND TIME

17 OCTOBER 2017

ESTABLISHMENT OF A PANEL FOR THE SUPPLY AND DELIVERY OF ELECTRONIC DATA LOGGING EQUIPMENT, INTEGRATED DATA LOGGING SYSTEMS, SENSORS AND POWER SUPPLY EQUIPMENT FOR THE MEASUREMENT AND TRANSMISSION OF HYDROLOGICAL PARAMETERS, FOR A PERIOD OF TWENTY FOUR (24) MONTHS ON AN AS AND WHEN REQUIRED BASIS

Compulsory briefing Session

**Date: 03-October-2017
Venue: Department of Water and Sanitation
Francis Baard Street (formerly Schoeman)
173 Emanzini Building, G18 Board Room
Pretoria, 0001
Time: 10:00 am**

**BID DOCUMENTS MAY BE POSTED TO:
POSTAL ADDRESS: DIRECTOR-GENERAL: WATER AND SANITATION
PRIVATE BAG X 313
PRETORIA, 0001**

OR

**DEPOSITED IN THE BID BOX SITUATED AT (STREET ADDRESS)
THE TENDER BOX AT THE ENTRANCE
OF ZWAMADAKA BUILDING
157 SCHOEMAN STREET
PRETORIA, 0002**

BIDDER: (Company address and stamp)

COMPILED BY: HYDROLOGICAL SERVICES

DEPARTMENT OF WATER AND SANITATION

BID W11237

ESTABLISHMENT OF A PANEL FOR SUPPLY AND DELIVERY OF ELECTRONIC DATA LOGGING EQUIPMENT, INTEGRATED DATA LOGGING SYSTEMS, SENSORS AND POWER SUPPLY EQUIPMENT FOR THE MEASUREMENT AND TRANSMISSION OF HYDROLOGICAL PARAMETERS, FOR A PERIOD OF TWENTY FOUR (24) MONTHSON AN AS AND WHEN REQUIRED BASIS.

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INVITATION TO BID

YOU ARE HEREBY INVITED TO BID FOR REQUIREMENTS OF THE (NAME OF DEPARTMENT/PUBLIC ENTITY)

BID NUMBER: **W11237**

CLOSING DATE: **17 OCTOBER 2017**

CLOSING TIME: **11:00**

The successful bidder will be required to fill in and sign a written Contract Form (SBD 7).

BID DOCUMENTS MAY BE POSTED TO:

**POSTAL ADDRESS: DIRECTOR-GENERAL: WATER AND SANITATION
PRIVATE BAG X 313
PRETORIA,0001**

OR

**DEPOSITED IN THE BID BOX SITUATED AT (STREET ADDRESS)
THE TENDER BOX AT THE ENTRANCE
OF ZWAMADAKA BUILDING
157 FRANCIS BAARD STREET
PRETORIA,0002**

Bidders should ensure that bids are delivered timeously to the correct address. If the bid is late, it will not be accepted for consideration.

The bid box is generally open 24 hours a day, 7 days a week.

ALL BIDS MUST BE SUBMITTED ON THE OFFICIAL FORMS – (NOT TO BE RE-TYPED)

THIS BID IS SUBJECT TO THE PREFERENTIAL PROCUREMENT POLICY FRAMEWORK ACT AND THE PREFERENTIAL PROCUREMENT REGULATIONS, 2011, THE GENERAL CONDITIONS OF CONTRACT (GCC) AND, IF APPLICABLE, ANY OTHER SPECIAL CONDITIONS OF CONTRACT

**THE FOLLOWING PARTICULARS MUST BE FURNISHED
(FAILURE TO DO SO MAY RESULT IN YOUR BID BEING DISQUALIFIED)**

NAME OF BIDDER

POSTAL ADDRESS

STREET ADDRESS

TELEPHONE NUMBER CODE.....NUMBER.....

CELLPHONE NUMBER

FACSIMILE NUMBER CODE NUMBER.....

E-MAIL ADDRESS

VAT REGISTRATION NUMBER

HAS AN ORIGINAL AND VALID TAX CLEARANCE CERTIFICATE BEEN SUBMITTED? (z) YES or NO

HAS A B-BBEE STATUS LEVEL VERIFICATION CERTIFICATE BEEN SUBMITTED? (SBD 6.1) YES or NO

IF YES, WHO WAS THE CERTIFICATE ISSUED BY?

AN ACCOUNTING OFFICER AS CONTEMPLATED IN THE CLOSE CORPORATION ACT (CCA).....
A VERIFICATION AGENCY ACCREDITED BY THE SOUTH AFRICAN ACCREDITATION SYSTEM (SANAS); OR.....
A REGISTERED AUDITOR
[TICK APPLICABLE BOX]

(A B-BBEE STATUS LEVEL VERIFICATION CERTIFICATE MUST BE SUBMITTED IN ORDER TO QUALIFY FOR PREFERENCE POINTS FOR B-BBEE)

**ARE YOU THE ACCREDITED REPRESENTATIVE
IN SOUTH AFRICA FOR THE GOODS / SERVICES / WORKS OFFERED?**

**YES or NO
[IF YES ENCLOSE PROOF]**

SIGNATURE OF BIDDER

DATE

CAPACITY UNDER WHICH THIS BID IS SIGNED

TOTAL BID PRICE..... TOTAL NUMBER OF ITEMS OFFERED

ANY ENQUIRIES REGARDING THE BIDDING PROCEDURE MAY BE DIRECTED TO:

Department: Water and Sanitation

Contact Person: JACOB MABUSELA

Tel: 012 336 7240

Fax:

E-mail address: mabuselaj@dws.gov.za

ANY ENQUIRIES REGARDING TECHNICAL INFORMATION MAY BE DIRECTED TO:

Contact Person: Mr.Chris Lloyd

Tel: 051 – 405 9248

Fax: 051 – 430 2166

E-mail address: lloyd@dws.gov.za

DEPARTMENT OF WATER AND SANITATION

BID W11237

SUPPLY AND DELIVERY OF ELECTRONIC DATA LOGGING EQUIPMENT, INTEGRATED DATA LOGGING SYSTEMS, SENSORS AND POWER SUPPLY EQUIPMENT FOR THE MEASUREMENT AND TRANSMISSION OF HYDROLOGICAL PARAMETERS, FOR A PERIOD OF TWENTY FOUR (24) MONTHSON AN AS AND WHEN REQUIRED BASIS

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DEPARTMENT OF WATER AND SANITATION

BID W11237

ESTABLISHMENT OF A PANEL FOR SUPPLY AND DELIVERY OF ELECTRONIC DATA LOGGING EQUIPMENT, INTEGRATED DATA LOGGING SYSTEMS, SENSORS AND POWER SUPPLY EQUIPMENT FOR THE MEASUREMENT AND TRANSMISSION OF HYDROLOGICAL PARAMETERS, FOR A PERIOD OF TWENTY FOUR (24) MONTHSON AN AS AND WHEN REQUIRED BASIS

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INSTRUCTIONS TO BIDDERS

1. ISSUING OF DOCUMENTS

- (a) A complete set of bid documents are issued to a prospective Bidder. These documents are obtainable at
- (b) Bidders must satisfy themselves that the document is complete and conform to the index of this document. Should any figures or writing be indistinct or should any pages be missing from this document or should this document or the drawing(s) contain any obvious errors, the Bidders must immediately notify the Department in order to have any discrepancy rectified or clarified before submitting his bid. Such clarification will be valid only if made by the Department by means of formal amendment as described hereunder prior to the date of submission of bids. The Department may issue amendments to clarify or modify the Bid Documents. A copy of each amendment will be issued to each bidder and shall be acknowledged on the form issued with the amendments. No claim whatsoever will be entertained for faults in the bid price resulting from the above-mentioned discrepancies.
- (c) No alterations, omissions or additions shall be made to this document, but should it be deemed necessary to do so, the Bidder is at liberty to qualify his bid.
- (d) All Bidders shall be deemed to have waived, renounced and abandoned any conditions printed or written upon any stationery used by them for the purpose of or in connection with the submission of bids which are in conflict with the conditions laid down in this document.

2. QUERIES WITH RESPECT TO THIS BID

Queries of a specific technical nature may be discussed personally or telephonically with Chris Lloyd telephone 051 405 9248

3. COMPLETION OF BIDS

- (a) The bid must be signed on the Invitation to Bid form (SBD 1) annexed hereto with all blanks in the bid and the appendix filled in.
- (b) All spaces in the bid forms and other annexures shall be completed in full.
- (c) The Technical Schedule contained in the bid document and the Pricing Schedule must be fully completed and priced out by the bidder. Failure to do so will deem your bid invalid.
- (d) The bid documents shall not be separated in any way nor must any pages be detached from the original documents.

4. SUBMISSION OF BIDS

- (a) The original Bid, together with a covering letter and supporting documents, shall be sealed in an envelope endorsed:

"ORIGINAL BID FOR BID ESTABLISHMENT OF A PANEL FOR SUPPLY AND DELIVERY OF ELECTRONIC DATA LOGGING EQUIPMENT, INTEGRATED DATA LOGGING SYSTEMS, SENSORS AND POWER SUPPLY EQUIPMENT FOR THE MEASUREMENT AND TRANSMISSION OF HYDROLOGICAL PARAMETERS, FOR A PERIOD OF TWENTY FOUR (24) MONTHS ON AN AS AND WHEN REQUIRED BASIS

and the name of the Bidder shall be clearly shown.

- (b) Bids endorsed as above, will be received by: The Supply Chain Management Office or may be deposited in the bid box at the entrance of the Department Of Water and Sanitation, Zwamadaka Building not later than 11:00 on the date stipulated on the front cover of this document.

5. SIGNATURE ON BIDS

The Bid, if by an individual, must be signed by that individual or by someone on his behalf duly authorised thereto and proof of such authority must be produced. If the bid is by a Company it must be signed by a person duly authorised thereto by a Resolution of a Board of Directors a copy of which Resolution, duly certified by the Chairman of the Company is to be submitted with the bid.

If the bid is submitted by joint venture of more than one person and/or Companies and/or firms it shall be accompanied by the following:

- (a) The original or a naturally certified copy of the original document under which such joint venture was constituted which must define precisely inter alia the conditions under which the joint venture will function, its period of duration and the participation of the several constituent persons and/or companies and/or firms.
- (b) A certificate signed by or on behalf of each participating person and/or company and/or firm authorising the person who signed the bid to do so.

6. GENERAL CONDITIONS OF CONTRACT

The General Conditions of Contract shall be regarded as an integral part of the contract documents.

7. FORM SBD 1

The copy of Form SBD 1 (Invitation to Bid), annexed to these documents, must be completed and signed by the Bidder. Failure to do so will deem your bid invalid.

8. PREFERENCE FOR EQUITY OWNERSHIP

Bidder desirous of claiming preference for equity ownership by previously disadvantaged individuals/women must fully complete and sign the Preference Certificate, Form SBD 6.1 or no preference will be allowed. A copy of your company registration forms and a valid accredited B-BBEE Status Level Verification Certificate **must** be submitted with the bid document.

NOTICE TO ALL POTENTIAL BIDDERS

PLEASE NOTE THAT PREFERENCE POINTS CLAIMED IN THE STANDARD BIDDING DOCUMENT PROVIDED WILL BE AUDITED BY AN INDEPENDENT PROFESSIONAL SERVICE PROVIDER. SUPPLIERS THAT PROVIDE INCORRECT OR FALSE INFORMATION REGARDING THE OWNERSHIP OF THEIR COMPANY, RUNS THE RISK OF BEING PROSECUTED WITH THE POSSIBLE RESTRICTION FROM PARTICIPATING IN CONTRACT WITH ANY DEPARTMENT IN THE SPHERE OF GOVERNMENT. PARTICULAR ATTENTION SHOULD BE GIVEN TO THE CONTENT OF SBD 6.1, PARAGRAPH 9.8.

9. BIDDERS TO COMPLY WITH DOCUMENTS

Where applicable, Bidders must allow in their Bids for all labour, material, machinery and everything necessary for the execution and completion of the Contract in accordance with the bid documents. No alterations may be made in the Invitation to Bid, Schedule of Quantities or other documents and the bid will be deemed to comply entirely with the terms of the documents.

10. TELEGRAPHIC BIDS

No bid forwarded by telegram, telex, facsimile, e-mail or similar apparatus will be considered.

11. THE DEPARTMENTS RIGHT TO DECLINE ANY BID

The Department does not bind itself to accept the lowest or any bid.

12. DEPARTMENT NOT LIABLE FOR BIDDER'S EXPENSES

The Department will not be held liable for any expenses incurred in preparing and submitting bids.

13. PAYMENTS UNDER THE CONTRACT

All payments due to the Contractor in terms of the contract will be done by means of Electronic Fund Transfer.

14. REJECTION OF BID

Bids not complying with the above-mentioned requirements and specifications may be regarded as incomplete and may not be considered. Any document submitted will be subjected to verification.

15. RESULTS OF BIDS

Results of non-acceptance of bids will be sent to individual unsuccessful bidders

16. ENGAGEMENT MODEL

The panel will be established as a National Panel and all suppliers will be required to service the whole of the department's regional offices. All service providers as enlisted will be approached to submit quotations requested as per the original bid during the establishment of the panel list and the department will then do an award of the submitted quotations based on the specifications issued. The department will further reserve the right to not award any quotations should it deem that the prices are not justifiably fair and cost effective.

SBD 4

DECLARATION OF INTEREST

1. Any legal person, including persons employed by the state¹, or persons having a kinship with persons employed by the state, including a blood relationship, may make an offer or offers in terms of this invitation to bid (includes an advertised competitive bid, a limited bid, a proposal or written price quotation). In view of possible allegations of favouritism, should the resulting bid, or part thereof, be awarded to persons employed by the state, or to persons connected with or related to them, it is required that the bidder or his/her authorised representative declare his/her position in relation to the evaluating/adjudicating authority where-
 - the bidder is employed by the state; and/or
 - the legal person on whose behalf the bidding document is signed, has a relationship with persons/a person who are/is involved in the evaluation and or adjudication of the bid(s), or where it is known that such a relationship exists between the person or persons for or on whose behalf the declarant acts and persons who are involved with the evaluation and or adjudication of the bid.
2. **In order to give effect to the above, the following questionnaire must be completed and submitted with the bid.**
 - 2.1 Full Name of bidder or his or her representative:
 - 2.2 Identity Number:.....
 - 2.3 Position occupied in the Company (director, trustee, shareholder², member):
.....
 - 2.4 Registration number of company, enterprise, close corporation, partnership agreement or trust:
.....
 - 2.5 Tax Reference Number:
 - 2.6 VAT Registration Number:
 - 2.6.1 The names of all directors / trustees / shareholders / members, their individual identity numbers, tax reference numbers and, if applicable, employee / PERSAL numbers must be indicated in paragraph 3 below.

¹"State" means –

- (a) any national or provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act No. 1 of 1999);
- (b) any municipality or municipal entity;
- (c) provincial legislature;
- (d) national Assembly or the national Council of provinces; or
- (e) Parliament.

²"Shareholder" means a person who owns shares in the company and is actively involved in the management of the enterprise or business and exercises control over the enterprise.

2.7

Are you or any person connected with the bidder presently employed by the state?

YES / NO

2.7.1

If so, furnish the following particulars:

Name of person / director / trustee / shareholder/ member:

Name of state institution at which you or the person connected to the bidder is employed :

Position occupied in the state institution:

Any other particulars:

2.7.2

If you are presently employed by the state, did you obtain the appropriate authority to undertake remunerative work outside employment in the public sector?

YES / NO

2.7.2.1

If yes, did you attach proof of such authority to the bid documents?

YES / NO

Note: Failure to submit proof of such authority, where applicable, may result in the disqualification of the bid.

2.7.2.2

If no, furnish reasons for non-submission of such proof:

2.8

Did you or your spouse, or any of the company's directors / trustees / shareholders / members or their spouses conduct business with the state in the previous twelve months?

YES / NO

2.8.1

If so, furnish particulars:

2.9

Do you, or any person connected with the bidder, have any relationship (family, friend, other) with a person employed by the state and who may be involved with the evaluation and or adjudication of this bid?

YES / NO

2.9.1

If so, furnish particulars.

2.10

Are you, or any person connected with the bidder, aware of any relationship (family, friend, other) between any other bidder and any person employed by the state

YES/NO

who may be involved with the evaluation and or adjudication of this bid?

2.10.1 If so, furnish particulars.

.....

2.11 Do you or any of the directors / trustees / shareholders / members of the company have any interest in any other related companies whether or not they are bidding for this contract?

YES/NO

2.11.1 If so, furnish particulars:

.....

3. Full details of directors / trustees / members / shareholders.

Full Name	Identity Number	Personal Income Tax Reference Number	State Employee Number / Persal Number

4. DECLARATION

I, THE UNDERSIGNED (NAME).....

CERTIFY THAT THE INFORMATION FURNISHED IN PARAGRAPHS 2 and 3 ABOVE IS CORRECT.
 I ACCEPT THAT THE STATE MAY REJECT THE BID OR ACT AGAINST ME SHOULD THIS DECLARATION PROVE TO BE FALSE.

.....
 Signature

.....
 Date

.....
 Position

.....
 Name of bidder

November 2011

PREFERENCE POINTS CLAIM FORM IN TERMS OF THE PREFERENTIAL PROCUREMENT REGULATIONS 2017

This preference form must form part of all bids invited. It contains general information and serves as a claim form for preference points for Broad-Based Black Economic Empowerment (B-BBEE) Status Level of Contribution

NB: BEFORE COMPLETING THIS FORM, BIDDERS MUST STUDY THE GENERAL CONDITIONS, DEFINITIONS AND DIRECTIVES APPLICABLE IN RESPECT OF B-BBEE, AS PRESCRIBED IN THE PREFERENTIAL PROCUREMENT REGULATIONS, 2017.

1. GENERAL CONDITIONS

1.1 The following preference point systems are applicable to all bids:

- the 80/20 system for requirements with a Rand value of up to R50 000 000 (all applicable taxes included); and
- the 90/10 system for requirements with a Rand value above R50 000 000 (all applicable taxes included).

1.2

- a) The value of this bid is estimated to exceed/not exceed R50 000 000 (all applicable taxes included) and therefore the preference point system shall be applicable; or
- b) Either the 80/20 or 90/10 preference point system will be applicable to this tender (*delete whichever is not applicable for this tender*).

1.3 Points for this bid shall be awarded for:

- (a) Price; and
- (b) B-BBEE Status Level of Contributor.

1.4 The maximum points for this bid are allocated as follows:

	POINTS
PRICE	80/90
B-BBEE STATUS LEVEL OF CONTRIBUTOR	20/10
Total points for Price and B-BBEE must not exceed	100

1.5 Failure on the part of a bidder to submit proof of B-BBEE Status level of contributor together with the bid, will be interpreted to mean that preference points for B-BBEE status level of contribution are not claimed.

1.6 The purchaser reserves the right to require of a bidder, either before a bid is adjudicated or at any time subsequently, to substantiate any claim in regard to preferences, in any manner required by the purchaser.

2. DEFINITIONS

- (a) **“B-BBEE”** means broad-based black economic empowerment as defined in section 1 of the Broad-Based Black Economic Empowerment Act;
- (b) **“B-BBEE status level of contributor”** means the B-BBEE status of an entity in terms of a code of good practice on black economic empowerment, issued in terms of section 9(1) of the Broad-Based Black Economic Empowerment Act;
- (c) **“bid”** means a written offer in a prescribed or stipulated form in response to an invitation by an organ of state for the provision of goods or services, through price quotations, advertised competitive bidding processes or proposals;
- (d) **“Broad-Based Black Economic Empowerment Act”** means the Broad-Based Black Economic Empowerment Act, 2003 (Act No. 53 of 2003);
- (e) **“EME”** means an Exempted Micro Enterprise in terms of a code of good practice on black economic empowerment issued in terms of section 9 (1) of the Broad-Based Black Economic Empowerment Act;
- (f) **“functionality”** means the ability of a tenderer to provide goods or services in accordance with specifications as set out in the tender documents.
- (g) **“prices”** includes all applicable taxes less all unconditional discounts;
- (h) **“proof of B-BBEE status level of contributor”** means:
 - 1) B-BBEE Status level certificate issued by an authorized body or person;
 - 2) A sworn affidavit as prescribed by the B-BBEE Codes of Good Practice;
 - 3) Any other requirement prescribed in terms of the B-BBEE Act;
- (i) **“QSE”** means a qualifying small business enterprise in terms of a code of good practice on black economic empowerment issued in terms of section 9 (1) of the Broad-Based Black Economic Empowerment Act;
- (j) **“rand value”** means the total estimated value of a contract in Rand, calculated at the time of bid invitation, and includes all applicable taxes;

3. POINTS AWARDED FOR PRICE

3.1 THE 80/20 OR 90/10 PREFERENCE POINT SYSTEMS

A maximum of 80 or 90 points is allocated for price on the following basis:

80/20

or

90/10

$$P_s = 80 \left(1 - \frac{P_t - P_{\min}}{P_{\min}} \right) \quad \text{or} \quad P_s = 90 \left(1 - \frac{P_t - P_{\min}}{P_{\min}} \right)$$

Where

P_s = Points scored for price of bid under consideration

P_t = Price of bid under consideration

$P_{\min}$ = Price of lowest acceptable bid

4. POINTS AWARDED FOR B-BBEE STATUS LEVEL OF CONTRIBUTOR

- 4.1 In terms of Regulation 6 (2) and 7 (2) of the Preferential Procurement Regulations, preference points must be awarded to a bidder for attaining the B-BBEE status level of contribution in accordance with the table below:

B-BBEE Status Level of Contributor	Number of points (90/10 system)	Number of points (80/20 system)
1	10	20
2	9	18
3	6	14
4	5	12
5	4	8
6	3	6
7	2	4
8	1	2
Non-compliant contributor	0	0

5. BID DECLARATION

5.1 Bidders who claim points in respect of B-BBEE Status Level of Contribution must complete the following:

6. B-BBEE STATUS LEVEL OF CONTRIBUTOR CLAIMED IN TERMS OF PARAGRAPHS 1.4 AND 4.1

6.1 B-BBEE Status Level of Contributor: . = ...(maximum of 10 or 20 points)

(Points claimed in respect of paragraph 7.1 must be in accordance with the table reflected in paragraph 4.1 and must be substantiated by relevant proof of B-BBEE status level of contributor.

7. SUB-CONTRACTING

7.1 Will any portion of the contract be sub-contracted?

(Tick applicable box)

YES	☐	NO	☐

7.1.1 If yes, indicate:

i) What percentage of the contract will be subcontracted.....%

ii) The name of the sub-contractor.....

iii) The B-BBEE status level of the sub-contractor.....

iv) Whether the sub-contractor is an EME or QSE

(Tick applicable box)

YES	☐	NO	☐

v) Specify, by ticking the appropriate box, if subcontracting with an enterprise in terms of Preferential Procurement Regulations,2017:

Designated Group: An EME or QSE which is at last 51% owned by:	EME √	QSE √
Black people		
Black people who are youth		
Black people who are women		
Black people with disabilities		
Black people living in rural or underdeveloped areas or townships		
Cooperative owned by black people		
Black people who are military veterans		
OR		
Any EME		
Any QSE		

8. **DECLARATION WITH REGARD TO COMPANY/FIRM**

8.1 Name of company/firm:.....

8.2 VAT registration number:.....

8.3 Company registration number:.....

8.4 TYPE OF COMPANY/ FIRM

Partnership/Joint Venture / Consortium

One person business/sole propriety

Close corporation

Company

(Pty) Limited

[TICK APPLICABLE BOX]

8.5 DESCRIBE PRINCIPAL BUSINESS ACTIVITIES

.....
.....
.....
.....

8.6 COMPANY CLASSIFICATION

Manufacturer

Supplier

Professional service provider

Other service providers, e.g. transporter, etc.

[TICK APPLICABLE BOX]

8.7 Total number of years the company/firm has been in business:.....

8.8 I/we, the undersigned, who is / are duly authorised to do so on behalf of the company/firm, certify that the points claimed, based on the B-BBE status level of contributor indicated in paragraphs 1.4 and 6.1 of the foregoing certificate, qualifies the company/ firm for the preference(s) shown and I / we acknowledge that:

- i) The information furnished is true and correct;
- ii) The preference points claimed are in accordance with the General Conditions as indicated in paragraph 1 of this form;
- iii) In the event of a contract being awarded as a result of points claimed as shown in paragraphs 1.4 and 6.1, the contractor may be required to furnish documentary proof to the satisfaction of the purchaser that the claims are correct;
- iv) If the B-BBEE status level of contributor has been claimed or obtained on a fraudulent basis or any of the conditions of contract have not been fulfilled, the purchaser may, in addition to any other remedy it may have –
 - (a) disqualify the person from the bidding process;
 - (b) recover costs, losses or damages it has incurred or suffered as a result of that person's conduct;
 - (c) cancel the contract and claim any damages which it has suffered as a result of having to make less favourable arrangements due to such cancellation;

(d) recommend that the bidder or contractor, its shareholders and directors, or only

the shareholders and directors who acted on a fraudulent basis, be restricted by the National Treasury from obtaining business from any organ of state for a period not exceeding 10 years, after the *audialterampartem* (hear the other side) rule has been applied; and

(e) forward the matter for criminal prosecution.

WITNESSES

1.

2.

.....
SIGNATURE(S) OF BIDDERS(S)

DATE:

ADDRESS

.....

.....

DECLARATION OF BIDDER'S PAST SUPPLY CHAIN MANAGEMENT PRACTICES

1. This Standard Bidding Document must form part of all bids invited.
2. It serves as a declaration to be used by institutions in ensuring that when goods and services are being procured, all reasonable steps are taken to combat the abuse of the supply chain management system.
3. The bid of any bidder may be disregarded if that bidder, or any of its directors have-
 - a. abused the institution's supply chain management system;
 - b. committed fraud or any other improper conduct in relation to such system; or
 - c. failed to perform on any previous contract.
4. In order to give effect to the above, the following questionnaire must be completed and submitted with the bid.

Item	Question	Yes	No
4.1	Is the bidder or any of its directors listed on the National Treasury's Database of Restricted Suppliers as companies or persons prohibited from doing business with the public sector? (Companies or persons who are listed on this Database were informed in writing of this restriction by the Accounting Officer/Authority of the institution that imposed the restriction after the audialterampartem rule was applied). The Database of Restricted Suppliers now resides on the National Treasury's website(www.treasury.gov.za) and can be accessed by clicking on its link at the bottom of the home page.	Yes ☐	No ☐
4.1.1	If so, furnish particulars:		
4.2	Is the bidder or any of its directors listed on the Register for Tender Defaulters in terms of section 29 of the Prevention and Combating of Corrupt Activities Act (No 12 of 2004)? The Register for Tender Defaulters can be accessed on the National Treasury's website (www.treasury.gov.za) by clicking on its link at the bottom of the home page.	Yes ☐	No ☐
4.2.1	If so, furnish particulars:		
4.3	Was the bidder or any of its directors convicted by a court of law (including a court outside of the Republic of South Africa) for fraud or corruption during the past five years?	Yes ☐	No ☐
4.3.1	If so, furnish particulars:		
4.4	Was any contract between the bidder and any organ of state terminated during the past five years on account of failure to perform on or comply with the contract?	Yes ☐	No ☐
4.4.1	If so, furnish particulars:		

CERTIFICATION

I, THE UNDERSIGNED (FULL NAME).....
CERTIFY THAT THE INFORMATION FURNISHED ON THIS DECLARATION FORM IS TRUE AND CORRECT.

I ACCEPT THAT, IN ADDITION TO CANCELLATION OF A CONTRACT, ACTION MAY BE TAKEN AGAINST
ME SHOULD THIS DECLARATION PROVE TO BE FALSE.

.....
Signature

.....
Date

.....
Position

.....
Name of Bidder

DEPARTMENT OF WATER AND SANITATION

INSTRUCTIONS TO BIDDERS: PURCHASES

1. The standard bidding forms should not be retyped or redrafted but photocopies may be prepared and used. Additional offers may be made of any item but only on a photocopy of the page in question or on other forms obtainable from the Head of Procurement: DEPARTMENT OF WATER AND SANITATION, Private Bag X313, Pretoria, 0001, Attention: Supply Chain Management Office. Additional offers made in any other manner may be disregarded.
2. Should standard bid forms not be filled in by means of mechanical devices, for example typewriters, ink, preferably black, must be used to fill in bids.
3. Bidders shall check the numbers of the pages and satisfy themselves that none are missing or duplicated. No liability shall be accepted in regard to claims arising from the fact that pages are missing or duplicated.
4. Where items are specified in detail, the specifications form an integral part of the bid document and bidders shall indicate in the space provided whether the items offered are to specification or not.
5. In respect of the paragraphs where the items offered are strictly to specification, bidders shall insert the words "as specified".
6. In cases where the items are not to specification, the deviations from the specifications shall be indicated.
7. The bid prices shall be given in the units shown.
8. With the exception of basic prices, where required, all prices shall be quoted in South African currency.
9. Delivery basis:
 - (a) Supplies which are held in stock or are in transit or on order from South African manufacturers at the date of bid shall be offered on a basis of delivery into consignee's store or on his site within the free delivery area of the bidder's centre, or carriage paid consignee's station if the goods are required elsewhere.
 - (b) Notwithstanding the provisions of paragraph 9(a), bid prices for supplies in respect of which installation/erection/assembly is a requirement, shall include ALL costs on a basis of delivered on site as specified.
10. Unless specifically provided for in the bid document, no bids transmitted by telegram, telex, facsimile, e-mail or similar apparatus shall be considered.
11. Bids received after the closing date and time are late and will as a rule not be accepted for consideration.
12. Bids will be opened in public, that is, bidders or their representatives may be present. If requested by any bidder, the names of bidders and if practical the total amount of each bid and of any alternative bids, will be read aloud.
13. The period for which offers are to remain valid and binding is indicated in the bid documents and is calculated from the closing date on the understanding that offers are to remain in force and binding until the close of business on the last day of the period calculated and if this day falls on a Saturday, Sunday or public holiday, the bid is to remain valid and binding until the close of business on the following working day.

14. After public opening of bids, information relating to the examination, clarification and evaluation of bids and recommendations concerning awards will not be disclosed to bidders or other persons not officially concerned with the process, until the successful bidder is notified of the award. The bid documentation of bidders is considered to be confidential and will under no circumstances be made available to other bidders or other persons.
15. If you are a supplier but not the actual manufacturer and will be sourcing the product(s) from another company, a letter from that company(ies)/supplier(s) confirming firm supply arrangement(s) in this regard, has to accompany your bid and failure to submit the document may invalidate your bid.
 - 17.1 The said company/supplier must confirm that it has familiarised itself with the item descriptions, specifications and bid conditions and if the bid consist of more than one item it should be clearly indicated in respect of which item(s) the supportive letter has been issued.
16. The financial standing of bidders and their ability to manufacture or to supply goods or to render a service may be examined before their bids are considered for acceptance.
17. The Department may, where a bid relates to more than one item, accept such bid in respect of any specific item or items and also accept part of the specified quantity of any specific item or items.
18. The Department is not obliged to accept any bid. The evaluation of a bid will be done in accordance with the Preferential Procurement Policy Framework Act, 2000 (Act no. 5 of 2000) and its regulations.
19. After approval of the bid, both parties must sign a written contract. The Contract Form must be filled in duplicate by both the successful bidder and the purchaser. Both Contract Forms must be signed in the original so that the successful bidder and the purchaser would be in possession of originally signed contracts for their respective records.
- 19.1 Failure of the successful bidder to sign the Contract Form in ink may result in the invalidation of their bid.

Special Conditions of Bid: Purchases
November 2011

CERTIFICATE OF INDEPENDENT BID DETERMINATION

1. This Standard Bidding Document (SBD) must form part of all bids¹ invited.
2. Section 4 (1) (b) (iii) of the Competition Act No. 89 of 1998, as amended, prohibits an agreement between, or concerted practice by, firms, or a decision by an association of firms, if it is between parties in a horizontal relationship and if it involves collusive bidding (or bid rigging).² Collusive bidding is a *pe se* prohibition meaning that it cannot be justified under any grounds.
3. Treasury Regulation 16A9 prescribes that accounting officers and accounting authorities must take all reasonable steps to prevent abuse of the supply chain management system and authorizes accounting officers and accounting authorities to:
 - a. disregard the bid of any bidder if that bidder, or any of its directors have abused the institution's supply chain management system and or committed fraud or any other improper conduct in relation to such system.
 - b. cancel a contract awarded to a supplier of goods and services if the supplier committed any corrupt or fraudulent act during the bidding process or the execution of that contract.
4. This SBD serves as a certificate of declaration that would be used by institutions to ensure that, when bids are considered, reasonable steps are taken to prevent any form of bid-rigging.
5. In order to give effect to the above, the attached Certificate of Bid Determination (SBD 9) must be completed and submitted with the bid:

¹ Includes price quotations, advertised competitive bids, limited bids and proposals.

² Bid rigging (or collusive bidding) occurs when businesses, that would otherwise be expected to compete, secretly conspire to raise prices or lower the quality of goods and / or services for purchasers who wish to acquire goods and / or services through a bidding process. Bid rigging is, therefore, an agreement between competitors not to compete.

(Bid Number and Description)

(Name of Institution)

I certify, on behalf of: _____ that:
(Name of Bidder)

- ³ Joint venture or Consortium means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract.

10. I am aware that, in addition and without prejudice to any other remedy provided to combat any restrictive practices related to bids and contracts, bids that are suspicious will be reported to the Competition Commission for investigation and possible imposition of administrative penalties in terms of section 59 of the Competition Act No 89 of 1998 and or may be reported to the National Prosecuting Authority (NPA) for criminal investigation and or may be restricted from conducting business with the public sector for a period not exceeding ten (10) years in terms of the Prevention and Combating of Corrupt Activities Act No 12 of 2004 or any other applicable legislation.

.....
Signature

.....
Date

.....
Position

.....
Name of Bidder

Js914w 2

DEPARTMENT OF WATER AND SANITATION

BID W11237

SECTION 2: CONDITIONS OF CONTRACT

CONTENTS

- A. GENERAL CONDITIONS OF CONTRACT
- B. SPECIAL CONDITIONS OF CONTRACT

NOTE:

Failure to indicate compliance accordingly in the Specification will invalidate the bid. (*Clearly delete/cross-out whichever is not applicable.)

CONDITIONS OF CONTRACT

A. GENERAL CONDITIONS OF CONTRACT

The Contract shall be governed by: "General Conditions of Contract", which is attached to this bid document. The only variations from these General Conditions of Contract shall be given in the Special conditions of Contract below.

B. SPECIAL CONDITIONS OF CONTRACT

This section must be completed in full failure to do so may invalidate your bid

***Delete which are not applicable**

1. Is the offer strictly in accordance with the conditions and specifications? *YES / NO

If not in accordance with the specification, furnish the deviations.

2. Period required for commencement with service after receipt of order.

3. Are you registered in terms of section 23(1) or 23(3) of the value Added Tax Act, 1991 (Act no 89 of 1991)? *YES / NO

If so, state your VAT registration number.

4. Is the bid price firm for the duration of the contract period? *YES / NO

5. **The DEPARTMENT OF WATER AND SANITATION will not entertain any claims for non-firm price increases claimed at a later state. No exception will be made in this regard.** **TAKE NOTE**

6. It is a specific condition of this contract with DWS ,that consultants awarded this contract undertake not to divulge to others, or use for their own benefit, confidential information gained during the course of the work.

In terms of section 21(2) of the Copyright act (Act no.98 of 1978) ("the Act ") the copyright regarding a work that is made under the direction or control of the State is owned by the state. Section 2(1) of the Act provides that the term "works", if they are original, include literary works, musical works artistic works, cinematograph films, sound recordings, broadcasts, programme-carrying signals, published editions and computer programs.

7. **EVALUATION CRITERIA**

The Evaluation Committee will be following a phased approach during the evaluation.

Phase 1

Mandatory Compliance:

Bidders are required to submit and or complete the following documents which should form part of the bid submitted by closing date. Omission to complete and/or submit the listed documents will render your bid non responsive and the bid will not be considered for the phase 2 evaluation.

- (a) Prequalification in terms of Preferential Procurement Regulation, 2017:
 - the bidding company must be 51% black owned,
 - minimum Level 3 Exempted Micro Enterprise (EME).
 (Bidders are required to submit certified and valid copy of BEE certificate and CIPC documentation for validation of the ownership)
- (b) Appointment letter OR Certificate from the Manufacturer as distributor/authorised agent of the instrumentation in South Africa.
- (c) Attendance of Compulsory Briefing Session Certificate
- (d) Warranty certificate for 12 months

Phase 2
Technical Compliance:

The bid will be evaluated using the below criteria and failure to comply with all the specifications as listed will render your bid as not to specification and non-responsive and the bid will not be considered for the phase 3 evaluation.

- (a) Standard Specifications as set out under Section 3: Specifications and the compliance thereof
- (b) The bid will be rendered non responsive if the bidder fails to complete the "Yes / No" section in the specification under Section 3: Specifications
- (c) Supply Manufacturers Certificate of Compliance for all offered items;
- (d) Supply document from the manufacturer of the offered items confirming the bidder as Authorised Agent.

NOTE: All service providers who meet all the requirements in terms of phase 2 above, will be enlisted to the list of the panel of Service Providers. The service providers as listed on the panel will be approached and submit quotation.

DEPARTMENT OF WATER AND SANITATION

BID W11237

SUPPLY AND DELIVERY OF ELECTRONIC DATA LOGGING EQUIPMENT, INTEGRATED DATA LOGGING SYSTEMS, SENSORS AND POWER SUPPLY EQUIPMENT FOR THE MEASUREMENT AND TRANSMISSION OF HYDROLOGICAL PARAMETERS, FOR A PERIOD OF TWENTY FOUR (24) MONTHS

SECTION 3: STANDARD SPECIFICATIONS

CONTENTS

GENERAL REQUIREMENTS

1. General
2. Environmental Conditions
3. Regulations and Standards
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5. Schedules of prices
6. Sub-contract work
7. Ordering of material and equipment
8. Delivery and Hoisting equipment
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10. Handbooks and instruction manuals
11. Tests
12. Test equipment and spares
13. Training of personnel

ELECTRONIC EQUIPMENT (GENERAL SPECIFICATION FOR THE DESIGN, DEVELOPMENT AND PRODUCTION OF ELECTRONIC CIRCUITS AND SYSTEMS)

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2. Ground potential
3. Grounding and electromagnetic radiation
4. Electrical connector
5. Current overload protection
6. Galvanic corrosion
7. Accessibility
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SOFTWARE AND SOFTWARE DOCUMENTATION

1. Scope
2. System design
3. Documentation
4. Data base compilation and building

GENERAL REQUIREMENTS**1. GENERAL:**

- 1.1. This Standard Technical Specification describes the general requirements with regard to material, equipment and workmanship and should be read together with the General Conditions of Tender, Contract and Order, Detail Specifications and Schedules.
- 1.2. Where any conflict exists, the relevant clauses of the Detail Specification shall take preference over the clauses of the Standard Technical Specification.
- 1.3. Should any conflict arise between the requirements of this standard specification and the General Conditions of Contract, Contract and Order, the General Conditions of Contract, Contract and Order would take preference.
- 1.4. The works and services required in terms of this specification shall comply with all the requirements of this specification, read together with the detail specification.
- 1.5. The Manufacturers Certificate of Compliance for each item offered must be supplied as part of the Bid Document in order for the Evaluation Panel to confirm compliance or non-compliance.
- 1.6. The Contractor shall be deemed to have examined all the constituent parts of this document carefully before the contract was submitted. Any doubts as to the meaning of any terms, phrases or clauses of the document, or any missing pages, shall be submitted to the Engineer in writing before a contract is submitted. No claims traceable to non-compliance with this clause will be considered.
- 1.7. If it is found at any stage of this contract that the Contractor has deviated from the requirements of this specification without the written consent of the Engineer, then the Engineer shall have the right to order the Contractor to remove the item(s) in question and to supply and/or install the exact equipment specified without any adjustment in the contract price.
- 1.8. Definitions:
 - 1.7.1. For the purposes of this contract all terms used shall be as defined in section 2 of SABS code 0142-1981, Article 1 of the Machinery and Occupational Safety Act, No 6 of 1983 and other relevant SABS specifications.

2. ENVIRONMENTAL CONDITIONS:

- 2.1. Except when otherwise specified, all equipment and material shall be designed and selected for the following climatic and environmental conditions:
 - 2.1.1. Operating temperature range: - 10° C to + 70° C.
 - 2.1.2. Relative humidity:
 - maximum 95% below 35° C;
 - maximum 75% above 35° C.
 - 2.1.3. Height above sea level: 0 - 3000 metres.
 - 2.1.4. All the equipment shall operate satisfactorily in the presence of a fair amount of water and dust, and shall comply with rating IP 54 as defined in IEC 144.
- 2.2. Metal work exposed to the elements shall be of a suitable stainless steel type or shall be painted or protected against corrosion to the standards specified by the SABS and as approved by the Engineer. Samples shall be submitted for approval before installation is commenced with.
- 2.3. Contact between dissimilar metals shall be avoided wherever possible. The following electrode potentials shall not be exceeded:
 - 2.3.1 For connections exposed to the weather or salt water - 0,25V
 - 2.3.2 For connections of interior parts exposed to condensation but not contaminated by salt - 0,5V.
- 2.4. In addition to the normal operating conditions specified above, the equipment should also be capable of operating under temporary adverse periods. If additional protection is required for the equipment and

installation under these conditions, then it shall be provided by the Contractor, at his cost, until conditions have improved to the point where additional protection is no longer required.

3. REGULATIONS AND STANDARDS:

- 3.1. The Contractor's manufacturing facility must be in existence of at least 5 years with an established office registered in the Republic of South Africa, to carry suitable stock and spares and employ technical personnel for service and maintenance.
- 3.2. The equipment must be Hydrometry dedicated and be field proven for at least 2 years. The Engineer may request the Contractor for any proof in this regard before the contract is awarded.
- 3.3. All material and equipment supplied shall be new and of an acceptable quality.
- 3.4. The work shall be carried out strictly in accordance with the latest revision and amendments of the following:
 - 3.4.1 SABS 0142: "Code of practice for the Wiring of Premises" hereinafter called the "Wiring Code".
 - 3.4.2 The "Machinery and Occupational Safety Act 1983", Act no 6 of 1983, hereinafter called the "Act".
 - 3.4.3 The Municipal By-laws and any special requirements of the Local Supply Authority.
 - 3.4.4 The Local Fire Office Regulations.
 - 3.4.5 The regulations of the Department of Post and Telecommunications.
- 3.5. All work shall comply with the relevant SABS specifications for workmanship and material. Where no SABS specification exists, the applicable BS, DIN or IEC specification shall be followed.
- 3.6. Any conflict that should arise between any of the above mentioned regulations and this specification shall forthwith be referred to the Engineer in writing for his ruling. Under no circumstances shall the Contractor modify any part of the works to comply with amended regulations that may come in force during the construction period before the matter has been cleared with the Engineer.
- 3.7. The manufacturing company must preferably adhere to ISO 9001 standards.

4. DESCRIPTION OF THE PROJECT:

- 4.1 The project is completely detailed in **SECTION 4, Detail Specification**. Should the Bidder require any further information, then this shall be referred to the Engineer in writing.

5. SCHEDULES OF PRICES:

- 5.1 The attention of Bidders is drawn to the Schedules of Prices which form part of this specification and which are to be completed in full. Bidders, which do not adhere to this request, will be disqualified and their bids will not be considered.

6. SUB-CONTRACT WORK:

- 6.1 All work as specified shall only be performed by the Bidder's own personnel and shall under no circumstances be sub-contracted.

7. ORDERING OF MATERIAL AND EQUIPMENT:

- 7.1 The Electronic Contractor is made aware of the fact that material and equipment shall when required be ordered well in advance as late deliveries will be his sole responsibility. If for some reason late deliveries are found to be to the advantage of the Client or are to be postponed by the Contractor the prior approval shall be obtained from the Engineer.

8. DELIVERY AND HOISTING EQUIPMENT:

- 8.1 The Contractor shall make the necessary arrangements to get all equipment delivered to site / office in accordance with the program and in an undamaged condition. The Contractor shall be responsible for the acquisition of any insurance cover that may be required for equipment in transit and temporary storage.

9. WORKSHOP ASSEMBLY AND IDENTIFICATION OF SUB-SECTIONS AND COMPONENTS:

- 9.1 To assist in the erection and installation activities on site, components, equipment and sub-assemblies must be assembled in the workshop, after manufacture. Individual units shall be clearly marked by employing an identification code in such manner that actual re-assembly, erection and installation on site could be done in a minimum of time with a minimum of fitting and adjusting on site.
- 9.2 Equipment should be delivered to site in the largest sub-assemblies, which are practical.
- 9.3 Where practical, according to the discretion of the Engineer, complete electronic and other control units shall be assembled in the workshop for preliminary tests. This shall be done to check whether the equipment complies with predetermined set values and shall produce certain predetermined set results, as set out in the various parts of the document.
- 9.4 The Engineer may upon request of the Contractor inspect existing installations or proto-type assemblies in the factory to determine whether such units and workmanship are of the required standard for this installation. This may be done to obviate the possibility of having to replace unacceptable equipment at a later stage.

10. HANDBOOK AND INSTRUCTION MANUALS:

- 10.1 The Contractor shall keep accurate records of all tests carried out and the results achieved, all meter readings taken after installation of the equipment, etc. A comprehensive instruction shall be built up by the Contractor and shall be considered to be part of the equipment offered. This manual shall provide complete equipment schematics; Complete equipment layout drawings; All manufacturers handbooks having reference to the equipment; installation, test and alignment procedures; All inter connection and inter cabling diagrams; All parts and spares lists; Complete trouble shooting procedures and any other information deemed necessary to permit rapid and efficient maintenance of any part of the equipment by a qualified technician. Three copies of all test results, amendments and readings, together with three copies of the instruction manual, built-up as indicated above shall be handed to the Engineer before he will accept any equipment supplied to meet this specification. All the above shall be fully updated to include whatever final modifications are required to be made by the Contractor to his equipment in order for it to gain acceptance by the Engineer as being to specification.
- 10.2 The Contractor shall provide complete operating instructions and operating manuals that will enable staff to operate and understand the equipment and systems and to utilize the equipment to its full extent.

11. TESTS:

- 11.1 All materials and workmanship shall be of the respective kinds described in the contract and in accordance with the Engineer's instructions and shall be subjected from time to time to such tests and by such persons as the Engineer may direct at the place of manufacture or fabrication or on the site or at all or any of such places. Excepts as otherwise provided in the specification the Contractor shall supply such assistance, instruments, machines, labour and materials as are normally required for examining, measuring and testing of any work and the quality, mass or quantity of any materials used and shall supply samples of material before incorporation in the works for testing as may be selected and required by the Engineer.
- 11.2 All samples shall be supplied by the Contractor at his own cost if the supply thereof is clearly intended by or provided for in the specification but if not, then at the cost of the Employer.
- 11.3 The cost of making any test shall be borne by the Contractor if such test is clearly intended by or provided for in the specification and (in the case only of a test under load or a test to ascertain whether the design of any finished or partly finished work is appropriate for the purposes which it was intended to fulfil) if such is particularised in the specification in sufficient detail to enable the Contractor to price or allow for the same in his contract.

- 11.4 If any test is ordered by the Engineer which is either-
- a) not so intended by or provided for; or
 - b) not so particularised; or
 - c) though so intended by or provided for is ordered by the Engineer to be carried out by an independent person or body at any other place than the site or the place of manufacture or fabrication of the materials or equipment tested;
then the cost of such test shall be borne by the Contractor if the test shows the workmanship of materials not be in accordance with the provisions of the Contract or the Engineer's instructions, but otherwise by the Employer.

12. TEST EQUIPMENT AND SPARES:

- 12.1 It is a requirement of this contract that the Contractor shall have available all the test equipment that would be required to allow the Employer's staff to commission any part of any system provided in terms of this contract.
- 12.2 The exact test equipment required will depend on the systems supplied and the Contractor shall submit a complete list of the test equipment to be used.
- 12.3 The Contractor shall recommend spares that would be required on site for emergency repairs, complete with unit costs for consideration by the Engineer.

13. TRAINING OF PERSONNEL:

- 13.1 Training provided by the Contractor shall be directly applicable to the actual equipment to be used at the installation. All training shall be carried out on site, unless otherwise requested by the Employer.
- 13.2 Three categories of training for technical personnel are required, viz:
- 13.2.1 Installation training.
 - 13.2.2 Operation training.
 - 13.2.3 Maintenance training.
- 13.3 The hardware maintenance training shall include the computers, microcomputers, programmable logic controllers and all the peripheral equipment.
- 13.4 The Employer will bear the cost of salaries, accommodation and other allowances and travelling expenses of its personnel, but all other expenses shall be borne by the Contractor. The Contractor shall provide all course material including manuals.
- 13.5 The Bidder shall indicate his proposals and local facilities to provide training in particular aspects of operation and maintenance of the equipment being offered.
- 13.6 Training courses shall be made available and completed within the period of six months after the contract is awarded.
- 13.7 At the conclusion of the training periods, both in regard to the operation and maintenance of the equipment, the Engineer will give the Contractor a signed statement to the effect that these training sessions were adequate.

GENERAL SPECIFICATION FOR THE DESIGN, DEVELOPMENT AND PRODUCTION OF ELECTRONIC CIRCUITS AND SYSTEMS

1. ELECTRICAL SUPPLY CIRCUITS:

- 1.1. The design shall incorporate methods to protect personnel from accidental contact with potentially dangerous currents and voltages.

2. GROUND POTENTIAL:

- 2.1 The design and construction of the equipment shall be such that all external parts, surfaces and shields shall be at ground potential at all times during normal operation.

3. GROUNDING AND ELECTROMAGNETIC RADIATION:

- 3.1. Equipment is often required to operate within their specified limits adjacent to radio transmitters. Electromagnetic compatibility design principals shall be incorporated to accommodate this application. To allow systems integration, the equipment capability to withstand RF field strengths shall be clearly stated.
- 3.2. The design shall also provide measures to eliminate electromagnetic radiation from the equipment and if applicable, the technical specification for this shall be provided.
- 3.3. All equipment to be used shall be suitably suppressed against radio frequency interference which may be introduced by operating radio transmitters in the equipment room. The Bidder is required to indicate the maximum RF field strength that the equipment can handle satisfactorily. If this information is not supplied, it will be assumed that the equipment offered is suitably suppressed for all operating conditions. All electromagnetic radiations shall comply with the requirements of the Radio Act, Act No 3 of 1952.

4. ELECTRICAL CONNECTORS:

- 4.1 Connectors shall be selected so that it will be impossible to insert the plug in a receptacle other than intended.

5 CURRENT OVERLOAD PROTECTION:

- 5.1 Protector devices such as fuses, circuit breakers, thermal cutouts, and solid state current interruption devices shall be used.
- 5.2 Fuses providing protection to the equipment shall be so located that they are readily accessible and in a convenient location. At least one extra fuse of each type and rating used shall be supplied and attached to the applicable units of equipment. Panel mounted fuse posts shall be such to permit renewal of fuses without the use of tools.
- 5.3 Restoring of switching devices in the case of circuit breakers, shall be readily accessible to the operator. The circuit breaker shall give a visual indication when the breaker is tripped.

6 GALVANIC CORROSION:

- 6.1 When dissimilar metals are used in intimate contact, suitable protection against galvanic corrosion shall be applied.

7 ACCESSIBILITY:

- 7.1 Each article of equipment on each major sub assembly shall provide for the necessary access to its interior parts, terminals, and wiring for adjustments, required circuit checking, removal and replacement of maintenance parts.
- 7.2 The unsoldering of wires, or wire harnesses, parts or assemblies for routine maintenance purposes in order to gain access to terminals are not acceptable.

8 THERMAL DESIGN:

- 8.1 Adequate steps shall be taken in the design of the equipment. In order to maintain equipment parts within their permissible operating temperature limits.
- 8.2 Where necessary, the design shall incorporate temperature sensing devices, to prevent thermal run-away. If it is not desirable to completely shut off the equipment, the performance of such equipment will be reduced to a lower level until the temperature has dropped to a safe level.
- 8.3 It is preferable to use cooling techniques based on conduction, radiation and free convection. External devices such as cooling fans shall be used when natural cooling can not be accommodated.

9 ERGONOMICS:

- 9.1 Ergonomics design criteria and principals shall be applied in the design of the electronic equipment so as to achieve effective performance by the operator, maintenance and control personnel and to minimize the skill requirements.

10 IDENTIFICATION AND MARKING:

- 10.1 Every assembly unit shall be marked with its serial number and version number and if applicable its part number.
- 10.2 When applicable, all controls, test points, components, functional markings, fuse designation and ratings, power supply polarities etc. shall be marked adjacent to the item itself.

11 GENERAL CONSTRUCTION:

- 11.1 All control switches, handles etc. shall be so designed and positioned in relation to other fittings as to be easily accessible.
- 11.2 All instrument dials and indicating devices such as displays shall be fitted in such a manner as to be clearly visible from the operator's normal operating position.
- 11.3 Fuses and circuit breakers shall (where applicable) be mounted on the exterior of the equipment and be easily accessible.
- 11.4 Adequate test and measuring points shall be incorporated in the design to facilitate ease of testing.

12 PRINTED CIRCUIT BOARDS:

- 12.1 Maximum use shall be made of plug-in printed circuit boards using reliable, high quality components. The boards shall be designed to operate satisfactorily under worst- case conditions.
- 12.2 The printed circuit boards shall be of high grade glass epoxy copper clad laminate. Phenolic or bakelised paper board will not be accepted.

- 12.3 The boards shall be of a thickness which is compatible with the weight of the components mounted on it, but in any case, shall not be less than 1,0mm.
- 12.4 The boards shall be of an adequate copper laminate. It is expected that the copper would be 600gm/m² (2 ozs/ft/ft). The size employed is to be indicated in the contract.
- 12.5 In general, printed circuit boards shall conform to RS 4025 or equivalent. If multi layer printed circuit board is used, the connections through the boards shall be plated through holes in accordance with BS 4597.
- 12.6 Particular attention will be paid to the hole location and size tolerance, the conductor thickness and width, the conductor spacing, the diameter of the holes relative to the component legs and the size of the solder pads and holes.
- 12.7 The minimum distance between the conductive tracks on the edge of the printed circuit boards and any adjacent conductive surface, such as frames, shall be calculated as follows: 0,0305mm per volt + 0,35mm. Boards that slide into guide rails or supporting structures shall have a minimum conductor to guide distance of at least 2,5mm. (This requirement is not applicable to ground planes or heat sinks). Tin lead plating shall be used to plate printed circuit boards to facilitate soldering.
- 12.8 Printed circuit boards shall be treated with a polymer conformal coating, after the production process to prevent the ingress of moisture and growth of fungus. Parts such as connectors, switches and adjustable components where mechanical movement is required to align and tune the electronic circuit, shall be protected during the application of the conformal coating.
- 12.9 Multi pin high quality plugs and sockets are preferred rather than printed board edge connectors.
- 12.10 Each plug-in card shall be polarized by means of a mechanical key to prevent a card from being plugged into a socket for which it was not intended, and to prevent a card from being inserted upside down. The key must be demonstrated to be permanent and not capable of being removed by the action of withdrawing the plug-in card. If this is not possible with the equipment offered, then the terminals shall be so arranged that no damage shall result if a card is accidentally or intentionally inserted into the wrong slot.
- 12.11 All components and parts shall be mounted on one side of the printed board only. All components shall be so mounted as to not obscure access to any terminations or any other parts. No portion of any component attached to the printed circuit board will extend beyond the edge of the printed circuit board.
- 12.12 Components and parts designed to be mounted with mechanical fasteners will be so mounted as to withstand all vibrations and mechanical shock hazards encountered during normal road transport.
- 12.13 No lead bend radius shall be less than the lead diameter.
- 12.14 All components and parts shall be located and spaced so that any other part can be removed from the printed circuit board without having to remove the other part. Parts shall not be placed across or on top of each other.
- 12.15 The frames into which the cards are plugged shall provide rigid and positive support and location for the card over the whole length to prevent rocking of the card in the container.
- 12.16 Component identification is essential and for this purpose the use of silk screen printing on the printed circuit boards is recommended.

13 COMPONENTS:

- 13.1 Only components with at least one and preferably two sources of alternative supply are to be used. Components shall be of the JEDEC-coded type or better, where possible. If the components are labelled with type numbers other than registered JEDEC numbers, then a list giving alternative replacement numbers shall be provided.

- 13.2 Preference will be given to systems utilizing large scale integrated circuits that are generally obtainable from the major component manufacturers. Specially developed components shall be avoided as far as possible.
- 13.3 The equipment shall not contain thermionic devices. (this excludes the cathode ray tube required for the terminal equipment, where specified). All semi-conductor components used shall be of the silicon type unless otherwise approved.
- 13.4 The use of electrolytic capacitors shall be kept to a minimum. Where they can not be avoided they shall have a guaranteed life time in excess of 100 000 hours. The capacitor elements and internal connecting leads shall be aluminium and no aluminium to copper joints shall be allowed inside the capacitor. Capacitors are not preferred on circuits which are responsible for basic clock pulse generation.
- 13.5 Any relays used shall preferably be of the sealed contact type or mercury wetted reed relays and shall be equipped with resistor/diode transients. Diodes shall be of the fast recovery types with an inverse voltage rating of at least double that of the relay supply voltage. The resistance value shall not exceed that of the supply voltage. The resistance value shall not exceed that of the relay coil. Failure of a relay contact or associated components shall not cause an undesired command to be given from the device in the case of output circuits.
- 13.6 Indicating devices shall use lamps of a locally produced type and preferably only one type of lamp shall be used throughout the installation. Where feasible, high quality LED or LCD's should be used. All lamps shall be easily replaceable from the front of the equipment, and if a lamp extractor is needed, one unit minimum shall provided for each location.
- 13.7 Where lamps are transistor driven, a series resistor shall be incorporated in the circuit to protect the transistor against cold switch-on surges. Each resistor shall be mounted close to the transistor and shall be rated such that the surface temperature rise is no more than 10 degree C above ambient under worst case conditions.
- 13.8 Annunciators shall incorporate at least two lamps in parallel and lettering shall not be less than 2,5 mm in height. The enunciator windows shall be large enough to accommodate the English and Afrikaans inscriptions in one window unless otherwise specified. Each window shall be able to accommodate at least 16 characters without undue crowding.

14 CONNECTORS:

- 14.1 The practice of hard wiring wires directly onto the printed circuit board shall not be permitted. Connectors will be used as far as possible.
- 14.2 Preference will be given to connectors which will be fitted to cables which provide some form of grip to discourage the practice of pulling the cable to release the connector. Connectors shall be provided with some means of retention adequate to the conditions of use.
- 14.3 Where similar connectors are so placed that possible mis-mating could occur, the connectors shall be provided with alternative inserts, key way settings etc. in addition to the clear identification markings.
- 14.4 Only high quality connectors suitable for the application will be used.

15 HAND SOLDERING:

- 15.1 Hand solder practices shall be of the highest standard and the following shall be considered: The solder shall cover the conductor and a concave fillet shall be formed between the lower half of the conductor and the other end of the soldering connection.
- 15.2 The contour of conductor and the stand of stranded wire shall not be obscured by the solder. Care shall be taken to prevent relative movement in the solder joint during solidification. (Forced cooling of the solder prior to solidification is prohibited).

- 15.3 After the solder has completely solidified, all residual flux and solids shall be removed within one hour using solvents which will remove polar and non polar contaminants.
- 15.4 The workmanship shall be of a quality level adequate to ensure that the processed products shall meet the performance requirements.
- 15.5 The solder connections shall have a smooth, bright appearance with metallic lustre and shall not have a chalky, gritty or irregular surface. It shall not exhibit point, pits, scars, fractures, tramped flux or foreign materials. (The connection shall be completely covered by solder to the extent that no base metal is visible including the ends of cut wire or leads).

16 WIRING AND WIRING HARNESSSES:

- 16.1 Wiring harnesses shall not restrict the easy replacement of parts or components which may require replacement or adjustment.
- 16.2 Wiring routes shall be planned to avoid hot spots and to preclude the possibility of the use of wires as hand holds.
- 16.3 Wires shall be routed to avoid the formation of current loops which will produce undesirable netting fields so that interference would be experienced with other circuits or devices.
- 16.4 Where a harness is terminated in a connector mating with a connector fixed to an assembly, flexibility of the harness shall (where applicable) be such to allow the insertion of a test adapter between the harness termination and the assembly.
- 16.5 Wires shall not be carried over or bent round any sharp corner or edge without suitable protection.
- 16.6 Sufficient slack shall be left at the ends of wiring runs, to allow for the displacement of components to which they are attached, for inspection and servicing. All wires in a wiring harness shall be clearly identified by means of colour coding or other suitable means. Clamps designed to support the wire harnesses shall be such that it will not affect the mechanical or electrical performance of the wires adversely.

17 LIGHTNING AND SURGE PROTECTION:

- 17.1 The supply and installation of lightning and surge protection equipment forms part of this contract except when otherwise specified.
- 17.2 The Contractor shall supply and install all the necessary lightning protectors, arrestors and other devices to provide protection for people and equipment on the premises.

GENERAL SPECIFICATION FOR SOFTWARE DOCUMENTATION

1. SCOPE:

- 1.1 This specification covers the design and documentation requirements for software supplied under this contract.

2. SYSTEM DESIGN:

- 2.1 The system shall make use of a well defined, standard, tested, debugged and field-proven operating system to control other programme modules which handle the user functional requirements. The operating system shall be capable of handling all input/output organization, scheduling, time-keeping, power failure procedures and to control communications with field hardware and operator devices, process system outputs and command requests.
- 2.2 The operating system shall initialize software upon restart conditions and allocate memory usage of application programmes. Furthermore, the operating system shall enable the system operator to create, store and run application and user programmes while operating system is busy controlling the real time application system. This user programme modifying facility should be menu driven under operating system control to enable operations to easily effect user system changes.
- 2.3 The operating system shall preferably reside in firmware and the software shall be task orientated, with linking and synchronisation possible between tasks. Tasks shall be allocated priorities and shall be able to control themselves relative to real-time so that the complete system is not "hung-up" by a faulty input device, such as chattering alarm relay.

3. DOCUMENTATION:

The successful Bidder shall supply full software documentation within two months after the delivery date of the equipment.

Four copies of each of the following shall be provided:

- 3.1 A system manual containing detailed description of the operating system and the drivers of each software module, task or sub-module used. This description shall clearly specify the functions and structure of each module and the interfaces and links between them. This manual shall also describe how new software modules can be added, running under the same operating system.
- 3.2 A manual containing a complete set of programme listings.
- 3.3 An operator's manual, specifying all the system operating procedures in detail, for each system forming part of this contract.
- 3.4 A software user's manual (for each system) providing detailed information on how additions to the system can be generated, for instance the addition of an out-station, creation of a new access control category etc., or how system parameters can be changed or deleted. This manual should avoid the use of computer system jargon, shall include a definition of terms used and shall be written in such a way that operators without formal computer hardware or software training will be able to effect the changes as far as possible.

4. DATA BASE COMPILATION AND BUILDING:

- 4.1 The successful Bidder shall create, edit, debug and put into operation the initial data base required for each system to be supplied in terms of this document. The data base shall be compiled and built from the specified parameters and from information which will be supplied by the Employer where applicable.
- 4.2 Bidders are, therefore, required to allow for the compilation of the required data basis in their contracts.

SECTION 4:

DETAIL SPECIFICATIONS

CONTENTS

GENERAL REQUIREMENTS:

1. Scope
2. Standards and Specifications
3. Departures from the services rendered
4. Purpose of the equipment
5. Testing of equipment
6. Installation
7. Transport
8. Maintenance and Spares
9. Manuals and Training
10. Technical Schedules
11. General Technical Requirements

DATA LOGGING EQUIPMENT:

12. Scope
13. Single Channel Data Logging systems with display;
14. Single Channel Data Logging systems without display;
15. Submersible Single Channel Data Logging systems with display;
16. Submersible Single Channel Data Logging systems without display;
17. Multi Channel Data Logging systems with display;
18. Multi Channel Data Logging systems without display;
19. Submersible Multi Channel Data Logging systems with display;
20. Submersible Multi Channel Data Logging systems without display;

INTEGRATED DATA LOGGING EQUIPMENT:

- 21. Scope
- 22. Single Channel Data Logger with integrated Shaft Encoder
- 23. Compact Single Channel Data Logger with Integrated Water Temperature Sensor
- 24. Single Channel Data Logger with integrated Pressure Transducer without LC Display
- 25. Single Channel Data Logger with integrated Pressure Transducer with LC Display
- 26. Two Channel Data Logger with Integrated Pressure Transducer
- 27. Two Channel Data Logger with Integrated Pressure Transducer and Data Transmission capabilities;
- 28. Three Channel Data Logger with Integrated Pressure Transducer;
- 29. Three Channel Data Logger with Integrated Pressure Transducer and Data Transmission capabilities;

BAROMETRIC WATER LEVEL INSTRUMENTATION:

- 30. Scope
- 31. Barometric Data Logging System, using the "Capacitive Ceramic" measuring method
- 32. Barometric Data Logging System, using the "Piezo-Resistive" measuring method

MULTI CHANNEL DATA LOGGING EQUIPMENT AND TRANSMISSION:

- 33. Scope
- 34. Multi Channel Data Logger with a maximum of two channels and:
- 35. Multi Channel Data Logger with a maximum of three channels and:
- 36. Multi Channel Data Logger with a minimum of four channels and:
- 37. Submersible Multi channel data logger with a minimum of two channels and:
- 38. Low Power Multi Channel data logger with a minimum of two channels and:
- 39. Compact Multi-Channel Data Logger for the measurement of Weather Parameters, with Integrated Weather Sensors with optional data transmission capabilities;
- 40. Multi-Channel Data Logger with Integrated pressure Transducer and Water Velocity measurement for use in Large Streams;
- 41. Multi-Channel Data Logger with Integrated pressure Transducer and Water Velocity measurement for use in Medium Streams;
- 42. Multi-Channel Data Logger with Integrated pressure Transducer and Water Velocity measurement for use in Small Streams;
- 43. Multi-Channel Data Logger with Integrated pressure Transducer and Water Velocity measurement for use in Shallow Streams;
- 44. GSM Cellular Telephone Modem;
- 45.** GSM/GPRS Modem

SENSORS:

46. Scope
47. Shaft Encoder
48. Pressure transducer for water level measurement using the "Capacitive Ceramic" method with 1 – 5 V or 4 – 20 mA output Signal;
49. Pressure transducer for water level measurement using the "Capacitive Ceramic" method with 0 – 10 V or 4 – 20 mA output Signal;
50. Pressure transducer for water level measurement using the "Capacitive Ceramic" method with SDI12 interface or 4 – 20 mA or RS485 output Signal;
51. Pressure transducer for water level measurement using the "Piezo-resistive" method (stainless steel sensor) with 1 – 5 V or 4 – 20 mA output Signal;
52. Pressure transducer for water level measurement using the "Piezo-resistive" method with 4 - 20 mA output Signal or SDI 12 Interface;
53. Bubble sensor for water level measurement;
54. Radar Sensor for water level measurement;
55. Laser Sensor for Water Level measurement;
56. Ultrasonic Sensor for flow measurement;
57. Tipping Bucket Rain Gauge;
58. Weighing type rain gauge;
59. Laser optical type rain gauge;
60. Humidity and Air Temperature Sensor;
61. Barometric Pressure Sensor
62. Anemometer
63. Wind Direction Indicator
64. Net Radiation
65. Miniature Field Camera;
66. Contact Gauge;
67. Multi Parameter Water Quality Sensor;
68. Temperature Sensor.

WATER QUALITY

69. Scope
70. Multi-Parameter Handheld Water Quality System (with pH-, Dissolved Oxygen-, Electrical Conductivity- and Temperature Sensor);
71. Handheld Conductivity and Temperature System (without pH- and Oxygen Sensor);
72. Handheld pH-, Conductivity- and Temperature Sensor (without Oxygen Sensor);
73. Handheld Water Quality Profiling System (with Depth-, pH-, Oxygen-, Electrical Conductivity- and Temperature Sensor);
74. Multi-Parameter Handheld Water Quality System with Wireless Smart Device Display
75. Multi-Parameter Water Quality Sonde with pH-, Electrical Conductivity-, Temperature-, Depth and Optical Oxygen Sensors (Bluetooth Communication Capability) – Diameter less than five centimetres;
76. Deep Water (minimum 245m) Multi-Parameter Water Quality Sonde with Optical and Smart Sensor Technology - Diameter less than five centimetres;
77. Deep Water (minimum 245m) Multi-Parameter Water Quality Sonde with Optical and Smart Sensor Technology - Diameter less than nine centimetres;
78. Extreme Depth Profiling (minimum 1500m) Multi Parameter Online/Memory Probe with Calculated Data Output – up to 16-Channels for Physical, Chemical and Optical Parameters;
79. Three Channel Data Logger with Integrated Pressure, Temperature and Conductivity Sensors – for Unattended Deployment with no Cables Attached
80. Three Channel Data Logger with Integrated Pressure, Temperature and Conductivity Sensors – For Permanent Submerged Deployment with Fixed (Non Removable) Communication Cable and Vented Tube.
81. Three Channel Data Logger with Integrated Pressure Transducer, Temperature- and Conductivity Sensors – for Permanent Deployment with Fixed (Non Removable) Communication Cable, Vented Tube and Built-in SIM Telemetry System (GSM Standard, GSM Quad band, GPRS).

POWER SUPPLY EQUIPMENT:

- 82. Scope;
- 83. Solar Panels;
- 84. Batteries;
- 85. Power Control Unit or Mains Transformer;
- 86. Portable power back-up;
- 87. Battery chargers;

GENERAL REQUIREMENTS:**1. SCOPE**

This contract makes provision for the supply and delivery of electronic data logging equipment, integrated data logging equipment, sensors and power supply equipment for mentioned equipment and application software for mainly the Directorate Hydrological Services of the Department of Water and Sanitation. Other Directorates within the Department (Government Water Schemes, Water Quality, etc.) could also make use of some of the equipment. The equipment will be used to collect and transmit hydrological data from evaporation gauging stations, river gauging stations, dam gauging stations and boreholes, situated throughout the country, for transfer to various Databases.

**No guarantee can be given to the Bidder with regard to the quantity of each item required.
Installation assistance, maintenance and back-up facilities shall be provided by the Bidder.**

2. STANDARDS AND SPECIFICATIONS:

- 2.1 The offered equipment with regard to its operational performance is to be in strict accordance with each and every term of the documents listed below:
- 2.1.1 The Standard Specifications - Section 3.
 - 2.1.2 The Detail Specifications - Section 4.
 - 2.1.3 The information provided in the Technical Schedules - Section 5.
- 2.2 The Bidder shall be required to provide back-up and maintenance on all the equipment supplied.
- 2.3 Next to each detail specification a block is provided for the bidder to complete the following:
- 2.3.1 Offered equipment / item to specification - ☐ **Y** or ☒
 - 2.3.2 Offered equipment / item not to specification - ☐ **N** or ☐ **X**
(Refer to Paragraph 3, below.)
 - 2.3.3 The bidder must initialise each page, he/she has filled and completed

Suppliers are required to indicate accordingly. Failure to indicate such will result in your bid being disqualified

3. DEPARTURES FROM THE SERVICES TO BE RENDERED:

- 3.1 If, in their offers to meet these specifications, there are any departures whatsoever from any of the provisions, or from any of the terms set out in paragraph 2 (Standards and Specifications), then Bidders shall list each and every departure in Section 1. (Annexure A). The list, which shall accompany the bid offer, shall be so numbered as to correlate each departure from the relative paragraph contained in the documents listed at 2.1. above.
- 3.2 **Failure on the part of any Bidder to meet this requirement in full shall signify compliance with the terms and conditions of the contract.**

4. PURPOSE OF THE EQUIPMENT:

- 4.1 The data loggers will be automatic, self-powered and required to sample selected parameters at different locations at a gauging site, parameters being: water level, conductivity, water temperature, pH, air temperature, precipitation, net radiation, wind speed, wind direction, turbidity, humidity and air temperature. The parameters will be sampled at predefined intervals and the data logger needs to store the collected data in the form of analogue values or digital signals.
- 4.2 At regular intervals, typically 30 to 60 days, the stored data will be read out via an USB, infrared interface or RS 232 port with a laptop computer or palmtop computer. The data will then be read out at the data processing facilities at Head Office in Pretoria, or at the Regional Offices.
- 4.3 The data loggers should have the capability of interfacing with either a transmitter to send data via satellite, national telephone link or cellular telephone link to the processing facilities at Head Office in Pretoria or Regional Offices.

5. TESTING OF EQUIPMENT:

- 5.1 The Engineer reserves the right to instruct the successful Bidder to submit a complete data logging system to the SABS to be tested for the following, before final awarding of the contract:
- 5.1.1 Compliance with the limits on the emission of radio frequency interference, as controlled in terms of the Radio Act.
 - 5.1.2 Satisfactory operation of the equipment at the extremes of the ambient operation conditions specified.
- The cost for the performance of these tests shall be for the Bidder's account.

- 5.2 It is a condition of this bid that, on request of the Engineer, the Bidder shall be able to demonstrate, within 2 weeks, after the closure of the bid, a unit of the equipment offered to the Engineer before the bid shall be awarded. On request of the Engineer, the Bidder shall install the unit/item at the Department's testing facility at Pretoria West, for evaluation of the equipment's performance. The Engineer will submit this request within two weeks after the closing date of this bid. The bid will be awarded after the Engineer is fully satisfied with the testing results performed at the testing facility. Failure to comply with these requests will invalidate the bid offer.

6. INSTALLATION:

- 6.1 The equipment shall be designed to allow installation by relatively unskilled staff. No special precautions shall be applicable and connectors shall be so configured that damage will not result should devices be swapped around. Equipment shall be cross polarity protected.
- 6.2 It is a condition of this contract that the Bidder shall assist the Department with the installation of the equipment, in order to ensure proper operation thereof. Installation procedures shall be incorporated in the user manual and all wiring diagrams and information for the proper installation shall be given. Physical installation on site will however be undertaken by Departmental staff.

7. TRANSPORT:

- 7.1 The equipment shall be designed and packaged to withstand transport by vehicle over rough, unmade dusty roads. All printed circuit boards and modules shall be securely mounted using nuts, bolts, stand-offs and PC board sliding tracks. No components shall be glued to the cabinet or other parts.

8. MAINTENANCE, SPARES AND ACCESSORIES:

- 8.1 The Bidder shall be able to maintain and guarantee all the equipment supplied for a minimum period of one year, starting from the date of delivery.
- 8.2 The Bidder shall provide the equipment listed in the various parts of the specifications and he shall during the maintenance period be obliged to maintain the spares in proper working condition and any failed equipment shall be repaired promptly.
- 8.3 The Bidder shall, at all times, have available, four complete sets of spare equipment so that the Employer will be in a position to repair any part of the equipment by way of substitution. Any faulty equipment will be replaced on site by the Bidder with a spare unit and the faulty unit will be transported to the workshops for repair.
- 8.4 During the initial guarantee period, should it be deemed necessary by the Engineer that the Bidder needs to visit a particular site; the cost will be borne by the Bidder.
- 8.5 All equipment shall be designed to require a minimum of maintenance. Routine maintenance inspections shall be limited to the physical cleaning of the equipment housing and power supply system.
- 8.6 During the contract period, no equipment is to be repaired without an official quotation from the Bidder. No repairs will be paid without an official quotation and official government order.
- 8.7 A list of general spares / Services that are available on each item will be listed.
- 8.8 Should any Accessories be available to be used with the main item, ie. Enclosures, GSM Modems, Antennae, Tools, etc., it should be listed.

9. MANUALS AND TRAINING:

- 9.1 The Bidder shall provide complete sets of user manuals, in English, included into the unit price, for each system and sub-system to be provided in terms of this contract. The user manual shall include the following:
- Equipment specifications;
 - Assembly and operation details;
 - Wiring diagrams;

- Troubleshooting;
- Explanation of error codes and possible remedial action;
- Maintenance;

9.2 In terms of paragraph 13 in Section 3 (Page 64), the Bidder shall be required to provide the following training, should it be deemed necessary by the Employer:

- 9.2.1 Training of technical staff will be presented at two venues in South Africa, as identified by the Engineer. All costs for these training sessions, i.e. Travelling, Accommodation and Meals etc. will be borne by the Bidder.
- 9.2.2 A course in the installation of the equipment, first line maintenance, faultfinding and operator's procedures, is required and this will be attended by a maximum of 25 people per venue.
- 9.2.3 Follow up on job training as per the request of the Technical Officials

10. TECHNICAL SCHEDULE:

Bidders are advised that it is in their own interest to provide accurate and detailed information in answer to all the questions asked in the Technical Schedules, which appear in Section 5 of this specification.

Failure to comply with this request will invalidate the bid offer.

11. GENERAL TECHNICAL AND OTHER REQUIREMENTS:

- 11.1. All submersible instrumentation shall function reliably in water with a high saline content as well as a high silt content, including various chemical pollutants (including sulphates and phosphates) originating from agricultural run-off and other human sources.
- 11.2. Only high quality equipment capable of offering extended service under arduous, hostile conditions in a long-term installation, on unmanned sites, shall be offered.
- 11.3. All instrumentation shall fully comply or exceed the specifications laid down in this Section. No deviation from the specified standards will be accepted.
- 11.4. Only microprocessor-controlled, frequency-synthesis instrumentation incorporating the latest in surface-mount technology shall be acceptable.
- 11.5. Bidders shall not offer instrumentation that has been superseded by later models or that will be discontinued in the near future. All instrumentation offered shall be of the most recent design. Should the Bidder be aware of any impending modifications or new equipment he / she shall state the expected implications of such in his / her offer.
- 11.6. All equipment offered shall have a high reliability and shall have a proven record (case history) of usage in the field of Hydrometry / hydrological measurement.
- 11.7. Except when otherwise specified, all equipment shall be suitably protected against lightning and surge damage, up to 2 kV; the relevant test certificates should preferably accompany the bid offer or shall be made available on request to the Engineer.
- 11.8. Labels:
The instrumentation shall have durable, clearly legible labels, indicating the make, model, serial number, ratings and other relevant information.
- 11.9. Mounting Brackets:
The mounting brackets for the instrumentation must be robust and not sensitive to impact and vibration. Where possible, it should be manufactured from corrosion-resistant material, preferably stainless steel, or the equivalent thereof.

- 11.10. Various makes, models, manufacturers' equipment will be used and therefore the Bidder will at all times make the offered equipment's protocol available to the Engineer for the compatibility to other equipment offered on this contract.
- 11.11. All data logger software updates will be supplied free of charge during the contract period. These upgrades will be delivered / sent / emailed by the Bidder to the relevant offices, which make use of the Bidder's equipment.
- 11.12. Should the Bidder or Manufacturing Company do any additional development during the contract period, on any item awarded to him / her, the Bidder will inform the Engineer in writing of such action. The Bidder will also outline what the effect it will have on the current contract and/or equipment.
- 11.13. Should a newly developed model of any of the offered equipment be introduced into the open market, the Bidder can supply such equipment on the following conditions:
 - 11.13.1. The Engineer will be informed in writing and only after the equipment has been tested and satisfying results have been obtained, the Engineer can approve such action.
 - 11.13.2. Back up, Maintenance and spares on the existing equipment will still be made available by the Bidder, at no additional cost.
 - 11.13.3. The client will still have the option to purchase the older model.
 - 11.13.4. The newly developed item will be offered at no additional cost.

DATA LOGGING EQUIPMENT - DETAIL SPECIFICATIONS

12. SCOPE:

- 12.1 This part of the specification covers the detail hardware and software requirements for the Data logger equipment.
- 12.2 The data loggers will be utilised at remote measuring stations to collect data. Operation will be in a totally unattended mode, with inspections by staff on a 30 to 60 day cycle.
- 12.3 The installed logger shall be designed and built for minimum maintenance and maximum life expectancy of 10 years or more - and shall be completely fit for the intended purpose. The product is intended to be permanently installed and will be designed for long term unattended operation and minimal maintenance. The long term reliability of the product whilst operating in harsh environments and the product battery life will be considered as very significant factors in the product selection.
- 12.4 The equipment will be mounted in recorder huts, either from mild steel, concrete or brick, with a minimum size of 800 x 800 x 1 800 mm high or mounted in pipes with diameters from 100 mm to 300 mm, and will be subjected to a harsh environment.
- 12.5 Enclosures, if available, should be offered for this equipment under "Accessories". These enclosures can be offered in Fibreglass, Robust Plastic, Mild Steel, Stainless Steel, etc.
- 12.6 Preference shall be given to enclosures that include anti-vandalism systems.
- 12.7 Each bidder shall offer complete power supply system/s with the logger offered and should be listed under "Accessories" in the Price Schedule.
- 12.8 Each bidder shall offer a suitable USB converter to enable configuration of the equipment via Laptop. The item should be listed under "Accessories" in the Price Schedule.
- 12.9 The logger and the associated meter interfaces must be able to be installed in an underground chamber, which could be flooded from time to time.

Administrative Compliance

Please note that all bidders must comply with the following administrative compliance

No.	Name of the document that must be submitted	Requirements
1	Invitation to bid –SBD 1	Please complete and sign the supplied proforma document.
2	Registration with Central Supplier Database as per National Treasury SCM Instruction 4 of 2015/17 par 5.2	Attach proof of print out as proof of registration or supplier number.
3	Declaration of Interest–SBD 4	Please complete and sign the supplied proforma document.
4	Declaration of Bidder's Past Supply Chain Management Practices– SBD8	Please complete and sign the supplied proforma document.
5	Certificate of Independent Bid Determination – SBD 9	Please complete and sign the supplied proforma document.

EVALUATION CRITERIA

The department of Water and Sanitation will evaluate all proposals in terms of the Preferential Procurement Regulations 2017. A copy of the Preferential Procurement Regulations 2017 can be downloaded from www.treasury.gov.za. A two phase evaluation criteria will be considered in evaluating the bid.

Phase 1: Mandatory Compliance (if not complied with bid will be disqualified)

Phase 2: Technical Compliance

Phase 1: Mandatory compliance

Bidders are required to submit and or complete the following documents which should form part of the bid submitted by closing date. Omission to complete and/or submit the listed documents will render your bid non responsive and the bid will not be considered for the phase 2 evaluation.

- (a) Pre-qualification in terms of Preferential Procurement Regulation, 2017, the bidding company must be 51% black owned, minimum level 3 Exempted Micro Enterprise (EME). Bidders are required to submit certified and valid copy of BEE certificate and CIPC documentation.
- (b) Appointment letter OR Certificate from the Manufacturer as distributor of the instrumentation in South Africa.
- (c) Appointment letter OR Certificate from the Manufacturer as Authorised Agent of the instrumentation in South Africa.
- (d) Warranty certificate for 12 months

PHASE 2: Technical Compliance

The specification questionnaire below is the 2nd phase evaluation of the proposals to be in compliance with the specification.

Next to each detail specification (Section 3) a block is provided for the Bidder to complete the following:

2.2.1. Offered equipment / item to specification- or

Y	✓

2.2.2. Offered equipment / item not to specification -or (Refer to Paragraph 3, below.)

N	X

2.2.3. The bidder must initialise each page, he/she has filled and completed

Suppliers are required to indicate accordingly. Failure to indicate such will result in your bid being disqualified.

13. SINGLE CHANNEL DATA LOGGING SYSTEMS WITH DISPLAY;

13.1 Hardware Requirements:

13.1.1 Environmental conditions:

- The equipment shall be designed to function satisfactorily under the following conditions:
 - Temperature range: Operating: -10° C to +60° C ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

13.1.2 Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

13.1.3 Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 30 seconds per month, operating under the environmental conditions listed above in Paragraph 13.1.1. ☐

13.1.4 Memory:

- The data loggers shall be provided with the following types of memory systems:
 - Non-volatile memory for system and station parameters and user defined variables. ☐
 - Battery backed RAM for intermediate data storage and processing. (Minimum 128 KB) Stored more than 2 years data if not downloaded ☐

13.1.5 Operator interface:

The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit, capable of displaying the full ASCII character set. ☐

13.1.6 Serial communication port:

- Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via a 9-pin RS 232 or USB serial port. ☐
- The RS 232 port configuration shall allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 9600 and above baud shall be available for selection. ☐
- The logger shall have the facility to interface with 4-20 mA output signal equipment. ☐

13.2 Power supply:

- 13.2.1 Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (± 12 minutes) ☐
- 13.2.2 Power for all the sensors will be derived from the internal main battery via the data logger for more than five years at an interval of 12 minutes. ☐
- 13.2.3 The logger must have low power consumption on standby mode. ☐
- 13.2.4 The data logger must be reverse polarity protected. ☐

13.3 Input functions and interfacing:

- 13.3.1 The analogue modules shall be designed to input either Pulse, 4 - 20 mA, signals. ☐
- 13.3.2 Digital inputs shall be parallel, pulse or V24 signals. ☐
- 13.3.3 Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- 13.3.4 The analogue input signals shall be measured to an overall accuracy of better than 0.5%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- 13.3.5 In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilization time for sensors must be controlled by the logger. ☐
- 13.3.6 During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- 13.3.7 Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- 13.3.8 Input connectors for sensors shall be clearly labelled, shall be polarized to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

13.4 Enclosure and Housing:

- 13.4.1 **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. **No logger** will be considered should the operator need to open the housing to access the keypad, LC Display, Connectors, etc. ☐
- 13.4.2 The data logger shall be enclosed in wall mounted / standing enclosures, for installation in a recorder hut. ☐
- 13.4.3 The logger housing shall be water and dust protected and shall comply with rating IP68 as defined in IEC144. ☐
- 13.4.4 The housing shall be manufactured of corrosion resistant material. ☐
- 13.4.5 The data logger housing shall preferably not exceed the following dimensions:
- Height – less than 200mm;
 - Width – less than 100mm;
 - Depth – less than 100mm.
- ☐

13.5 Internal Software Requirements:

13.5.1 General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space, and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required for the data logger. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the data base or data recordings by entering faulty or erroneous instructions or messages. Password protected. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐

13.5.2 Cold start:

- When the data logger is switched on, it shall perform a self-test, checking that all required cards and devices are present and that all RAM is operational. If any fault is detected, it shall display the fault description on the display and halt operation. If no fault or error is detected, it shall resume operation, using the system information in RAM. ☐

13.6 Data storage:

13.6.1 Data records shall contain the following information:

- ID no, Sensor/Channel no, Time/Date and measured value. ☐
- The measured value shall be given in engineering units. ☐

13.6.2 Data storage shall be done on a circulating storage system, first in - first out. ☐

13.6.3 The data must be able to be read out as often as desired, without destroying it. ☐

13.6.4 The memory contents must be retained in the case of a power supply breakdown. ☐

13.7 Data display:

13.7.1 All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐

13.7.2 When connecting to the data logger, the following information should be displayed: ☐

- Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-Minute period.

13.7.3 A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐

13.7.4 The data logger display will indicate when it is busy with data transfer. ☐

13.8 Operators procedures:

13.8.1 Menu-driven procedures:

All operator activities shall be menu driven.

- Station Settings - must be able to display and/or set:
 - Alphanumeric station ID;
 - Date and time settings;
 - Internal lithium cell voltage.
 - Software version.
 - RAM capacity.
 - The sensor.
 - Last data readout date.
 - Port settings.
 - Language settings (if necessary).☐
- Sensor settings - The sensor must include the following:
 - Sensor number.
 - Sensor description.
 - Display units.
 - Show minimum and maximum values for the last 24 hours.
 - Sample intervals.
 - Storage intervals.
 - Delta values for event logging.☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in 13.8.1. (Bullet 1 & 2).
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated).
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so.☐

13.8.2 Data retrieval:

- Data shall be able to be retrieved by the following means:
 - Laptop/ palmtop, via direct blue tooth and/or
 - Laptop, via cable and/or nine-pin connectors☐

It would be in the interest of the bidder to offer the option of data retrieval using a Data reader.

13.8.3 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals.☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval.☐

13.9 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions.

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14. SINGLE CHANNEL DATA LOGGING SYSTEMS WITHOUT DISPLAY;

14.1 Hardware Requirements:

14.1.1 Environmental conditions:

- The equipment shall be designed to function satisfactorily under the following conditions:
 - Temperature range: Operating:-10° C to +60° C; ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

14.1.2 Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

14.1.3 Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 30 seconds per month, operating under the environmental conditions listed above in Paragraph 14.1.1. ☐

14.1.4 Memory:

- The data loggers shall be provided with the following types of memory systems:
 - Non-volatile memory for system and station parameters and user defined variables. ☐
 - Battery backed RAM for intermediate data storage and processing. (Minimum 128 KB) Stored more than 2 years data if not downloaded ☐

14.1.5 Operator interface:

The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit, capable of displaying the full ASCII character set. ☐

14.1.6 Serial communication port:

- Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via a 9-pin RS 232 or USB serial port. ☐
- The RS 232 port configuration shall allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 9600 and above baud shall be available for selection. ☐
- The logger shall have the facility to interface with 4-20 mA output signal equipment. ☐

14.2 Power supply:

- 14.2.1 Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (± 12 minutes) ☐
- 14.2.2 Power for all the sensors will be derived from the internal main battery via the data logger for more than five years at an interval of 12 Minutes. ☐
- 14.2.3 The logger must have low power consumption on standby mode. ☐
- 14.2.4 The data logger **must be** reverse polarity protected. ☐

14.3 Input functions and interfacing:

- 14.3.1 The analogue modules shall be designed to input either Pulse, 4 - 20 mA, signals. ☐
- 14.3.2 Digital inputs shall be parallel, pulse or V24 signals. ☐
- 14.3.3 Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- 14.3.4 The analogue input signals shall be measured to an overall accuracy of better than 0.5%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- 14.3.5 In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilization time for sensors must be controlled by the logger. ☐
- 14.3.6 During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- 14.3.7 Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- 14.3.8 Input connectors for sensors shall be clearly labelled, shall be polarized to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

14.4 Enclosure and Housing:

- 14.4.1 **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. **No logger** will be considered should the operator need to open the housing to access the keypad, LCD, Connectors, etc. ☐
- 14.4.2 The data logger shall be enclosed in wall mounted / standing enclosures, for installation in a recorder hut. ☐
- 14.4.3 The logger housing shall be water and dust protected and shall comply with rating IP68 as defined in IEC144. ☐
- 14.4.4 The housing shall be manufactured of corrosion resistant material. ☐
- 14.4.5 The data logger housing shall preferably not exceed the following dimensions:
- Height – less than 200mm;
 - Width – less than 100mm;
 - Depth – less than 100mm.
- ☐

14.8 Operators procedures:

14.8.1 Menu-driven procedures:

All operator activities shall be menu driven.

- Station Settings - must be able to display and/or set:
 - Alphanumeric station number;
 - Date and time settings;
 - Internal lithium cell voltage.
 - Software version.
 - RAM capacity.
 - The sensor.
 - Last data readout date.
 - Port settings.
 - Language settings (if necessary).☐
- Sensor settings - The sensor must include the following:
 - Sensor number.
 - Sensor description.
 - Display units.
 - Show minimum and maximum values for the last 24 hours.
 - Sample intervals.
 - Storage intervals.
 - Delta values for event logging.☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in 14.8.1. (Bullet 1 & 2).
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated).
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so.☐

14.8.2 Data retrieval:

- Data shall be able to be retrieved by the following means:
 - Laptop/ palmtop, via direct blue tooth and/or
 - Laptop, via cable and/or nine-pin connectors☐

It would be in the interest of the bidder to offer the option of data retrieval using a Data reader.

14.8.3 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals.
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval.☐
☐

14.9 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions.

☐

14.5 Internal Software Requirements:

14.5.1 General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space, and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required for the data logger. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the data base or data recordings by entering faulty or erroneous instructions or messages. Password protected. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐

14.5.2 Cold start:

- When the data logger is switched on, it shall perform a self-test, checking that all required cards and devices are present and that all RAM is operational. If any fault is detected, it shall display the fault description on the display and halt operation. If no fault or error is detected, it shall resume operation, using the system information in RAM. ☐

14.6 Data storage:

14.6.1 Data records shall contain the following information:

- ID no, Sensor/Channel no, Time/Date and measured value. ☐
- The measured value shall be given in engineering units. ☐

14.6.2 Channel shall be numbered numerically. ☐

14.6.3 Data storage shall be done on a circulating storage system, first in - first out. ☐

14.6.4 The data must be able to be read out as often as desired, without destroying it. ☐

14.6.5 The memory contents must be retained in the case of a power supply breakdown. ☐

14.7 Data display:

14.7.1 All conversation between the data logger and the operator shall be done either via display or the laptop/palmtop. ☐

14.7.2 When connecting to the data logger, the following information should be displayed:

- Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-Minute period. ☐

14.7.3 A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐

14.7.4 The data logger display will indicate when it is busy with data transfer. ☐

15. SUBMERSIBLE SINGLE CHANNEL DATA LOGGING SYSTEMS WITH DISPLAY;

15.1 Hardware Requirements:

15.1.1 Environmental conditions:

- The equipment shall be designed to function satisfactorily under the following conditions:
 - Temperature range: Operating:-10° C to +60° C ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The data logger shall meet the requirement of IP68. In particular it shall tolerate submersions to a depth of 1 meter for 12 hours. ☐

15.1.2 Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

15.1.3 Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 30 seconds per month, operating under the environmental conditions listed above in Paragraph 15.1.1. ☐

15.1.4 Memory:

- The data loggers shall be provided with the following types of memory systems:
 - Non-volatile memory for system and station parameters and user defined variables. ☐
 - Battery backed RAM for intermediate data storage and processing. (Minimum 128 KB) Stored more than 2 years data if not downloaded ☐

15.1.5 Operator interface:

The data logger shall be provided with the following minimum **built in** facilities, to be used by operating and maintenance staff:

- A LCD unit, capable of displaying the full ASCII character set. ☐

15.1.6 Serial communication port:

- Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via a 9-pin RS 232 or USB serial port. ☐
- The RS 232 port configuration shall allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 9600 and above baud shall be available for selection. ☐
- The logger shall have the facility to interface with 4-20 mA output signal equipment. ☐

15.2 Power supply:

- 15.2.1 Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (± 12 minutes) ☐
- 15.2.2 Power for all the sensors will be derived from the internal main battery via the data logger for more than five years at an interval of 12 Minutes. ☐
- 15.2.3 The logger must have low power consumption on standby mode. ☐
- 15.2.4 The data logger **must be** reverse polarity protected. ☐

15.3 Input functions and interfacing:

- 15.3.1 The analogue modules shall be designed to input either Pulse, 4 - 20 mA, signals. ☐
- 15.3.2 Digital inputs shall be parallel, pulse or V24 signals. ☐
- 15.3.3 Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- 15.3.4 The analogue input signals shall be measured to an overall accuracy of better than 0.5%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- 15.3.5 In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilization time for sensors must be controlled by the logger. ☐
- 15.3.6 During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- 15.3.7 Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- 15.3.8 Input connectors for sensors shall be clearly labelled, shall be polarized to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

15.4 Enclosure and Housing:

- 15.4.1 **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. **No logger** will be considered should the operator need to open the housing to access the keypad, LC Display, Connectors, etc. ☐
- 15.4.2 The data logger shall be enclosed in wall mounted / standing enclosures, for installation in a recorder hut. ☐
- 15.4.3 The logger housing shall be water and dust protected and shall comply with rating IP68 as defined in IEC144. ☐
- 15.4.4 The housing shall be manufactured of corrosion resistant material. ☐
- 15.4.5 The data logger housing shall preferably not exceed the following dimensions:
- Height – less than 200mm;
 - Width – less than 100mm;
 - Depth – less than 100mm.
- ☐

15.5 Internal Software Requirements:

15.5.1 General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space, and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required for the data logger. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the data base or data recordings by entering faulty or erroneous instructions or messages. Password protected. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐

15.5.2 Cold start:

- When the data logger is switched on, it shall perform a self-test, checking that all required cards and devices are present and that all RAM is operational. If any fault is detected, it shall display the fault description on the display and halt operation. If no fault or error is detected, it shall resume operation, using the system information in RAM. ☐

15.6 Data storage:

- 15.6.1 Data records shall contain the following information:
- ID no, Sensor/Channel no, Time/Date and measured value.
 - The measured value shall be given in engineering units.
- ☐
- 15.6.2 Channel shall be numbered numerically. ☐
- 15.6.3 Data storage shall be done on a circulating storage system, first in - first out. ☐
- 15.6.4 The data must be able to be read out as often as desired, without destroying it. ☐
- 15.6.5 The memory contents must be retained in the case of a power supply breakdown. ☐

15.7 Data display:

- 15.7.1 All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐
- 15.7.2 When connecting to the data logger, the following information should be displayed:
- Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-Minute period. ☐
- 15.7.3 A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- 15.7.4 The data logger display will indicate when it is busy with data transfer. ☐

15.8 Operators procedures:

15.8.1 Menu-driven procedures:

All operator activities shall be menu driven.

- Station Settings - must be able to display and/or set:
 - Alphanumeric station number;
 - Date and time settings;
 - Internal lithium cell voltage.
 - Software version.
 - RAM capacity.
 - The sensor.
 - Last data readout date.
 - Port settings.
 - Language settings (if necessary). ☐
- Sensor settings - The sensor must include the following:
 - Sensor number.
 - Sensor description.
 - Display units.
 - Show minimum and maximum values for the last 24 hours.
 - Sample intervals.
 - Storage intervals. ☐
 - Delta values for event logging.
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in 14.8.1. (Bullet 1 & 2).
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated).
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐

15.8.2 Data retrieval:

- Data shall be able to be retrieved by the following means:
 - Laptop/ palmtop, via direct blue tooth and/or ☐
 - Laptop, via cable and/or nine-pin connectors

It would be in the interest of the bidder to offer the option of data retrieval using a Data reader.

15.8.3 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

15.9 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

16. SUBMERSIBLE SINGLE CHANNEL DATA LOGGING SYSTEMS WITHOUT DISPLAY;

16.1 Hardware Requirements:

16.1.1 Environmental conditions:

- The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range: Operating:

-10° C to +60° C

☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The data logger shall meet the requirement of IP68. In particular it shall tolerate submersions to a depth of 1 meter for 12 hours. ☐

16.1.2 Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

16.1.3 Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 30 seconds per month, operating under the environmental conditions listed above in Paragraph 16.1.1. ☐

16.1.4 Memory:

- The data loggers shall be provided with the following types of memory systems:

Non-volatile memory for system and station parameters and user defined variables.

☐

Battery backed RAM for intermediate data storage and processing. (Minimum 128 KB) Stored more than 2 years data if not downloaded

☐

16.1.5 Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit, capable of displaying the full ASCII character set. ☐

- 16.1.6 Serial communication port:
- Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via a 9-pin RS 232 or USB serial port. ☐
 - The RS 232 port configuration shall allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 9600 and above baud shall be available for selection. ☐
 - The logger shall have the facility to interface with 4-20 mA output signal equipment. ☐
- 16.1.7 Power supply: Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (± 12 minutes) ☐
- 16.1.8 Power for all the sensors will be derived from the internal main battery via the data logger for more than five years at an interval of 12 Minutes. ☐
- 16.1.9 The logger must have low power consumption on standby mode. ☐
- 16.1.10 The data logger **must be** reverse polarity protected. ☐
- 16.2 Input functions and interfacing:
- 16.2.1 The analogue modules shall be designed to input either Pulse, 4 - 20 mA, signals. ☐
- 16.2.2 Digital inputs shall be parallel, pulse or V24 signals. ☐
- 16.2.3 Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- 16.2.4 The analogue input signals shall be measured to an overall accuracy of better than 0.5%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- 16.2.5 In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilization time for sensors must be controlled by the logger. ☐
- 16.2.6 During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- 16.2.7 Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- 16.2.8 Input connectors for sensors shall be clearly labelled, shall be polarized to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

16.3 Enclosure and Housing:

- 16.3.1 **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. **No logger** will be considered should the operator need to open the housing to access the keypad, LCD, Connectors, etc. ☐
- 16.3.2 The data logger shall be enclosed in wall mounted / standing enclosures, for installation in a recorder hut. ☐
- 16.3.3 The logger housing shall be water and dust protected and shall comply with rating IP68 as defined in IEC144. ☐
- 16.3.4 The housing shall be manufactured of corrosion resistant material. ☐
- 16.3.5 The data logger housing shall preferably not exceed the following dimensions:
- Height – less than 200mm;
 - Width – less than 100mm;
 - Depth – less than 100mm.
- ☐

16.4 Internal Software Requirements:

16.4.1 General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space, and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required for the data logger. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the data base or data recordings by entering faulty or erroneous instructions or messages. Password protected. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐

16.4.2 Cold start:

- When the data logger is switched on, it shall perform a self-test, checking that all required cards and devices are present and that all RAM is operational. If any fault is detected, it shall display the fault description on the display and halt operation. If no fault or error is detected, it shall resume operation, using the system information in RAM. ☐

16.5 Data storage:

- 16.5.1 Data records shall contain the following information:
- ID no, Sensor/Channel no, Time/Date and measured value.
 - The measured value shall be given in engineering units.
- ☐
- 16.5.2 Channel shall be numbered numerically. ☐
- 16.5.3 Data storage shall be done on a circulating storage system, first in - first out. ☐
- 16.5.4 The data must be able to be read out as often as desired, without destroying it. ☐
- 16.5.5 The memory contents must be retained in the case of a power supply breakdown. ☐

16.6 Data display:

- 16.6.1 All conversation between the data logger and the operator shall be done via the laptop/palmtop. ☐
- 16.6.2 When connecting to the data logger, the following information should be displayed:
- Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-Minute period. ☐
- 16.6.3 A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- 16.6.4 The data logger display will indicate when it is busy with data transfer. ☐

16.7 Operators procedures:

16.7.1 Menu-driven procedures:

All operator activities shall be menu driven. ☐

- Station Settings - must be able to display and/or set:
 - Alphanumeric station number
 - Date and time settings;
 - Internal lithium cell voltage.
 - Software version.
 - RAM capacity.
 - The sensor.
 - Last data readout date.
 - Port settings.
 - Language settings (if necessary). ☐
- Sensor settings - The sensor must include the following:
 - Sensor number.
 - Sensor description.
 - Display units.
 - Show minimum and maximum values for the last 24 hours.
 - Sample intervals.
 - Storage intervals.
 - Delta values for event logging. ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in 16.8.1. (Bullet 1 & 2).
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated).
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐

16.7.2 Data retrieval:

- Data shall be able to be retrieved by the following means:
 - Laptop/ palmtop, via direct blue tooth and/or ☐
 - Laptop, via cable and/or nine-pin connectors

It would be in the interest of the bidder to offer the option of data retrieval using a Data reader.

16.7.3 Determination of sampling intervals:

- Procedure:

- Time Recording:

Sample at set intervals:

Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals.

☐

- Delta recording for water levels:

Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval.

☐

16.8 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions.

☐

17. MULTI CHANNEL DATA LOGGING SYSTEMS WITH DISPLAY;

17.1 Hardware Requirements:

17.1.1 Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C ☐
 - Operating: -40° C to +70° C ☐
 - Display (On) -20° C to +70° C ☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

17.1.2 Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

17.1.3 Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above in Paragraph 17.1.1. ☐

17.1.4 Memory:

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
- Data must still be available after being read out. ☐
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- The logger should have a RTOS operating system ensuring minimum power consumption ☐

17.1.5 Operator interface:

The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

17.1.6 Communication ports:

- Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:
 - 9-pin RS 232 or USB serial port;
 - Host USB interface;
 - Device USB interface.☐

17.1.7 Communication protocols:

- The data logger shall have the following protocols available on each of the above mentioned communication ports:
 - MODBUS;
 - SDI-12 (via RS485);
 - CREX code (satellite communication);
 - Terminal Mode;
 - FTP.☐

17.2 Power supply:

- 17.2.1 The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- 17.2.2 Power consumption should be within 25mA to 400mA at 12V_{DC} dependant on sensors and configuration used; ☐
- 17.2.3 The logger must have low power consumption on standby mode; ☐
- 17.2.4 Logger should have a input Voltage protection of 36 V_{DC}; ☐
- 17.2.5 The data logger must be reverse polarity protected; ☐
- 17.2.6 Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

17.3 Surge Protection:

- 17.3.1 The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- 17.3.2 The following equipment shall be included as an absolute minimum requirement: ☐
- On all analog/digital input and output circuits - DEHNBLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

17.4 Input functions and interfacing:

- 17.4.1 The logger should have as a standard configuration 4 physical input channels with the following sensor interface capabilities:
- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12.☐
 - Three channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485.☐
 - The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input.☐
 - The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
 - The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

17.5 Enclosure and Housing:

- 17.5.1 The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- 17.5.2 The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- 17.5.3 All connections to be made internally - no external connections. ☐
- 17.5.4 The housing shall be manufactured of corrosion resistant material. ☐
- 17.5.5 Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- 17.5.6 The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- 17.5.7 The data logger housing shall preferably not exceed the following dimensions: ☐
- 17.5.8 Height - 130mm; Width - 130mm; Depth - 70mm. ☐

17.6 Internal software requirements:

17.6.1 General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐

- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

17.7 Data acquisition:

- 17.7.1 The data logger shall operate with a fixed interval logging sequences. ☐
- 17.7.2 The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
- Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- 17.7.3 The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

17.8 Data processing:

- 17.8.1 The data logger shall the following options available in the software configuration to process measured values:
- Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).
- ☐

17.9 Data storage:

- 17.9.1 Data records shall contain the following information:
- Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- 17.9.2 Data storage shall be done on a circulating storage system, first in - first out. ☐
- 17.9.3 The data must be able to be read out as often as desired, without destroying it. ☐
- 17.9.4 The memory contents must be retained in the case of a power supply breakdown. ☐
- 17.9.5 Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

17.10 Data display:

- 17.10.1 All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- 17.10.2 All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐
- 17.10.3 When connecting to the data logger, the following information should be displayed:
- Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- 17.10.4 A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- 17.10.5 The data logger display will indicate when it is busy with data transfer.

17.11 Operator's procedures:

17.11.1 Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an optional extra external communication device or remotely by means of a dial-up telephone connection, SMS text messages, GPRS transmission or satellite connection. ☐

17.11.2 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections: ☐
 - RS-232 port;
 - USB port.
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved.
 - Option to select individual sensors for data retrieval.
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

17.11.3 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

17.12 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

18. MULTI CHANNEL DATA LOGGING SYSTEMS WITHOUT DISPLAY;

18.1 Hardware Requirements:

18.1.1 Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C ☐
 - Operating: -40° C to +70° C ☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

18.1.2 Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

18.1.3 Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above in Paragraph 18.1.1. ☐

18.1.4 Memory:

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
- Data must still be available after being read out. ☐
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- The logger should have a RTOS operating system ensuring minimum power consumption. ☐

18.1.5 Communication ports:

- Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:
 - 9-pin RS 232 or USB serial port;
 - Host USB interface;
 - Device USB interface.☐

18.1.6 Communication protocols:

- The data logger shall have the following protocols available on each of the above mentioned communication ports:
 - MODBUS;
 - SDI-12 (via RS485);
 - CREX code (satellite communication);
 - Terminal Mode;
 - FTP.

☐

18.2 Power supply:

18.2.1 The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC};

☐

18.2.2 Power consumption should be within 25mA to 400mA at 12V_{DC} dependant on sensors and configuration used;

☐

18.2.3 The logger must have low power consumption on standby mode;

☐

18.2.4 Logger should have a input Voltage protection of 36 V_{DC};

☐

18.2.5 The data logger must be reverse polarity protected;

☐

18.2.6 Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes)

☐

18.3 Surge Protection:

18.3.1 The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits.

☐

18.3.2 The following equipment shall be included as an absolute minimum requirement:

- On all analog / digital input and output circuits - DEHNBLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings.
- On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent.
- The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers.
- It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level.

☐☐☐☐

18.4 Input functions and interfacing:

18.4.1 The logger should have as a standard configuration 4 physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12.

☐

- Three channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485.☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input.☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops.
 ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types.
 ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger.
 ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels.
 ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit.
 ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines.
 ☐

18.5 Enclosure and Housing:

- 18.5.1 The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut.
 ☐
- 18.5.2 The logger housing shall be water and dust protected and shall comply with rating IP41.
 ☐
- 18.5.3 All connections to be made internally - no external connections.
 ☐
- 18.5.4 The housing shall be manufactured of corrosion resistant material.
 ☐
- 18.5.5 Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector.
 ☐
- 18.5.6 The housing will preferably house an operator interface, keypad / jog shuttle and LC Display.
 ☐
- 18.5.7 The data logger housing shall preferably not exceed the following dimensions:
 ☐
- 18.5.8 Height - 130mm; Width - 130mm; Depth - 70mm.

18.5.9 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

18.5.10 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and
 - Maximum sampling time of 24 hours. ☐
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

18.5.11 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

18.5.12 Data storage:

- Data records shall contain the following information:
 - ID number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

18.5.13 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐

18.6 Operator's procedures:

18.6.1 Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required ☐
- The operator shall have the ability to add or remove channels in the configuration as required ☐
- The operator shall have the option to do a system reset or restore factory settings if required ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an **optional extra** external communication device or remotely by means of a dial-up telephone connection, SMS text messages, GPRS transmission or satellite connection. ☐

18.6.2 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port. ☐

- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved.
 - Option to select individual sensors for data retrieval.
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display.

☐

18.6.3 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals.
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval.

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18.7 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions.

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19. SUBMERSIBLE MULTI CHANNEL DATA LOGGING SYSTEMS WITH DISPLAY;

19.1 Hardware Requirements:

19.1.1 Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C ☐
 - Operating: -40° C to +70° C ☐
 - Display (On) -20° C to +70° C ☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The data logger shall meet the requirement of IP68. In particular it shall tolerate submersions to a depth of 1 meter for 12 hours. ☐
- The equipment shall be designed and built for minimum maintenance and maximum life expectancy of 10 years or more - and shall be completely fit for the intended purpose. ☐

19.1.2 Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

19.1.3 Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above in Paragraph 19.1.1. ☐

19.1.4 Memory:

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
- Data must still be available after being read out. ☐
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- The logger should have a RTOS operating system ensuring minimum power consumption ☐

19.1.5 Communication ports:

- Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:
 - 9-pin RS 232 or USB serial port;
 - Host USB interface;
 - Device USB interface.

☐

19.1.6 Communication protocols:

- The data logger shall have the following protocols available on each of the above mentioned communication ports:
 - MODBUS;
 - SDI-12 (via RS485);
 - CREX code (satellite communication);
 - Terminal Mode;
 - FTP.

☐

19.2 Power supply:

19.2.1 The data logger shall have a minimum battery life of 5 years under the following conditions of use:

- Logging interval 15 minutes
- Recording of one flow and pressure

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19.2.2 The battery shall be user replaceable.

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19.2.3 The logger must have low power consumption on standby mode;

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19.2.4 The data logger must be reverse polarity protected;

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19.2.5 Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (± 15 minutes);

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19.2.6 The hardware of the data logger will permit battery change by the user.

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19.2.7 Assuming battery change is carried out in less than one hour, the following processes will be unaffected by battery change:

- Data held in the data logger
- Index upkeep
- Internal data logger time
- Recording process
- Site specific information previously programmed in the logger

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19.2.8 During main battery change, it is expected that the data logging, a back-up cell will maintain internal clock and data retention capability of the data logger internal to the data logger. This backup cell is not interchangeable, and should have a design life of no less than that of the product itself.

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19.3 Surge Protection:

19.3.1 The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits.

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19.3.2 The following equipment shall be included as an absolute minimum requirement:

- On all analog / digital input and output circuits - DEHNBLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings.

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- On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
- The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
- It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

19.4 Input functions and interfacing:

19.4.1 The logger should have as a standard configuration a minimum of 4 physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12.☐
- For flow profile and consumption recording the unit should be capable of recording data from a minimum of two channels + readings from the meter index. ☐
- For pressure monitoring applications the unit will be fitted with an integral pressure sensor. ☐
- For state recording the unit should be equipped with a minimum of 1 channel and a maximum of 8 channels (user configurable). ☐
- For applications where voltage (0-2.5V or 4-20mA across a 100 ohm resistor), event and frequency inputs are to be recorded the unit will have a minimum of 1 channel and a maximum of 8 channels (user configurable). ☐

19.4.2 Pressure Input:

- The data logger will feature an optional integral pressure sensor for connection to the water pressure. ☐
- The measuring range of the pressure sensor shall be either 100m or 200m water. The pressure measurement shall be of absolute pressure (above atmospheric), thereby avoiding the need for atmospheric reference required for a gauge measurement. ☐
- Accuracy and resolution of the pressure sensor shall be $\pm 0.5\%$ of full scale over the specified temperature range. ☐
- Three channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485.☐

- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input.☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

19.5 Enclosure and Housing:

- 19.5.1 The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- 19.5.2 The logger housing shall be water and dust protected and shall comply with rating IP68. ☐
- 19.5.3 All connections to be made internally - no external connections. ☐
- 19.5.4 The Connectors used for flow connection and for the serial port shall meet the requirements of MIL-C- 26482 or better. The connectors shall be protected by waterproof covers attached to the housing when not in use. ☐
- 19.5.5 The housing shall be manufactured of corrosion resistant material. ☐
- 19.5.6 Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- 19.5.7 The housing will preferably house an operator interface, keypad / jog shuttle and LC Display. ☐
- 19.5.8 The data logger housing shall preferably not exceed the following dimensions: ☐
- 19.5.9 Height - 130mm; Width - 130mm; Depth - 70mm.

19.6 Internal software requirements:

19.6.1 General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

19.6.2 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

19.6.3 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).☐

19.6.4 Data storage:

- Data records shall contain the following information:
 - ID number, Time/Date code and measured value.
 - The measured value shall be given in engineering units.
- Data storage shall be done on a circulating storage system, first in - first out.
- The data must be able to be read out as often as desired, without destroying it.
- The memory contents must be retained in the case of a power supply breakdown.
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning.

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19.6.5 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet.

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19.7 Operator's procedures:

19.7.1 Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software.
- Logger configuration Settings - user must be able to be set:
 - Site number or numerical reference
 - Scale factors and offsets for each input
 - Units and formats for measurements
 - Channels to be recorded
 - Memory allocated to each channel
- The operator shall have the option to set and adjust port settings as required
- The operator shall have the ability to add or remove channels in the configuration as required
- The operator shall have the option to do a system reset or restore factory settings if required
- The operator shall have the option to upgrade firmware if required means of a laptop on site
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an **optional extra** external communication device or remotely by means of a dial-up telephone connection, SMS text messages, GPRS transmission or satellite connection.

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19.7.2 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port.

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- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved.
 - Option to select individual sensors for data retrieval.
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display.

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19.7.3 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals.
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval.

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19.8 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions.

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20. SUBMERSIBLE MULTI CHANNEL DATA LOGGING SYSTEMS WITHOUT DISPLAY;

20.1 Hardware Requirements:

20.1.1 Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
- Relative humidity: 5% to 95%, non condensing
- Elevation: 0 - 3 500 m above sea level
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites.
- The data logger shall meet the requirement of IP68. In particular it shall tolerate submersions to a depth of 1 meter for 12 hours.
- The equipment shall be designed and built for minimum maintenance and maximum life expectancy of 10 years or more - and shall be completely fit for the intended purpose.

20.1.2 Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered.
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance.

20.1.3 Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy.
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years.
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above in Paragraph 20.1.1.

20.1.4 Memory:

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings.
- Data must still be available after being read out.
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired.
- The logger should have a RTOS operating system ensuring minimum power consumption

20.1.5 Communication ports:

- Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:
 - 9-pin RS 232 or USB serial port;
 - Host USB interface;
 - Device USB interface.

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20.1.6 Communication protocols:

- The data logger shall have the following protocols available on each of the above mentioned communication ports:
 - MODBUS;
 - SDI-12 (via RS485);
 - CREX code (satellite communication);
 - Terminal Mode;
 - FTP.

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20.2 Power supply:

20.2.1 The data logger shall have a minimum battery life of 5 years under the following conditions of use:

- Logging interval 15 minutes
- Recording of one flow and pressure

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20.2.2 The battery shall be user replaceable.

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20.2.3 The logger must have low power consumption on standby mode;

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20.2.4 The data logger must be reverse polarity protected;

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20.2.5 Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (± 15 minutes);

☐

20.2.6 The hardware of the data logger will permit battery change by the user.

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20.2.7 Assuming battery change is carried out in less than one hour, the following processes will be unaffected by battery change:

- Data held in the data logger
- Index upkeep
- Internal data logger time
- Recording process
- Site specific information previously programmed in the logger

☐

20.2.8 During main battery change, it is expected that the data logging, a back-up cell will maintain internal clock and data retention capability of the data logger internal to the data logger. This backup cell is not interchangeable, and should have a design life of no less than that of the product itself.

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20.3 Surge Protection:

20.3.1 The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits.

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20.3.2 The following equipment shall be included as an absolute minimum requirement:

☐

- On all analog / digital input and output circuits - DEHNBLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings.

☐

- On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
- The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
- It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

20.4 Input functions and interfacing:

20.4.1 The logger should have as a standard configuration a minimum of 4 physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12.☐
- For flow profile and consumption recording the unit should be capable of recording data from a minimum of two channels + readings from the meter index. ☐
- For pressure monitoring applications the unit will be fitted with an integral pressure sensor. ☐
- For state recording the unit should be equipped with a minimum of 1 channel and a maximum of 8 channels (user configurable). ☐
- For applications where voltage (0-2.5V or 4-20mA across a 100 ohm resistor), event and frequency inputs are to be recorded the unit will have a minimum of 1 channel and a maximum of 8 channels (user configurable). ☐

20.4.2 Pressure Input:

- The data logger will feature an optional integral pressure sensor for connection to the water pressure. ☐
- The measuring range of the pressure sensor shall be either 100m or 200m water. The pressure measurement shall be of absolute pressure (above atmospheric), thereby avoiding the need for atmospheric reference required for a gauge measurement. ☐
- Accuracy and resolution of the pressure sensor shall be $\pm 0.5\%$ of full scale over the specified temperature range. ☐
- Three channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485.☐

- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input.☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops.
 ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types.
 ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger.
 ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels.
 ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit.
 ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines.
 ☐

20.5 Enclosure and Housing:

- 20.5.1 The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut.
 ☐
- 20.5.2 The logger housing shall be water and dust protected and shall comply with rating IP68.
 ☐
- 20.5.3 All connections to be made internally - no external connections.
 ☐
- 20.5.4 The Connectors used for flow connection and for the serial port shall meet the requirements of MIL-C- 26482 or better. The connectors shall be protected by waterproof covers attached to the housing when not in use.
 ☐
- 20.5.5 The housing shall be manufactured of corrosion resistant material.
 ☐
- 20.5.6 Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector.
 ☐
- 20.5.7 The housing will preferably house an operator interface, keypad / jog shuttle and LC Display.
 ☐
- 20.5.8 The data logger housing shall preferably not exceed the following dimensions:
 ☐
- 20.5.9 Height - 130mm; Width - 130mm; Depth - 70mm.
 ☐

20.6 Internal software requirements:

20.6.1 General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

20.6.2 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and
 - Maximum sampling time of 24 hours. ☐
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

20.6.3 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

20.6.4 Data storage:

- Data records shall contain the following information:
 - ID number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

20.6.5 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐

20.7 Operator's procedures:

20.7.1 Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Site number or numerical reference
 - Scale factors and offsets for each input
 - Units and formats for measurements
 - Channels to be recorded
 - Memory allocated to each channel☐
- The operator shall have the option to set and adjust port settings as required ☐
- The operator shall have the ability to add or remove channels in the configuration as required ☐
- The operator shall have the option to do a system reset or restore factory settings if required ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an **optional extra** external communication device or remotely by means of a dial-up telephone connection, SMS text messages, GPRS transmission or satellite connection. ☐

Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port.☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved.
 - Option to select individual sensors for data retrieval.
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display.☐

20.7.2 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals.☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval.☐

20.8 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions.

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INTEGRATED DATA LOGGING EQUIPMENT- DETAIL SPECIFICATIONS:

21. SCOPE

- 21.1 This part of the specification covers the detail hardware and software requirements for the Integrated Data logging equipment.
- 21.2 The data loggers will be utilised at remote measuring stations to collect data. Operation will be in a totally unattended mode, with inspections by staff on a 30 to 60 day cycle.
- 21.3 The equipment will be mounted in recorder huts, either from mild steel, concrete or brick, with a minimum size of 800 x 800 x 1 800 mm high or mounted in pipes with diameters from 100 mm to 300 mm, and will be subjected to a harsh environment.
- 21.4 Enclosures, if available, should be offered for this equipment under "Accessories". These enclosures can be offered in Fibreglass, Robust Plastic, Mild Steel, Stainless Steel, etc.
- 21.5 Preference shall be given to enclosures that include anti-vandalism systems.
- 21.6 Each bidder shall offer complete power supply system/s with the logger offered and should be listed under "Accessories" in the Price Schedule.

22. SINGLE CHANNEL DATA LOGGER WITH INTEGRATED SHAFT ENCODER;

22.1 The Shaft Encoder:

22.1.1 Application:

- The shaft encoder will operate with a float and counterweight system. ☐
- The shaft encoder must preferably have a standard resolution of 1 mm and must preferably be capable of measuring water levels from 0 - 19,999 m (mm resolution) and 0-199,99 m (cm resolution). Desired resolution must be able to be scaled by the user. ☐
- All replacement spares and accessories, needed for complete installation and data collection should be listed under "Accessories" in the Price Schedule. ☐

22.1.2 Design and technical details:

- The shaft encoder must be compact, robust and corrosion-resistant. ☐
- The shaft encoder unit must be connected to the data logger with a flexible cable. ☐
- The sense of rotation must be able to be selected by the user for left- or right hand rising. ☐
- The shaft encoder must be able to process an extremely high rotation speed. At least 1m rise or fall in 20 seconds, or better. ☐
- The pulley of the shaft encoder must be able to accommodate 1 mm Ø float cable. ☐
- The float cable must not slip on the encoder pulley. ☐
- A corrosion-resistant bracket for stand-alone operation must be available. ☐

22.2 The Data Logger:

22.2.1 Data Processing:

- The data logger and circuit shall be adequately protected against surge and system will automatically restart in case of a severe electrical or electromagnetic disturbance. ☐

22.2.2 Real time clock:

- The data logger shall be equipped with a battery backed hardware real time clock system. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 30 seconds per month, operating under the specified environmental conditions. ☐

22.2.3 Memory:

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 30 000 readings over approximately 270 days, at a storage interval of 60 minutes. ☐
- Data must still be available after being read out. ☐

22.2.4 Operator interface:

- Preferably the data logger shall be provided with the following minimum built-in facilities, to be used by operating and maintenance staff:
 - A well readable single line, 4½ character LCD unit, capable of displaying the water level (to the nearest mm or cm), date, time and battery voltage. ☐

22.2.5 Power supply:

- No mains power supplies will be available to power the data loggers. The equipment should be of absolute sensor system with no permanent power supply necessary. ☐
- The logger should operate for at least 6 months with commercially available dry alkaline batteries. ☐
- Easy access for the change of the battery must be assured. ☐

22.2.6 Serial communication port:

- Data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via infrared technology or a 9-pin RS 232 port. ☐
- The data logger shall also be equipped with an easy accessible RS 232 and/or SDI 12 interface for data transmission via a communication facility (Telephone line, Cellular telephone link, Satellite Transmitter and Satellite telephone link) ☐

22.2.7 Enclosure and Housing:

- The logger housing shall be water and dust protected and must comply with IP68 rating. ☐
- All connections to be made internally. ☐
- The housing shall be manufactured of corrosion resistant material. ☐

22.3 Internal software requirements:

22.3.1 General:

- All software packages shall be written and structured in a high-level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the data base or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐

22.3.2 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data. ☐
 - Minimum sampling time of 60 seconds; and a
 - Maximum sampling time of 24 hours.

22.3.3 Data storage:

- Data records shall contain the following information: ☐
 - ID number, Time/Date code and measured value.
 - The measured value shall be given in engineering units.
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐

22.3.4 Data display:

- All conversation between the data logger and the operator shall be done via a laptop, PDA, tablet or dedicated device. ☐
- The following information shall be displayed: ☐
 - Measured value, Date, Time and Battery status.
- A time-out shall be provided, so that the display will switch off if no activity is detected for a period. (Typically 5 minutes) ☐

22.4 Operators procedures:

22.4.1 Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software: ☐
- Station Settings - must be able to display and/or set: ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. A2H010_A01
 - Date and time settings.
 - Water Level

22.4.2 Data retrieval:

- Data shall be preferably be retrieved by a laptop, PDA, tablet or dedicated read out device, via an infrared data adapter or 9-pin RS 232 port. ☐

22.4.3 Determination of sampling intervals:

- Procedure: ☐
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals.
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

22.5 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions.

☐

22.6 A complete unit with a GSM modem for pipe installations, with the following minimum specifications, should be offered as an option:

22.6.1 A watertight housing with all accessories needed for installations on 4", 5" or 6" pipes.

☐

22.6.2 GSM modem with build in antenna and all accessories for pipe installation.

☐

22.6.3 Additional power supply to modem – Commercially available lithium batteries.

☐

23. COMPACT SINGLE CHANNEL DATA LOGGER WITH INTEGRATED WATER TEMPERATURE SENSOR

23.1 Application:

23.1.1 Logger will be offered as standard with integrated temperature sensor

☐

23.2 Design and technical details:

23.2.1 Maximum dimension: 115mm (length) x 30mm diameter or similar volume, maximum weight: 150g

☐

23.2.2 Logger housing must be robust, corrosion-resistant, insensitive to impact and vibration and watertight up to at least 45 m depth.

☐

23.2.3 The logger housing could be fitted with a watertight plug for connection to a communication cable.

☐

23.2.4 The sensitivity of the measuring element shall be approximately 0,2 °C between a temperature range of at least -0°C to +40°C.

☐

23.2.5 The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years.

☐

23.2.6 The data logger shall preferably be provided with a EEPROM ring memory (first in, first out) for buffered storage capacity of at least to 30 000 readings.

☐

23.2.7 The logger must be programmable to log at a fixed rate or multiple logging intervals from 1 minute to 12 hours.

☐

23.2.8 Loggers with non-standard batteries that cannot be replaced by the operator must have a battery life of at least 5 years at an hourly logging interval under the specified operating temperatures.

☐

23.2.9 Loggers with batteries that can be replaced by the operator must have a battery life of at least 3 years at an hourly logging interval under the specified operating temperatures.

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23.2.10 Extras, communication cable, operating software and spares to be listed and priced as sub items

☐

24. SINGLE CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE TRANSDUCER WITHOUT LC DISPLAY

24.1 The Pressure Transducer:

24.1.1 Application:

- The pressure transducer must be capable of measuring water levels from 0 - 50 m, the range of each probe being determined by the Employer and pre-set in the factory. Typical ranges must be: 0 - 5 m; 0 - 10 m; 0 - 50 m, and >50 m on request. ☐
- The transducer must be suitably protected against lightning, and the necessary test results must be available on request of the Engineer. ☐

24.1.2 Design and technical details:

- Transducer housing:
 - The transducer housing must be robust, corrosion-resistant, insensitive to impact and vibration and watertight up to at least 70 m of water column. ☐
 - The transducer housing shall preferably not exceed the following dimensions and weight:
 - i. Length - 500 mm
 - ii. Diameter - 50 mm
 - iii. Weight - 1,0 kg☐
 - The transducer housing could be fitted with a watertight plug for connection to the transducer cable. ☐
- Pressure sensor:
 - The pressure measuring cell must be chemically and thermally resistant and must preferably be manufactured of aluminium oxide ceramics, or equivalent. ☐
 - ☐
 - The pressure measuring cell must preferably operate, using the capacitive method. Sensors using piezo-resistive, can also be considered. ☐
 - ☐
 - The pressure transducer shall be designed to function satisfactorily under the following temperature range: -5°C to +45°C ☐
 - ☐
 - The pressure transducer shall have a built-in temperature compensator. ☐
- Transducer cable:

The transducer cable must have the following characteristics:

 - Flexible and have at least a double sheathing with interposed tinned copper braiding, or better, with an outer diameter of not more than 12 mm; ☐
 - As the transducer cable shall be used as the carrying rope, it shall preferably feature, for longitudinal stability, an internal kevlar core assembly, or equivalent. ☐
 - A polyamide pressure-compensation capillary tube for measuring the reference pressure, with an inside diameter of preferably 3 mm, but not less than 1,0 mm. ☐
 - End of cable should preferably be connected to a logistics unit with an exchangeable humidity absorber. ☐
 - The pressure sensor and transducer cable shall be designed to function satisfactorily with a cable length of at least 100 m. ☐

- The transducer cable can be provided with a watertight plug for connection to the transducer housing. ☐
- Temperature sensor:
 - The pressure transducer should preferably have an integrated temperature sensor, preferably of the platinum resistor type. The sensitivity of the measuring element shall be approximately 0,1 °C between a temperature range of at least -5°C to +40°C. ☐
- Output signal:
 - The voltage output signal for each measuring range should be 4 - 20 mA.
- Measuring accuracy:
 - The overall measuring accuracy of the pressure transducer must be better than, or equal to 0,1 % of the full scale. ☐

24.2 Humidity absorber and pressure compensation:

- 24.2.1 The capillary tube in the transducer cable is intended to vent the measuring cell to atmospheric pressure. In order to avoid humid air passing along this capillary tube, it is necessary to remove moisture at the vented side. This should preferably be done in a humidity absorber housing, using silica gel crystals, or equivalent. ☐
- 24.2.2 The pressure compensation box should be compact, wall mountable, and provide easy access for the changing of the desiccant silica gel cartridge. Where other methods of humidity absorption are offered, the bidder must supply proof of efficiency. ☐

24.3 The Data Logger:

24.3.1 Data Processing:

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

24.3.2 Real time clock:

- The data logger shall be equipped with a battery backed hardware real time clock system. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ±30 seconds per month, operating under the environmental conditions as specified in this section. ☐

24.3.3 Memory:

- The data logger shall preferably be provided with a EEPROM ring memory (first in, first out) for buffered storage capacity of at least 128 KB for up to 50 000 readings. ☐
- Data must still be available after being read out. ☐

24.3.4 Enclosure and Housing:

- The data logger interface shall be enclosed as described in paragraph 12. ☐

24.3.5 Power Supply:

- No mains power supplies will be available to power the data loggers. The equipment should be of absolute sensor system with no permanent power supply necessary. ☐
- The logger should operate for at least 1 year with commercially available dry alkaline batteries.
- Easy access for the change of the battery must be assured. ☐

24.4 Internal software requirements:

24.4.1 General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐

24.4.2 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data.
 - Minimum sampling time of 60 seconds; and a
 - Maximum sampling time of 24 hours. ☐

24.4.3 Data storage:

- Data records shall contain the following information:
 - ID number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units.
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐

24.4.4 Data display:

- All conversation between the data logger and the operator shall be done via a data reader unit or laptop/palmtop. ☐

24.5 Operators procedures:

24.5.1 Menu-driven procedures:



- All operator activities shall be menu driven from the set-up software:
- Station Settings - must be able to be set:
 - Alphanumeric station ID, with at least 9 digits. eg. A2H010A01
 - Date and time settings.
 - Water Level.

☐

24.5.2 Data retrieval:

- Data shall be preferably be retrieved by a laptop / palmtop, via an infrared data adapter or 9-pin RS 232 port.
- The following procedures shall be available to the operator using a laptop:
 - View and alter time and date information.

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24.5.3 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals.
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval.

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24.6 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions.

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25. SINGLE CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE TRANSDUCER WITH LC DISPLAY

25.1 The Pressure Transducer:

25.1.1 Application:

- The pressure transducer must be capable of measuring water levels from 0 - 50 m, the range of each probe being determined by the Employer and pre-set in the factory. Typical ranges must be: 0 - 5 m; 0 - 10 m; 0 - 50 m, and >50 m on request. ☐
- The transducer must be suitably protected against lightning, and the necessary test results must be available on request of the Engineer. ☐

25.1.2 Design and technical details:

- Transducer housing:
 - The transducer housing must be robust, corrosion-resistant, insensitive to impact and vibration and watertight up to at least 70 m of water column. ☐
 - The transducer housing shall preferably not exceed the following dimensions and weight:
 - i. Length - 500 mm
 - ii. Diameter - 50 mm
 - iii. Weight - 1,0 kg☐
 - The transducer housing could be fitted with a watertight plug for connection to the transducer cable. ☐
- Pressure sensor:
 - The pressure measuring cell must be chemically and thermally resistant and must preferably be manufactured of aluminium oxide ceramics, or equivalent. ☐
 - ☐
 - The pressure measuring cell must preferably operate, using the capacitive method. Sensors using piezo-resistive, can also be considered. ☐
 - ☐
 - The pressure transducer shall be designed to function satisfactorily under the following temperature range: -5°C to +45°C ☐
 - ☐
 - The pressure transducer shall have a built-in temperature compensator. ☐
- Transducer cable:

The transducer cable must have the following characteristics:

 - Flexible and have at least a double sheathing with interposed tinned copper braiding, or better, with an outer diameter of not more than 12 mm; ☐
 - As the transducer cable shall be used as the carrying rope, it shall preferably feature, for longitudinal stability, an internal kevlar core assembly, or equivalent. ☐
 - A polyamide pressure-compensation capillary tube for measuring the reference pressure, with an inside diameter of preferably 3 mm, but not less than 1,0 mm. ☐
 - End of cable should preferably be connected to a logistics unit with an exchangeable humidity absorber. ☐
 - The pressure sensor and transducer cable shall be designed to function satisfactorily with a cable length of at least 100 m. ☐

- The transducer cable can be provided with a watertight plug for connection to the transducer housing. ☐
- Temperature sensor:
 - The pressure transducer should preferably have an integrated temperature sensor, preferably of the platinum resistor type. The sensitivity of the measuring element shall be approximately 0,1 °C between a temperature range of at least -5°C to +40°C. ☐
- Output signal:
 - The voltage output signal for each measuring range should be 4 - 20 mA.
- Measuring accuracy:
 - The overall measuring accuracy of the pressure transducer must be better than, or equal to 0,1 % of the full scale. ☐

25.2 Humidity absorber and pressure compensation:

- 25.2.1 The capillary tube in the transducer cable is intended to vent the measuring cell to atmospheric pressure. In order to avoid humid air passing along this capillary tube, it is necessary to remove moisture at the vented side. This should preferably be done in a humidity absorber housing, using silica gel crystals, or equivalent. ☐
- 25.2.2 The pressure compensation box should be compact, wall mountable, and provide easy access for the changing of the desiccant silica gel cartridge. Where other methods of humidity absorption are offered, the bidder must supply proof of efficiency. ☐

25.3 The Data Logger:

25.3.1 Data Processing:

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

25.3.2 Real time clock:

- The data logger shall be equipped with a battery backed hardware real time clock system. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ±30 seconds per month, operating under the environmental conditions as specified in this section. ☐

25.3.3 Memory:

- The data logger shall preferably be provided with a EEPROM ring memory (first in, first out) for buffered storage capacity of at least 128 KB for up to 50 000 readings. ☐
- Data must still be available after being read out. ☐

25.3.4 Enclosure and Housing:

- The data logger interface shall be enclosed as described in paragraph 12. ☐

25.3.5 Power Supply:

- No mains power supplies will be available to power the data loggers. The equipment should be of absolute sensor system with no permanent power supply necessary. ☐
- The logger should operate for at least 1 year with commercially available dry alkaline batteries. ☐
- Easy access for the change of the battery must be assured. ☐

25.4 Internal software requirements:

25.4.1 General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐

25.4.2 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data.
 - Minimum sampling time of 60 seconds; and a
 - Maximum sampling time of 24 hours. ☐

25.4.3 Data storage:

- Data records shall contain the following information:
 - ID number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units.
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐

25.4.4 Data display:

- All conversation between the data logger and the operator shall be done via a data reader unit or laptop/palmtop. ☐
- The data logger shall be provided with the following minimum built-in facilities, to be used by operating and maintenance staff: ☐
 - A well readable single line, 4½ character LCD unit, capable of displaying the water level (to the nearest mm or cm), date, time and battery voltage. ☐
- A time-out shall be provided, so that the display will switch off if no activity is detected for a period. (Typically 5 minutes) ☐

25.5 Operators procedures:

25.5.1 Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software: ☐
- Station Settings - must be able to be set:
 - Alphanumeric station ID, with at least 9 digits. eg. A2H010A01 ☐
 - Date and time settings.
 - Water Level.

25.5.2 Data retrieval:

- Data shall be preferably be retrieved by a laptop / palmtop, via an infrared data adapter or 9-pin RS 232 port. ☐
- The following procedures shall be available to the operator using a laptop:
 - View and alter time and date information. ☐

25.5.3 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

25.6 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

26. TWO CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE TRANSDUCER

26.1 The Pressure Transducer:

26.1.1 Application:

- The pressure transducer must be capable of measuring either water level or water pressure, the measuring range of each unit to be specified by the Employer and preset in the factory. Standard measuring ranges would include: 0-0.5m; 0-1m; 0-2m; 0-5m; 0-10m; 0-20m; 0-30m; 0-50m and 0-100m, with cable lengths specified for each individual logger by the Employer irrelevant of the measuring range of the probe. ☐
- The transducer must be suitably protected against lightning, and the necessary test results must be available on request from the Employer. ☐

26.1.2 Design and technical details:

- Transducer Housing:
 - The transducer housing must be manufactured from high grade stainless steel preferably SAE Steel grade 904 or better, robust, corrosion-resistant (estuarine environments), insensitive to impact and vibration and watertight up to at least 100 m of water column. ☐
 - The transducer housing shall preferably not exceed the following dimensions and weight:
 - i. Length - 200 mm ☐
 - ii. Diameter - 25 mm
 - iii. Weight - 0.3 kg
- Pressure sensor:
 - The pressure measuring cell must be chemically and thermally resistant and must be manufactured of ceramics. ☐
 - The pressure measuring cell must operate, using the capacitive method. ☐
 - The pressure transducer shall be designed to function satisfactorily under the following temperature range: -25°C to +70°C. ☐
 - The pressure transducer shall have a built-in temperature compensator. ☐
 - The pressure transducer must be able to operate in a "dry mode", i.e. When water level goes below the transducer. ☐
- Transducer cable:

The transducer cable must have the following characteristics:

 - Flexible and have at least a double sheathing with interposed tinned copper braiding, or better, with an outer diameter of not more than 10 mm; ☐
 - As the transducer cable shall be used as the carrying rope, it shall feature, for longitudinal stability, an internal Kevlar core assembly, or equivalent; ☐
 - A polyamide pressure-compensation capillary tube for measuring the reference pressure, with an inside diameter of preferably 3 mm, but not less than 1 mm; ☐
 - End of cable must be connected and sealed for moisture or water ingress in areas with high humidity or when submerged to the communication module with an exchangeable desiccant cartridge; ☐
 - The pressure sensor and transducer cable shall be designed to function satisfactorily with a cable length of at least 100 m. The transducer cable will be watertight up to a water column of 100 m; ☐

- For troublesome installations an optional cable joining enclosure (IP65 rating) option must be available when transducer cable needs to be cut and reassembled; ☐
- Standard cable should lengths include, but the Employer could specify other custom cable lengths for each individual logger: 2m; 5m; 10m; 20m; 30m; 40m; 50m; 60m; 70m; 75m; 80m; 90m; 100m; 120m; 125m and 150m. ☐
- Temperature sensor:
 - The temperature sensor must have the following characteristics:
 - i. The sensor must be able to measure water temperature ranging from -25°C to +70°C; ☐
 - ii. Temperature measurement resolution must be a minimum of 0.01°C; ☐
 - iii. Accuracy of temperature measurement must be $\pm 0.1^\circ\text{C}$; ☐
 - iv. Units of measurement should include °C and °F. ☐

26.2 Humidity absorber and pressure compensation:

- 26.2.1 The capillary tube in the transducer cable is intended to vent the measuring cell to atmospheric pressure. In order to avoid humid air passing along this capillary tube, it is necessary to remove moisture at the vented side. This should be done inside the non submersible side (communication module of the logger) with user replaceable desiccant cartridges as no external humidity absorption boxes can be used due to limited installation space at some sites. ☐

26.3 Data Logger:

26.3.1 Environmental conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -40° C to +85° C;
 - Operating: -30° C to +85° C. ☐
- Relative humidity: 30% to 95%, Condensing; ☐
- Elevation: 0 - 3 500 m above sea level; ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

26.3.2 Logger firmware and internal configuration specifications:

- Data Processing:
 - The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- Real time clock:
 - The data logger shall be equipped with a battery backed hardware real time clock system. ☐
 - The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
 - The accuracy and stability of the real time clock shall be better than ± 1 minute per month, operating under the environmental conditions as specified. ☐

- Memory:
 - The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
 - Data must still be available after being read out. ☐
 - Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- Operator interface:
 - Communication with the data logger will be via laptop, PDA, tablet or dedicated device. ☐
- Input functions and interfacing:
 - The data logger shall have three dedicated analogue channels – Water level or pressure, Temperature and Conductivity with salinity and TDS as standard data outputs. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Power Supply:
 - No mains power supplies will be available to power the data loggers. The equipment should be of absolute sensor system with no permanent power supply necessary. ☐
 - The logger should operate for at least 1 year with commercially available dry alkaline batteries or 10 years with Lithium batteries. ☐
 - Easy access and replacement of batteries on the non submersible communication module of the logger, without the need to remove from its installation. ☐

26.3.3 Internal software requirements:

- General:
 - All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
 - The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
 - It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
 - The data logger software shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐

26.3.4 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and a ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

26.3.5 Data storage:

- Data records shall contain the following information:
 - ID number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units.
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

26.3.6 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐

26.4 Operators procedures:

26.4.1 Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software; ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof
 - Date and time settings.
 - Calibration or user adjustable water Level and unit selection.
 - Each sensor must have user adjustable number and name
 - Each sensor must be separately configurable - logging and sampling intervals. ☐

26.4.2 Data retrieval:

- Data shall be retrieved by a PDA, laptop or tablet via an infrared data adapter. ☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐

- Option to select individual sensors for data retrieval. ☐
- Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

26.4.3 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

26.5 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

27. TWO CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE TRANSDUCER AND DATA TRANSMISSION CAPABILITIES;

27.1 The Pressure Transducer:

27.1.1 Application:

- The pressure transducer must be capable of measuring either water level or water pressure, the measuring range of each unit to be specified by the Employer and preset in the factory. Standard measuring ranges would include: 0-0.5m; 0-1m; 0-2m; 0-5m; 0-10m; 0-20m; 0-30m; 0-50m and 0-100m, with cable lengths specified for each individual logger by the Employer irrelevant of the measuring range of the probe. ☐
- The transducer must be suitably protected against lightning, and the necessary test results must be available on request from the Employer. ☐

27.1.2 Design and technical details:

- Transducer Housing:
 - The transducer housing must be manufactured from high grade stainless steel preferably SAE Steel grade 904 or better, robust, corrosion-resistant (estuarine environments), insensitive to impact and vibration and watertight up to at least 100 m of water column. ☐
 - The transducer housing shall preferably not exceed the following dimensions and weight:
 - iv. Length - 200 mm ☐
 - v. Diameter - 25 mm
 - vi. Weight - 0.3 kg
- Pressure sensor:
 - The pressure measuring cell must be chemically and thermally resistant and must be manufactured of ceramics. ☐
 - The pressure measuring cell must operate, using the capacitive method. ☐
 - The pressure transducer shall be designed to function satisfactorily under the following temperature range: -25°C to +70°C. ☐
 - The pressure transducer shall have a built-in temperature compensator. ☐
 - The pressure transducer must be able to operate in a "dry mode", i.e. When water level goes below the transducer. ☐
- Transducer cable:

The transducer cable must have the following characteristics:

 - Flexible and have at least a double sheathing with interposed tinned copper braiding, or better, with an outer diameter of not more than 10 mm; ☐
 - As the transducer cable shall be used as the carrying rope, it shall feature, for longitudinal stability, an internal Kevlar core assembly, or equivalent; ☐
 - A polyamide pressure-compensation capillary tube for measuring the reference pressure, with an inside diameter of preferably 3 mm, but not less than 1 mm; ☐
 - End of cable must be connected and sealed for moisture or water ingress in areas with high humidity or when submerged to the communication module with an exchangeable desiccant cartridge; ☐
 - The pressure sensor and transducer cable shall be designed to function satisfactorily with a cable length of at least 100 m. The transducer cable ☐

will be watertight up to a water column of 100 m;

- For troublesome installations an optional cable joining enclosure (IP65 rating) option must be available when transducer cable needs to be cut and reassembled; ☐
- Standard cable should lengths include, but the Employer could specify other custom cable lengths for each individual logger: 2m; 5m; 10m; 20m; 30m; 40m; 50m; 60m; 70m; 75m; 80m; 90m; 100m; 120m; 125m and 150m. ☐
- Temperature sensor:
 - The temperature sensor must have the following characteristics:
 - v. The sensor must be able to measure water temperature ranging from -25°C to +70°C; ☐
 - vi. Temperature measurement resolution must be a minimum of 0.01°C; ☐
 - vii. Accuracy of temperature measurement must be $\pm 0.1^{\circ}\text{C}$; ☐
 - viii. Units of measurement should include $^{\circ}\text{C}$ and $^{\circ}\text{F}$. ☐

27.2 Humidity absorber and pressure compensation:

- 27.2.1 The capillary tube in the transducer cable is intended to vent the measuring cell to atmospheric pressure. In order to avoid humid air passing along this capillary tube, it is necessary to remove moisture at the vented side. This should be done inside the non submersible side (communication module of the logger) with user replaceable desiccant cartridges as no external humidity absorption boxes can be used due to limited installation space at some sites. ☐

27.3 Data Logger:

27.3.1 Environmental conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -40° C to +85° C; ☐
 - Operating: -30° C to +85° C. ☐
- Relative humidity: 30% to 95%, Condensing; ☐
- Elevation: 0 - 3 500 m above sea level; ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

27.3.2 Logger firmware and internal configuration specifications:

- Data Processing:
 - The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

- Real time clock:
 - The data logger shall be equipped with a battery backed hardware real time clock system. ☐
 - The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
 - The accuracy and stability of the real time clock shall be better than ± 1 minute per month, operating under the environmental conditions as specified. ☐
- Memory:
 - The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
 - Data must still be available after being read out. ☐
 - Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- Operator interface:
 - Communication with the data logger will be via laptop, PDA, tablet or dedicated device. ☐
- Input functions and interfacing:
 - The data logger shall have three dedicated analogue channels – Water level or pressure, Temperature and Conductivity with salinity and TDS as standard data outputs. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Power Supply:
 - No mains power supplies will be available to power the data loggers. The equipment should be of absolute sensor system with no permanent power supply necessary. ☐
 - The logger should operate for at least 1 year with commercially available dry alkaline batteries or 10 years with Lithium batteries. ☐
 - Easy access and replacement of batteries on the non submersible communication module of the logger, without the need to remove from its installation. ☐

27.3.3 Internal software requirements:

- General:
 - All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
 - The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
 - It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
 - The data logger software shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐

27.3.4 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and a ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

27.3.5 Data storage:

- Data records shall contain the following information:
 - ID number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units.
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐
- GSM Signal strength recording is a requirement as this information is used to determine signal quality and the best period during the day for transmission of data - possible seasonal changes. ☐

27.3.6 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐

27.4 Communication Module:

- 27.4.1 The Communication module and power supply housing must be fixed at the non submersible end of the logger. ☐
- 27.4.2 Communication and battery replacement should be capable without removing the logger from its installation. ☐
- 27.4.3 The communication module should have a minimum protection rating of IP68 and should be able to withstand temporary submerged conditions. ☐
- 27.4.4 The logger should be capable to allow bi-directional communication with external communication devices (laptop, PDA or tablet) by means of infra red communication with no serial or USB communication ports that can suffer corrosion in coastal environments. ☐
- 27.4.5 Communication module and battery housing must be of a high grade aluminium, robust, corrosion resistant, vibration and impact insensitive. ☐
- 27.4.6 The communication module housing should have exchangeable desiccant cartridges that remove moisture ingress inside the housing. ☐

- 27.4.7 The communication module should have an integrated modem with Standard GSM, GSM Quadband and GPRS cellular using FTP, HTTP, SMS or e-mail (SMTP) to transmit data and alarm messages. ☐
- 27.4.8 The instrument must be capable to receive and process SMS configuration commands via the GSM network to accept alterations to the logger configuration if needed. ☐
- 27.4.9 The communication module must have an integrated robust GSM antenna with the option to connect an external high gain antenna if desired. ☐
- 27.4.10 The communication module housing shall preferably not exceed the following dimensions and weight:
- Length - 550 mm
 - Diameter - 50 mm
 - Weight - 1.0 kg
- ☐

27.5 Operators procedures:

27.5.1 Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software; ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof
 - Date and time settings.
 - Calibration or user adjustable water Level and unit selection.
 - Each sensor must have user adjustable number and name
 - Each sensor must be separately configurable - logging and sampling intervals. ☐

27.5.2 Data retrieval:

- Data shall be retrieved by a PDA, laptop or tablet via an infrared data adapter. ☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

27.5.3 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

27.6 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions.



28. THREE CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE TRANSDUCER;

28.1 The Pressure Transducer:

28.1.1 Application:

- The pressure transducer must be capable of measuring either water level or water pressure, the measuring range of each unit to be specified by the Employer and preset in the factory. Standard measuring ranges would include: 0-0.5m; 0-1m; 0-2m; 0-5m; 0-10m; 0-20m; 0-30m; 0-50m and 0-100m, with cable lengths specified for each individual logger by the Employer irrelevant of the measuring range of the probe. ☐
- The transducer must be suitably protected against lightning, and the necessary test results must be available on request from the Employer. ☐

28.1.2 Design and technical details:

- Transducer Housing:
 - The transducer housing must be manufactured from high grade stainless steel preferably SAE Steel grade 904 or better, robust, corrosion-resistant (estuarine environments), insensitive to impact and vibration and watertight up to at least 100 m of water column. ☐
 - The transducer housing shall preferably not exceed the following dimensions and weight:
 - i. Length - 200 mm
 - ii. Diameter - 25 mm
 - iii. Weight - 0.3 kg☐
- Pressure sensor:
 - The pressure measuring cell must be chemically and thermally resistant and must be manufactured of ceramics. ☐
 - The pressure measuring cell must operate, using the capacitive method. ☐
 - The pressure transducer shall be designed to function satisfactorily under the following temperature range: -25°C to +70°C. ☐
 - The pressure transducer shall have a built-in temperature compensator. ☐
 - The pressure transducer must be able to operate in a "dry mode", i.e. When water level goes below the transducer. ☐
- Transducer cable:

The transducer cable must have the following characteristics:

 - Flexible and have at least a double sheathing with interposed tinned copper braiding, or better, with an outer diameter of not more than 10 mm; ☐
 - As the transducer cable shall be used as the carrying rope, it shall feature, for longitudinal stability, an internal Kevlar core assembly, or equivalent; ☐
 - A polyamide pressure-compensation capillary tube for measuring the reference pressure, with an inside diameter of preferably 3 mm, but not less than 1 mm; ☐
 - End of cable must be connected and sealed for moisture or water ingress in areas with high humidity or when submerged to the communication module with an exchangeable desiccant cartridge; ☐
 - The pressure sensor and transducer cable shall be designed to function satisfactorily with a cable length of at least 100 m. The transducer cable will be watertight up to a water column of 100 m; ☐

- For troublesome installations an optional cable joining enclosure (IP65 rating) option must be available when transducer cable needs to be cut and reassembled; ☐
- Standard cable should lengths include, but the Employer could specify other custom cable lengths for each individual logger: 2m; 5m; 10m; 20m; 30m; 40m; 50m; 60m; 70m; 75m; 80m; 90m; 100m; 120m; 125m and 150m. ☐
- Temperature sensor:

The temperature sensor must have the following characteristics:

 - The sensor must be able to measure water temperature ranging from - 25°C to +70°C; ☐
 - Temperature measurement resolution must be a minimum of 0.01°C; ☐
 - Accuracy of temperature measurement must be $\pm 0.1^\circ\text{C}$; ☐
 - Units of measurement should include $^\circ\text{C}$ and $^\circ\text{F}$. ☐
- Conductivity sensor:

The conductivity sensor must have the following characteristics:

 - Manufactured from high grade graphite electrodes inured to polarization effects and contamination. ☐
 - The sensor must be able to measure dependant on the resolution the following ranges:
 - i. 0.001 to 2.000 mS/cm or
 - ii. 0.01 to 100.00 mS/cm☐
 - The sensor must be able to measure in the following resolutions:
 - i. 0.001 mS/cm or
 - ii. 0.01 mS/cm☐
 - The sensor must have the following accuracy dependant on the resolution:
 - i. $\pm 0.5\%$ of the measured value or
 - ii. $\pm 1.5\%$ of the measured value☐
 - Units of measurement should include $\mu\text{S/cm}$ and mS/cm . ☐

28.2 Humidity absorber and pressure compensation:

- 28.2.1 The capillary tube in the transducer cable is intended to vent the measuring cell to atmospheric pressure. In order to avoid humid air passing along this capillary tube, it is necessary to remove moisture at the vented side. This should be done inside the non submersible side (communication module of the logger) with user replaceable desiccant cartridges as no external humidity absorption boxes can be used due to limited installation space at some sites. ☐

28.3 Data Logger:

28.3.1 Environmental conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -40° C to +85° C;
 - Operating: -30° C to +85° C.☐
- Relative humidity: 30% to 95%, Condensing; ☐
- Elevation: 0 - 3 500 m above sea level; ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

28.3.2 Logger firmware and internal configuration specifications:

- Data Processing: ☐
 - The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance.
- Real time clock:
 - The data logger shall be equipped with a battery backed hardware real time clock system. ☐
 - The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
 - The accuracy and stability of the real time clock shall be better than ±1 minute per month, operating under the environmental conditions as specified. ☐
- Memory:
 - The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
 - Data must still be available after being read out. ☐
 - Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- Operator interface: ☐
 - Communication with the data logger will be via laptop, PDA, tablet or dedicated device.
- Input functions and interfacing: ☐
 - The data logger shall have three dedicated analogue channels – Water level or pressure, Temperature and Conductivity with salinity and TDS as standard data outputs. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐

- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Power Supply:
 - No mains power supplies will be available to power the data loggers. The equipment should be of absolute sensor system with no permanent power supply necessary. ☐
 - The logger should operate for at least 1 year with commercially available dry alkaline batteries or 10 years with Lithium batteries. ☐
 - Easy access and replacement of batteries on the non submersible communication module of the logger, without the need to remove from its installation. ☐

28.3.3 Internal software requirements:

- General:
 - All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
 - The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
 - It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
 - The data logger software shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐

28.3.4 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and a ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

28.3.5 Data storage:

- Data records shall contain the following information:
 - ID number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐

- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

28.3.6 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐

28.4 Operators procedures:

28.4.1 Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software; ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof
 - Date and time settings.
 - Calibration or user adjustable water Level and unit selection.
 - Each sensor must have user adjustable number and name
 - Each sensor must be separately configurable - logging and sampling intervals. ☐

28.4.2 Data retrieval:

- Data shall be retrieved by a PDA, laptop or tablet via an infrared data adapter. ☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

28.4.3 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
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28.5 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions.

☐

29. THREE CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE TRANSDUCER AND DATA TRANSMISSION CAPABILITIES;

29.1 The Pressure Transducer:

29.1.1 Application:

- The pressure transducer must be capable of measuring either water level or water pressure, the measuring range of each unit to be specified by the Employer and preset in the factory. Standard measuring ranges would include: 0-0.5m; 0-1m; 0-2m; 0-5m; 0-10m; 0-20m; 0-30m; 0-50m and 0-100m, with cable lengths specified for each individual logger by the Employer irrelevant of the measuring range of the probe. ☐
- The transducer must be suitably protected against lightning, and the necessary test results must be available on request from the Employer. ☐

29.1.2 Design and technical details:

- Transducer Housing:
 - The transducer housing must be manufactured from high grade stainless steel preferably SAE Steel grade 904 or better, robust, corrosion-resistant (estuarine environments), insensitive to impact and vibration and watertight up to at least 100 m of water column. ☐
 - The transducer housing shall preferably not exceed the following dimensions and weight:
 - iv. Length - 200 mm ☐
 - v. Diameter - 25 mm
 - vi. Weight - 0.3 kg
- Pressure sensor:
 - The pressure measuring cell must be chemically and thermally resistant and must be manufactured of ceramics. ☐
 - The pressure measuring cell must operate, using the capacitive method. ☐
 - The pressure transducer shall be designed to function satisfactorily under the following temperature range: -25°C to +70°C. ☐
 - The pressure transducer shall have a built-in temperature compensator. ☐
 - The pressure transducer must be able to operate in a "dry mode", i.e. When water level goes below the transducer. ☐
- Transducer cable:

The transducer cable must have the following characteristics:

 - Flexible and have at least a double sheathing with interposed tinned copper braiding, or better, with an outer diameter of not more than 10 mm; ☐
 - As the transducer cable shall be used as the carrying rope, it shall feature, for longitudinal stability, an internal Kevlar core assembly, or equivalent; ☐
 - A polyamide pressure-compensation capillary tube for measuring the reference pressure, with an inside diameter of preferably 3 mm, but not less than 1 mm; ☐
 - End of cable must be connected and sealed for moisture or water ingress in areas with high humidity or when submerged to the communication module with an exchangeable desiccant cartridge; ☐
 - The pressure sensor and transducer cable shall be designed to function satisfactorily with a cable length of at least 100 m. The transducer cable ☐

will be watertight up to a water column of 100 m;

- For troublesome installations an optional cable joining enclosure (IP65 rating) option must be available when transducer cable needs to be cut and reassembled; ☐
- Standard cable should lengths include, but the Employer could specify other custom cable lengths for each individual logger: 2m; 5m; 10m; 20m; 30m; 40m; 50m; 60m; 70m; 75m; 80m; 90m; 100m; 120m; 125m and 150m. ☐

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- Temperature measurement resolution must be a minimum of 0.01°C; ☐
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The conductivity sensor must have the following characteristics:

- Manufactured from high grade graphite electrodes inured to polarization effects and contamination. ☐
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- 29.2.1 The capillary tube in the transducer cable is intended to vent the measuring cell to atmospheric pressure. In order to avoid humid air passing along this capillary tube, it is necessary to remove moisture at the vented side. This should be done inside the non submersible side (communication module of the logger) with user replaceable desiccant cartridges as no external humidity absorption boxes can be used due to limited installation space at some sites. ☐

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 - The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
 - The accuracy and stability of the real time clock shall be better than ± 1 minute per month, operating under the environmental conditions as specified. ☐
- Memory:
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- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐

29.4 Communication Module:

- 29.4.1 The Communication module and power supply housing must be fixed at the non submersible end of the logger. ☐
- 29.4.2 Communication and battery replacement should be capable without removing the logger from its installation. ☐
- 29.4.3 The communication module should have a minimum protection rating of IP68 and should be able to withstand temporary submerged conditions. ☐
- 29.4.4 The logger should be capable to allow bi-directional communication with external communication devices (laptop, PDA or tablet) by means of infra red communication with no serial or USB communication ports that can suffer corrosion in coastal environments. ☐
- 29.4.5 Communication module and battery housing must be of a high grade aluminium, robust, corrosion resistant, vibration and impact insensitive. ☐
- 29.4.6 The communication module housing should have exchangeable desiccant cartridges that remove moisture ingress inside the housing. ☐
- 29.4.7 The communication module should have an integrated modem with Standard GSM, GSM Quadband and GPRS cellular using FTP, HTTP, SMS or e-mail (SMTP) to transmit data and alarm messages. ☐
- 29.4.8 The instrument must be capable to receive and process SMS configuration commands via the GSM network to accept alterations to the logger configuration if needed. ☐
- 29.4.9 The communication module must have an integrated robust GSM antenna with the option to connect an external high gain antenna if desired. ☐
- 29.4.10 The communication module housing shall preferably not exceed the following dimensions and weight:
 - Length - 550 mm
 - Diameter - 50 mm
 - Weight - 1.0 kg☐

29.5 Operators procedures:

29.5.1 Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software; ☐

- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof
 - Date and time settings.
 - Calibration or user adjustable water Level and unit selection.
 - Each sensor must have user adjustable number and name
 - Each sensor must be separately configurable - logging and sampling intervals. ☐

29.5.2 Data retrieval:

- Data shall be retrieved by a PDA, laptop or tablet via an infrared data adapter. ☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

29.5.3 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals.
 - Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

29.6 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

BAROMETRIC WATER LEVEL INSTRUMENTATION:

30. SCOPE

- 30.1 This part of the specification covers the detail hardware and software requirements for the Integrated Data logging equipment.
- 30.2 The data loggers will be utilised at remote measuring stations to collect data. Operation will be in a totally unattended mode, with inspections by staff on a 30 to 60 day cycle.
- 30.3 The equipment will be mounted in recorder huts, either from mild steel, concrete or brick, with a minimum size of 800 x 800 x 1 800 mm high or mounted in pipes with diameters from 100 mm to 300 mm, and will be subjected to a harsh environment.
- 30.4 Enclosures, if available, should be offered for this equipment under "Accessories". These enclosures can be offered in Fibreglass, Robust Plastic, Mild Steel, Stainless Steel, etc.
- 30.5 Preference shall be given to enclosures that include anti-vandalism systems.
- 30.6 Each bidder shall offer complete power supply system/s with the logger offered and should be listed under "Accessories" in the Price Schedule.

31. BAROMETRIC DATA LOGGING SYSTEM, USING THE “CAPACITIVE CERAMIC” MEASURING METHOD

31.1 The Instrument:

31.1.1 Application:

- The instrument must be able to measure water level and temperature as a standard with calibrated measuring ranges of at least 10 m; 50 m and 100 m ☐
- The instrument must be suitably protected against lightning, and the necessary test results must be available on request of the Engineer. ☐

31.1.2 Design and technical details:

- Instrument housing:
 - The instrument housing must be robust, corrosion-resistant, insensitive to impact and vibration and watertight up to at least 100 m of water column. ☐
 - The instrument housing shall preferably not exceed the following dimensions and weight:

Length:	100 mm	
Diameter:	25 mm	☐
Weight:	0,5 kg	
 - The instrument housing should preferably be able to be connected to a direct reading cable with the following minimum standard lengths: 5 m; 10 m; 15 m; 30 m; 60 m; 80 m and 100m ☐
 - The instrument housing should contain the pressure sensor, temperature sensor, data logger and battery and must be able to be suspended by a rope/cable/wire down the borehole. ☐
 - An option should be offered where the housing is manufactured with ceramics for when the instrument will be exposed to “aggressive” water. ☐
- Pressure sensor:
 - The pressure-measuring cell must be chemically and thermally resistant and must preferably be manufactured of aluminium oxide ceramics. ☐
 - The pressure measurement must preferably operate, using the barometric pressure method. ☐
 - The instrument shall be designed to function satisfactorily under the following temperature range: -20°C to +80°C ☐
 - The pressure sensor shall have a built-in temperature compensator. ☐
 - The pressure sensor must be able to operate in a “dry mode”, i.e. when water level goes below the sensor. ☐
- Measuring accuracy:
 - The overall measuring accuracy of the pressure transducer must be better than, or equal to 0.1 % of the full scale. ☐

31.2 Conductivity Measurement:

31.2.1 The sensor must be able to measure conductivity as an option with calibrated measuring ranges of at least 30 m and 100 m. ☐

31.2.2 The conductivity range must be able to be measured at least 0 up to 120mS/cm. ☐

31.3 The Data Logger:

31.3.1 Data Processing:

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

31.3.2 Real time clock:

- The data logger shall be equipped with a battery backed hardware real time clock system. ☐
- The real time clock system shall provide time (24 hour system) and date-information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 30 seconds per month, operating under the environmental conditions as specified in this section. ☐

31.3.3 Memory:

- The data logger shall preferably be provided with an EEPROM ring memory (first in, first out) for buffered storage capacity of at least 128 KB for up to 50 000 readings. ☐
- Data must still be available after being read out. ☐

31.3.4 Power Supply:

- No mains power supplies will be available to power the data loggers. The equipment should be of absolute sensor system with no permanent power supply necessary. ☐
- The logger should operate for at least 7 years with commercially available dry alkaline batteries. ☐
- Easy access for the change of the battery must be assured. ☐

31.4 Data Reader:

- A dedicated data reader with all the necessary cables should also be offered. ☐
- If a Handheld Computer could be utilized as a data reader, it should also be offered as an option. ☐

31.5 Real-Time Data System:

- Should the above specified equipment be able to communicate via any type of Telemetry System, i.e. Radio, Landline Telephone, GSM Telephone, Satellite, etc. all system/s should be offered for evaluation. ☐

32. BAROMETRIC DATA LOGGING SYSTEM, USING THE “PIEZO-RESISTIVE” MEASURING METHOD

32.1 The Instrument:

32.1.1 Application:

- The instrument must be able to measure water level and temperature as a standard with calibrated measuring ranges of at least 10 m; 50 m and 100 m ☐
- The instrument must be suitably protected against lightning, and the necessary test results must be available on request of the Engineer. ☐

32.1.2 Design and technical details:

- Instrument housing:
 - The instrument housing must be robust, corrosion-resistant, insensitive to impact and vibration and watertight up to at least 100 m of water column. ☐
 - The instrument housing shall preferably not exceed the following dimensions and weight:
Length - 100 mm
Diameter - 25 mm
Weight - 0,5 kg ☐
 - The instrument housing should preferably be able to be connected to a direct reading cable with the following minimum standard lengths:
5 m; 10 m; 15 m; 30 m; 60 m; 80 m and 100m ☐
 - The instrument housing should contain the pressure sensor, temperature sensor, data logger and battery and must be able to be suspended by a rope/cable/wire down the borehole. ☐
 - An option should be offered where the housing is manufactured with ceramics for when the instrument will be exposed to “aggressive” water. ☐
- Pressure sensor:
 - The pressure-measuring cell must be chemically and thermally resistant and must preferably be manufactured of aluminium oxide ceramics. ☐
 - The pressure measurement must preferably operate, using the barometric pressure method. ☐
 - The instrument shall be designed to function satisfactorily under the following temperature range: -20°C to +80°C ☐
 - The pressure sensor shall have a built-in temperature compensator. ☐
 - The pressure sensor must be able to operate in a “dry mode”, i.e. When water level goes below the sensor. ☐
- Measuring accuracy:
 - The overall measuring accuracy of the pressure transducer must be better than, or equal to 0,1 % of the full scale. ☐

32.2 Conductivity Measurement:

- 32.2.1 The sensor must be able to measure conductivity as an option with calibrated measuring ranges of at least 30 m and 100 m. ☐

32.2.2 The conductivity range must be able to be measured at least 0 up to 120mS/cm.

32.3 3.3. The Data Logger:

32.3.1 Data Processing:

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance.

32.3.2 Real time clock:

- The data logger shall be equipped with a battery backed hardware real time clock system.
- The real time clock system shall provide time (24 hour system) and date-information and shall make provision for leap years.
- The accuracy and stability of the real time clock shall be better than ± 30 seconds per month, operating under the environmental conditions as specified in this section.

32.3.3 Memory:

- The data logger shall preferably be provided with an EEPROM ring memory (first in, first out) for buffered storage capacity of at least 128 KB for up to 50 000 readings.
- Data must still be available after being read out.

32.3.4 Power Supply:

- No mains power supplies will be available to power the data loggers. The equipment should be of absolute sensor system with no permanent power supply necessary. ☐
- The logger should operate for at least 7 years with commercially available dry alkaline batteries. ☐
- Easy access for the change of the battery must be assured. ☐

32.4 3.4. Data Reader:

- A dedicated data reader with all the necessary cables should also be offered. ☐
- If a Handheld Computer could be utilized as a data reader, it should also be offered as an option. ☐

32.5 Real-Time Data System:

- Should the above specified equipment be able to communicate via any type of Telemetry System, i.e. Radio, Landline Telephone, GSM Telephone, Satellite, etc. all system/s should be offered for evaluation. ☐

MULTI CHANNEL DATA LOGGING EQUIPMENT AND TRANSMISSION:

33. SCOPE

- 33.1 This part of the specification covers the detail hardware and software requirements for the Multi Channel Data Logging Equipment and Transmissions.
- 33.2 The data loggers will be utilised at remote measuring stations to collect data. Operation will be in a totally unattended mode, with inspections by staff on a 30 to 60 day cycle.
- 33.3 The equipment will be mounted in recorder huts, either from mild steel, concrete or brick, with a minimum size of 800 x 800 x 1 800 mm high or mounted in pipes with diameters from 100 mm to 300 mm, and will be subjected to a harsh environment.
- 33.4 Enclosures, if available, should be offered for this equipment under "Accessories". These enclosures can be offered in Fibreglass, Robust Plastic, Mild Steel, Stainless Steel, etc.
- 33.5 Preference shall be given to enclosures that include anti-vandalism systems.
- 33.6 Each bidder shall offer complete power supply system/s with the logger offered and should be listed under "Accessories" in the Price Schedule.

34. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF TWO CHANNELS AND:

34.1 WITHOUT DISPLAY AND NO DATA TRANSMISSION CAPABILITIES;

34.1.1. Hardware Requirements:

- Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C ☐
 - Operating: -40° C to +70° C ☐
 - Display (On) -20° C to +70° C ☐

- Relative humidity: 5% to 95%, non condensing ☐

- Elevation: 0 - 3 500 m above sea level ☐

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

- Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐

- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐

- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- Memory:

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐

- Data must still be available after being read out. ☐

- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐

- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

34.1.2. Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

34.1.3. Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

34.1.4. Input functions and interfacing:

The logger should have as a standard configuration, two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

34.1.5. Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

34.1.6. Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

34.1.7. Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

34.1.8. Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).☐

34.1.9. Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

34.1.10. Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

34.1.11. Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

34.1.12. Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port.
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

34.1.13. Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

34.1.14. Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

34. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF TWO CHANNELS AND:

34.2 WITHOUT DISPLAY, WITH GSM / GPRS DATA TRANSMISSION CAPABILITIES;

34.2.1. Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C ☐
 - Operating: -40° C to +70° C ☐
 - Modem: -30° C to +70° C ☐

- Relative humidity: 5% to 95%, non condensing ☐

- Elevation: 0 - 3 500 m above sea level ☐

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐

- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐

- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐

- Data must still be available after being read out. ☐

- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐

- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port;
 - Host USB interface;
 - Device USB interface.
- ☐

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus;
 - SDI-12 (via RS485);
 - CREX code (satellite communication);
 - Terminal Mode;
 - FTP;
- ☐
-
- ☐
-
- ☐
-
- ☐
-
- ☐

34.2.2. Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

34.2.3. Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

34.2.4. Input functions and interfacing:

The logger should have as a standard configuration, two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

34.2.5. Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions: ☐
 Height - 130mm; Width - 130mm; Depth - 70mm. ☐

34.2.6. Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

34.2.7. Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data: ☐
 - Minimum sampling time of 60 seconds; and
 - Maximum sampling time of 24 hours. ☐
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

34.2.8. Data processing:

- The data logger shall the following options available in the software configuration to process measured values: ☐
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).

34.2.9. Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

34.2.10. Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

34.2.11. Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

34.2.12. Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port. ☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

34.2.13. Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

34.2.14. Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

34.2.15. GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority) ☐

The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes. ☐
- GSM/GPRS Logger Modem:
 - The system should be designed around receiving data from the probe with a sample period of at least 12 minutes. ☐
 - The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format. ☐
 - The system should be capable of transferring data at RSSI levels of -90dBm. ☐

- The following indications should be available on the front of the unit:
 - Power;
 - Transmit (TX);
 - Receive (RX);
 - Link Fail.☐

- From the above information it should be possible to determine:
 - Power Supply Available;
 - Unit Transmitting;
 - Unit Receiving;
 - Network connection error (e.g. no network, SIM card error)☐

- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.
 ☐

- The following protection should be built into the design of the electronic circuit board (PCB)
 - Reverse Polarity Protection
 - Voltage Clamping
 - DC filtering☐

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;
 - Interface to Data Logger via RS 232 Interface;
 - Read Logged Data at predefined intervals;
 - Configuration changes from Control Centre;
 - Alarm data - battery low, battery critical;
 - RSSI (Radio Signal Strength Indication)☐
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- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging;
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging.
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit.☐
☐
☐

- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below;
 - Updating of main Call Handling Centre number;
 - Control enable/disable alarm conditions;
 - Set status reporting period and time;
 - Graphical representation of data ;
 - Alarm if data not received within 36 hrs;
 - Export Data in predefined formats;
 - Monitor RSSI signal level;☐
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- Request the retransmission of data from field units;
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions.
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing.
- Current Consumption:
 - The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
 - The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
 - With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
 - Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐
- Antenna Selection:
 - Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
 - The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
 - A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
 - In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
 - A 8dBi Patch antenna should also be offered optional. ☐

34. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF TWO CHANNELS AND:

34.3 WITHOUT DISPLAY, WITH SATELLITE DATA TRANSMISSION CAPABILITIES;

34.3.1 Hardware Requirements:

- Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
Storage: -50° C to +85° C
Operating: -40° C to +70° C ☐
- Relative humidity: 5% to 95%, condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- No drives will be allowed, solid state memory only. ☐

- Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- Memory:

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters. ☐
- Non-volatile memory for system and station parameters and user defined variables. ☐
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings) ☐
- The data logger shall preferably be provided with a ring memory (first in, first out); ☐
- Data must still be available after being read out. ☐
- Remote data to be stored on memory stick (via USB) or SD memory card. ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

- 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
- USB serial port; ☐
- Host USB interface; ☐
- Device USB interface; ☐
- Infrared interface; ☐
- TCP/IP ☐

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus; ☐
- SDI-12 (via RS485); ☐
- CREX code (satellite communication); ☐
- Terminal Mode; ☐
- FTP; ☐
- The logger shall have the facility to interface with transmission equipment. ☐

34.3.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes); ☐
- Power for all the sensors will be derived from the main battery via the data logger and will be user definable between 12 V_{DC} or 24 V_{DC} for all Channels. ☐
- Different sets of Power Supply System/s should be offered with the Logger. (Powering different amount of Sensors) ☐

34.3.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

34.3.4 Input functions and interfacing:

The logger should have as a standard configuration, two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
To input either:
 - 0 - 20 mA,
 - -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12.☐
- The two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485.☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input.☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

34.3.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

34.3.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

34.3.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

34.3.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

34.3.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐

- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

34.3.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

34.3.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

34.3.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

34.3.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

34.3.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

34.3.15 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

- The transmitter should have the following minimum features:
 - Transmitting performance of maximum 10 Watt. ☐
 - Power Consumption:
 - Stand-by: < 250 µA ☐
 - Active Mode: < 250 mA ☐
 - During Transmission: < 4 A ☐
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick; ☐
 - Weight: 7,5 kg. ☐
- A commercially available "Yagi" antenna should be offered as an optional extra. ☐
- The input voltage to the system shall preferably be +12 volt DC. ☐
- Communication between the data logger and the modem must be via a RS 232 port. ☐
- The power supply as specified shall be utilised for the system. ☐

34.3.16 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid. ☐

34. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF TWO CHANNELS AND:

34.4 WITHOUT DISPLAY, WITH GSM / GPRS / SATELLITE DATA TRANSMISSION CAPABILITIES INCLUDING DATA HOSTING;

34.4.1 Hardware Requirements:

- Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Internal Modem: -30° C to +70° C☐
- Relative humidity: 5% to 95%, condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- No drives will be allowed, solid state memory only. ☐

- Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- Memory:

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters. ☐
- Non-volatile memory for system and station parameters and user defined variables. ☐
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings) ☐
- The data logger shall preferably be provided with a ring memory (first in, first out); ☐
- Data must still be available after being read out. ☐

- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

34.4.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes); ☐
- Power for all the sensors will be derived from the main battery via the data logger and will be user definable between 12 V_{DC} or 24 V_{DC} for all Channels. ☐
- Different sets of Power Supply System/s should be offered with the Logger. (Powering different amount of Sensors) ☐

34.4.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

34.4.4 Input functions and interfacing:

The logger should have as a standard configuration, two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - To input either:
 - 0 - 20 mA,
 - 4 -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines.

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34.4.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing.
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut.
- The logger housing shall be water and dust protected and shall comply with rating IP41.
- All connections to be made internally - no external connections.
- The housing shall be manufactured of corrosion resistant material.
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector.
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm.

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34.4.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended.
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system.
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages.
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up.
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection.
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger.
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors.

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34.4.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

34.4.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

34.4.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement ☐

for battery management purposes as well as possible identification of early logger malfunctioning.

34.4.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

34.4.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

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- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

34.4.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

34.4.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

34.4.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

34.4.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

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The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

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- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

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- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

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- The system should be capable of transferring data at RSSI levels of -90dBm.

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- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

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- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

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- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

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- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

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- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

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- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below;
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:

- The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
- The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
- With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
- Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐

- Antenna Selection:

- Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
- The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
- A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
- In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
- A 8dBi Patch antenna should also be offered optional. ☐

34.4.16 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt. ☐
- Power Consumption: ☐

- Stand-by: < 250 μ A
- Active Mode: < 250 mA
- During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

34.4.17 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

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34.4.18 Data hosting

- Control Centre:
 - The control centre should be based on a standard Intel computer with a GSM modem connected to it; ☐
 - One computer/control centre should be capable of recording data from up to 500 field units, depending on the GSM Network Service; ☐
 - Provider's ability to handle the influx of SMS messages each day. ☐
 - The software will be used to receive the SMS data messages from the field and reconstruct the information for display on the computer and export to other software. ☐
 - The tower will be connected to the LAN via an internal network card to provide access to the data received by authorised users. ☐
- Control Centre Specifications:
 - The Control Centre PC tower will be Windows based with the following minimum specifications:
 - Pentium P4
 - 512 Mb RAM
 - 3.0 GHz Processor
 - 2 x 80 GB SATA Hard Drive
 - CD ROM
 - Onboard Video
 - Integral LAN Card (EEPROM or Realtec Chipset)
 - 9-Pin Serial Port for Use with External GSM Modem☐

34. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF TWO CHANNELS AND:

34.5 WITH DISPLAY AND NO DATA TRANSMISSION CAPABILITIES;

34.5.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
Storage: -50° C to +85° C ☐
Operating: -40° C to +70° C ☐
Display (On) -20° C to +70° C ☐

- Relative humidity: 5% to 95%, non condensing ☐

- Elevation: 0 - 3 500 m above sea level ☐

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐

- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐

- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐

- Data must still be available after being read out. ☐

- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐

- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

34.5.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

34.5.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

34.5.4 Input functions and interfacing:

The logger should have as a standard configuration, 2 physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

34.5.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

34.5.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

34.5.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

34.5.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

34.5.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

34.5.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- The data logger display will indicate when it is busy with data transfer. ☐

34.5.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

34.5.12 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port. ☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

34.5.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

34.5.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

34. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF TWO CHANNELS AND:

34.6 WITH DISPLAY, WITH GSM / GPRS DATA TRANSMISSION CAPABILITIES;

34.6.1 Hardware Requirements:

- Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

- Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ±8 seconds per month, operating under the environmental conditions listed above. ☐

- Memory:

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
- Data must still be available after being read out. ☐
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus; ☐
- SDI-12 (via RS485); ☐
- CREX code (satellite communication); ☐
- Terminal Mode; ☐
- FTP; ☐

34.6.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

34.6.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

34.6.4 Input functions and interfacing:

The logger should have as a standard configuration, 2 physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

34.6.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

34.6.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐

- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

34.6.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and
 - Maximum sampling time of 24 hours. ☐
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

34.6.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

34.6.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

34.6.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐

- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- The data logger display will indicate when it is busy with data transfer. ☐

34.6.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

34.6.12 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port. ☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

- The following protection should be built into the design of the electronic circuit board (PCB)
 - Reverse Polarity Protection ☐
 - Voltage Clamping ☐
 - DC filtering ☐

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;
 - Interface to Data Logger via RS 232 Interface; ☐
 - Read Logged Data at predefined intervals; ☐
 - Configuration changes from Control Centre; ☐
 - Alarm data - battery low, battery critical; ☐
 - RSSI (Radio Signal Strength Indication) ☐

- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐

- Antenna Selection:
 - Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm; ☐
 - The unit should be offered standard with a 3dBi antenna connected to the unit;
 - A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
 - In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
 - A 8dBi Patch antenna should also be offered optional. ☐

34.6.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

34.6.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

34.6.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority) ☐

The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes. ☐
- GSM/GPRS Logger Modem:
 - The system should be designed around receiving data from the probe with a sample period of at least 12 minutes. ☐
 - The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format. ☐
 - The system should be capable of transferring data at RSSI levels of - 90dBm. ☐
 - The following indications should be available on the front of the unit:
 - Power;
 - Transmit (TX);
 - Receive (RX);
 - Link Fail. ☐
 - From the above information it should be possible to determine:
 - Power Supply Available;
 - Unit Transmitting;
 - Unit Receiving;
 - Network connection error (e.g. no network, SIM card error) ☐
 - In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre. ☐

34. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF TWO CHANNELS AND:

34.7 WITH DISPLAY, WITH SATELLITE DATA TRANSMISSION CAPABILITIES;

34.7.1 Hardware Requirements:

- Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C

☐

- Relative humidity: 5% to 95%, condensing

☐

- Elevation: 0 - 3 500 m above sea level

☐

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites.

☐

- Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered.

☐

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance.

☐

- No drives will be allowed, solid state memory only.

☐

- Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy.

☐

- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years.

☐

- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above.

☐

- Memory:

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters.

☐

- Non-volatile memory for system and station parameters and user defined variables.

☐

- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings)

☐

- The data logger shall preferably be provided with a ring memory (first in, first out);

☐

- Data must still be available after being read out.

☐

- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **built in** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

34.7.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes); ☐
- Power for all the sensors will be derived from the main battery via the data logger and will be user definable between 12 V_{DC} or 24 V_{DC} for all Channels. ☐
- Different sets of Power Supply System/s should be offered with the Logger. (Powering different amount of Sensors) ☐

34.7.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

34.7.4 Input functions and interfacing:

The logger should have as a standard configuration, two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
To input either:
 - 0 - 20 mA,
 - -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

34.7.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

34.7.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

34.7.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

34.7.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

34.7.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐

- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

34.7.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

34.7.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

34.7.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

34.7.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

34.7.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

34.7.15 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country.

☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system.

☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt. ☐
- Power Consumption:
 - Stand-by: < 250 μ A ☐
 - Active Mode: < 250 mA ☐
 - During Transmission: < 4 A ☐

- The flat antenna should preferably not exceed the following dimensions and weight:

- Dimensions: 600 mm x 600 mm x 150 mm thick; ☐
- Weight: 7,5 kg. ☐

- A commercially available "Yagi" antenna should be offered as an optional extra.

- The input voltage to the system shall preferably be +12 volt DC. ☐

- Communication between the data logger and the modem must be via a RS 232 port. ☐

- The power supply as specified shall be utilised for the system. ☐

34.7.16 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

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34. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF TWO CHANNELS AND:

34.8 WITH DISPLAY, WITH GSM / GPRS / SATELLITE DATA TRANSMISSION CAPABILITIES INCLUDING DATA HOSTING;

34.8.1 Hardware Requirements:

- Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C
- Relative humidity: 5% to 95%, condensing
- Elevation: 0 - 3 500 m above sea level
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites.

- Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered.
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance.
- No drives will be allowed, solid state memory only.

- Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy.
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years.
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above.

- Memory:

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters.
- Non-volatile memory for system and station parameters and user defined variables.
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings)
- The data logger shall preferably be provided with a ring memory (first in, first out);

- Data must still be available after being read out.
- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **built in** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

34.8.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes); ☐
- Power for all the sensors will be derived from the main battery via the data logger and will be user definable between 12 V_{DC} or 24 V_{DC} for all Channels. ☐
- Different sets of Power Supply System/s should be offered with the Logger. (Powering different amount of Sensors) ☐

34.8.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

34.8.4 Input functions and interfacing:

The logger should have as a standard configuration, two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
To input either:
 - 0 - 20 mA,
 - 4 -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

34.8.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

34.8.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

34.8.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

34.8.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

34.8.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement ☐

for battery management purposes as well as possible identification of early logger malfunctioning.

34.8.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

34.8.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

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- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

34.8.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

34.8.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

34.8.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

34.8.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

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The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

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- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

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- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

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- The system should be capable of transferring data at RSSI levels of -90dBm.

☐

- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

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- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

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- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

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- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

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- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

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- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below;
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:
 - The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
 - The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
 - With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
 - Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐
- Antenna Selection:
 - Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
 - The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
 - A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
 - In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
 - A 8dBi Patch antenna should also be offered optional. ☐

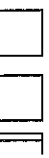
34.8.16 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐
- Design and technical details:
 - The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
 - The equipment shall function satisfactorily between -5°C to +50°C. ☐
 - The equipment must be compact, robust and corrosion-resistant. ☐
 - The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

 - The transmitter should have the following minimum features:
 - Transmitting performance of maximum 10 Watt. ☐
 - Power Consumption: ☐



- Stand-by: < 250 μ A
- Active Mode: < 250 mA
- During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

34.8.17 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

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34.8.18 Data hosting

- Control Centre:
 - The control centre should be based on a standard Intel computer with a GSM modem connected to it;
 - One computer/control centre should be capable of recording data from up to 500 field units, depending on the GSM Network Service; ☐
 - Providers ability to handle the influx of SMS messages each day. ☐
 - The software will be used to receive the SMS data messages from the field and reconstruct the information for display on the computer and export to other software. ☐
 - The tower will be connected to the LAN via an internal network card to provide access to the data received by authorised users. ☐
- Control Centre Specifications:
 - The Control Centre PC tower will be Windows based with the following minimum specifications:
 - Pentium P4
 - 512 Mb RAM
 - 3.0 GHz Processor
 - 2 x 80 GB SATA Hard Drive
 - CD ROM
 - Onboard Video
 - Integral LAN Card (EEPROM or Realtec Chipset)
 - 9-Pin Serial Port for Use with External GSM Modem☐

35 MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF THREE CHANNELS AND:

35.1 WITHOUT DISPLAY AND NO DATA TRANSMISSION CAPABILITIES;

35.1.1. Hardware Requirements:

- **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
Storage: -50° C to +85° C ☐
Operating: -40° C to +70° C ☐
Display (On) -20° C to +70° C ☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

- **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ±8 seconds per month, operating under the environmental conditions listed above. ☐

- **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
- Data must still be available after being read out. ☐
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

35.1.2. Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

35.1.3. Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

35.1.4. Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12.☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485.☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input.☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

35.1.5. Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

35.1.6. Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

35.1.7. Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data: ☐
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

35.1.8. Data processing:

- The data logger shall the following options available in the software configuration to process measured values: ☐
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).

35.1.9. Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

35.1.10. Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

35.1.11. Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

35.1.12.Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port.
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

35.1.13.Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

35.1.14.Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

35. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF THREE CHANNELS AND:

35.2 WITHOUT DISPLAY, WITH GSM / GPRS DATA TRANSMISSION CAPABILITIES;

35.2.1 Hardware Requirements:

- Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
Storage: -50° C to +85° C ☐
Operating: -40° C to +70° C ☐
Modem: -30° C to +70° C ☐

- Relative humidity: 5% to 95%, non condensing ☐

- Elevation: 0 - 3 500 m above sea level ☐

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- Data Processing:

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- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

- Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐

- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐

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- Memory:

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐

- Data must still be available after being read out. ☐

- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐

- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port;
- Host USB interface;
- Device USB interface.

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- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus;
- SDI-12 (via RS485);
- CREX code (satellite communication);
- Terminal Mode;
- FTP;

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35.2.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
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35.2.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
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35.2.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions: ☐
 Height - 130mm; Width - 130mm; Depth - 70mm. ☐

35.2.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
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- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
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35.2.7 Data acquisition:

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- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
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- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

35.2.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
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35.2.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

35.2.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

35.2.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

35.2.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port.
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

35.2.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

35.2.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

35.2.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

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The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

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- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

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- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

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- The system should be capable of transferring data at RSSI levels of - 90dBm.

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- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

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- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

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- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

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- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

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- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

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- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below;
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:

- The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
- The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
- With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
- Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐

- Antenna Selection:

- Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm; ☐
- The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
- A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
- In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
- An 8dBi Patch antenna should also be offered optional. ☐

35. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF THREE CHANNELS AND:
35.3 WITHOUT DISPLAY, WITH SATELLITE DATA TRANSMISSION CAPABILITIES;

35.3.1 Hardware Requirements:

- **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 Storage: -50° C to +85° C ☐
 Operating: -40° C to +70° C ☐
 Modem: -30° C to +70° C ☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

- **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
- Data must still be available after being read out. ☐
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port;
 - Host USB interface;
 - Device USB interface.
- ☐

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus;
 - SDI-12 (via RS485);
 - CREX code (satellite communication);
 - Terminal Mode;
 - FTP;
- ☐
-
- ☐
-
- ☐
-
- ☐
-
- ☐

35.3.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

35.3.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

35.3.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

35.3.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions: ☐
 Height - 130mm; Width - 130mm; Depth - 70mm. ☐

35.3.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

35.3.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

35.3.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).☐

35.3.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

35.3.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

35.3.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

35.3.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port. ☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

35.3.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

35.3.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

35.3.15 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt.
- Power Consumption:
 - Stand-by: < 250 μ A
 - Active Mode: < 250 mA
 - During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

35.3.16 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.



35. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF THREE CHANNELS AND:

35.4 WITHOUT DISPLAY, WITH GSM / GPRS / SATELLITE DATA TRANSMISSION CAPABILITIES INCLUDING DATA HOSTING;

35.4.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C ☐
 - Internal Modem: -30° C to +70° C
- Relative humidity: 5% to 95%, condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- No drives will be allowed, solid state memory only. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters. ☐
- Non-volatile memory for system and station parameters and user defined variables. ☐
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings) ☐
- The data logger shall preferably be provided with a ring memory (first in, first out); ☐
- Data must still be available after being read out. ☐

- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

35.4.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes); ☐
- Power for all the sensors will be derived from the main battery via the data logger and will be user definable between 12 V_{DC} or 24 V_{DC} for all Channels. ☐
- Different sets of Power Supply System/s should be offered with the Logger. (Powering different amount of Sensors) ☐

35.4.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

35.4.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
To input either:
 - 0 - 20 mA,
 - 4 -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12.☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485.☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input.☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

35.4.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

35.4.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

35.4.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

35.4.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

35.4.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement ☐

for battery management purposes as well as possible identification of early logger malfunctioning.

35.4.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

35.4.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

35.4.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

35.4.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

35.4.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

35.4.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

☐

The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

☐

- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

☐

- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

☐

- The system should be capable of transferring data at RSSI levels of - 90dBm.

☐

- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

☐

- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

☐

- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

☐

- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

☐

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

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- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below;
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:

- The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
- The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
- With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
- Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐

- Antenna Selection:

- Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
- The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
- A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
- In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
- A 8dBi Patch antenna should also be offered optional. ☐

35.4.16 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt. ☐
- Power Consumption: ☐



- Stand-by: < 250 μ A
- Active Mode: < 250 mA
- During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

35.4.17 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

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35.4.18 Data hosting

- Control Centre:
 - The control centre should be based on a standard Intel computer with a GSM modem connected to it; ☐
 - One computer/control centre should be capable of recording data from up to 500 field units, depending on the GSM Network Service; ☐
 - Provider's ability to handle the influx of SMS messages each day. ☐
 - The software will be used to receive the SMS data messages from the field and reconstruct the information for display on the computer and export to other software. ☐
 - The tower will be connected to the LAN via an internal network card to provide access to the data received by authorised users. ☐
- Control Centre Specifications:
 - The Control Centre PC tower will be Windows based with the following minimum specifications:
 - Pentium P4
 - 512 Mb RAM
 - 3.0 GHz Processor
 - 2 x 80 GB SATA Hard Drive
 - CD ROM
 - Onboard Video
 - Integral LAN Card (EEPROM or Realtec Chipset)
 - 9-Pin Serial Port for Use with External GSM Modem☐

35. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF THREE CHANNELS AND:

35.5 WITH DISPLAY AND NO DATA TRANSMISSION CAPABILITIES;

35.5.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

-	Temperature range:		
	Storage:	-50° C to +85° C	☐
	Operating:	-40° C to +70° C	☐
	Display (On)	-20° C to +70° C	☐

-	Relative humidity:	5% to 95%, non condensing	☐

-	Elevation:	0 - 3 500 m above sea level	☐

-	The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites.	☐

• **Data Processing:**

-	Only intelligent data loggers, equipped with a microprocessor will be considered.	☐

-	The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance.	☐

• **Real time clock:**

-	The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy.	☐

-	The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years.	☐

-	The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above.	☐

• **Memory:**

-	The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings.	☐

-	Data must still be available after being read out.	☐

-	Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired.	☐

-	The logger should have a RTOS operating system ensuring minimum power consumption	☐

- Operator interface:

The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

35.5.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

35.5.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

35.5.4 Input functions and interfacing:

The logger should have as a standard configuration, 2 physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The two channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

35.5.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

35.5.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

35.5.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data: ☐
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

35.5.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values: ☐
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).

35.5.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

35.5.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- The data logger display will indicate when it is busy with data transfer. ☐

35.5.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

35.5.12 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port. ☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

35.5.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

35.5.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

35. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF THREE CHANNELS AND:

35.6 WITH DISPLAY, WITH GSM / GPRS DATA TRANSMISSION CAPABILITIES;

35.6.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
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- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus; ☐
- SDI-12 (via RS485); ☐
- CREX code (satellite communication); ☐
- Terminal Mode; ☐
- FTP; ☐

35.6.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
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- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
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- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐

- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

35.6.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

35.6.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

35.6.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

35.6.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐

- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- The data logger display will indicate when it is busy with data transfer. ☐

35.6.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

35.6.12 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port. ☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

35.6.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

35.6.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

35.6.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority) ☐

The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes. ☐
- GSM/GPRS Logger Modem:
 - The system should be designed around receiving data from the probe with a sample period of at least 12 minutes. ☐
 - The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format. ☐
 - The system should be capable of transferring data at RSSI levels of -90dBm. ☐
 - The following indications should be available on the front of the unit:
 - Power;
 - Transmit (TX);
 - Receive (RX);
 - Link Fail.☐
 - From the above information it should be possible to determine:
 - Power Supply Available;
 - Unit Transmitting;
 - Unit Receiving;
 - Network connection error (e.g. no network, SIM card error)☐
 - In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre. ☐

- The following protection should be built into the design of the electronic circuit board (PCB)
 - Reverse Polarity Protection ☐
 - Voltage Clamping
 - DC filtering

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;
 - Interface to Data Logger via RS 232 Interface; ☐
 - Read Logged Data at predefined intervals; ☐
 - Configuration changes from Control Centre; ☐
 - Alarm data - battery low, battery critical; ☐
 - RSSI (Radio Signal Strength Indication) ☐

- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐

- Antenna Selection:
 - Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
 - The unit should be offered standard with a 3dBi antenna connected to the unit;
 - A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
 - In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
 - A 8dBi Patch antenna should also be offered optional. ☐

35. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF THREE CHANNELS AND:

35.7 WITH DISPLAY, WITH SATELLITE DATA TRANSMISSION CAPABILITIES;

35.7.1 Hardware Requirements:

- Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C☐
- Relative humidity: 5% to 95%, condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- No drives will be allowed, solid state memory only. ☐

- Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- Memory:

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters. ☐
- Non-volatile memory for system and station parameters and user defined variables. ☐
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings) ☐
- The data logger shall preferably be provided with a ring memory (first in, first out); ☐
- Data must still be available after being read out. ☐

- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **built in** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

35.7.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes); ☐
- Power for all the sensors will be derived from the main battery via the data logger and will be user definable between 12 V_{DC} or 24 V_{DC} for all Channels. ☐
- Different sets of Power Supply System/s should be offered with the Logger. (Powering different amount of Sensors) ☐

35.7.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

35.7.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
To input either:
 - 0 - 20 mA,
 - -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12.☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485.☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input.☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

35.7.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

35.7.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

35.7.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

35.7.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

35.7.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐

- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

35.7.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

35.7.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

35.7.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

35.7.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

35.7.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

35.7.15 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country.

☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system.

☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt. ☐
- Power Consumption:
 - Stand-by: < 250 μ A ☐
 - Active Mode: < 250 mA ☐
 - During Transmission: < 4 A ☐

- The flat antenna should preferably not exceed the following dimensions and weight:

- Dimensions: 600 mm x 600 mm x 150 mm thick; ☐
- Weight: 7,5 kg. ☐

- A commercially available "Yagi" antenna should be offered as an optional extra.

- The input voltage to the system shall preferably be +12 volt DC. ☐

- Communication between the data logger and the modem must be via a RS 232 port. ☐

- The power supply as specified shall be utilised for the system. ☐

35.7.16 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

☐

35. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF THREE CHANNELS AND:

35.8 WITH DISPLAY, WITH GSM / GPRS / SATELLITE DATA TRANSMISSION CAPABILITIES INCLUDING DATA HOSTING;

35.8.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C☐
- Relative humidity: 5% to 95%, condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- No drives will be allowed, solid state memory only. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters. ☐
- Non-volatile memory for system and station parameters and user defined variables. ☐
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings) ☐
- The data logger shall preferably be provided with a ring memory (first in, first out); ☐

- Data must still be available after being read out.
- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

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- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

35.8.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
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35.8.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
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35.8.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
To input either:
 - 0 - 20 mA,
 - 4 -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
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 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
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35.8.5 Enclosure and Housing:

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General:

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 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

35.8.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

35.8.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement ☐

for battery management purposes as well as possible identification of early logger malfunctioning.

35.8.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

35.8.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

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- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the above mentioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

35.8.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

35.8.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

35.8.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

35.8.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

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The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

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- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

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- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

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- The system should be capable of transferring data at RSSI levels of - 90dBm.

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- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

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- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

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- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

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- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

☐

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

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- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below;
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:

- The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
- The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
- With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
- Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐

- Antenna Selection:

- Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
- The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
- A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
- In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
- A 8dBi Patch antenna should also be offered optional. ☐

35.8.16 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt. ☐
- Power Consumption: ☐



- Stand-by: < 250 μ A
- Active Mode: < 250 mA
- During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

35.8.17 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

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35.8.18 Data hosting

- Control Centre:
 - The control centre should be based on a standard Intel computer with a GSM modem connected to it;
 - One computer/control centre should be capable of recording data from up to 500 field units, depending on the GSM Network Service; ☐
 - Providers ability to handle the influx of SMS messages each day. ☐
 - The software will be used to receive the SMS data messages from the field and reconstruct the information for display on the computer and export to other software. ☐
 - The tower will be connected to the LAN via an internal network card to provide access to the data received by authorised users. ☐
- Control Centre Specifications:
 - The Control Centre PC tower will be Windows based with the following minimum specifications:
 - Pentium P4
 - 512 Mb RAM
 - 3.0 GHz Processor
 - 2 x 80 GB SATA Hard Drive
 - CD ROM
 - Onboard Video
 - Integral LAN Card (EEPROM or Realtec Chipset)
 - 9-Pin Serial Port for Use with External GSM Modem ☐

36 MULTI CHANNEL DATA LOGGER WITH A MINIMUM OF FOUR CHANNELS AND:

36.1 WITHOUT DISPLAY AND NO DATA TRANSMISSION CAPABILITIES;

36.1.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C ☐
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C

- Relative humidity: 5% to 95%, non condensing ☐

- Elevation: 0 - 3 500 m above sea level ☐

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐

- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐

- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐

- Data must still be available after being read out. ☐

- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐

- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

36.1.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

36.1.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

36.1.4 Input functions and interfacing:

The logger should have as a standard configuration, four (4) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The four (4) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

36.1.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

36.1.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

36.1.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

36.1.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

36.1.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

36.1.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

36.1.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

36.1.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port. ☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

36.1.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

36.1.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

36. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

36.2 WITHOUT DISPLAY, WITH GSM / GPRS DATA TRANSMISSION CAPABILITIES;

36.2.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C ☐
 - Operating: -40° C to +70° C ☐
 - Modem: -30° C to +70° C ☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ±8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
- Data must still be available after being read out. ☐
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus; ☐
- SDI-12 (via RS485); ☐
- CREX code (satellite communication); ☐
- Terminal Mode; ☐
- FTP; ☐

36.2.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

36.2.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

36.2.4 Input functions and interfacing:

The logger should have as a standard configuration, four (4) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The four (4) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

36.2.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions: ☐
 Height - 130mm; Width - 130mm; Depth - 70mm. ☐

36.2.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

36.2.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

36.2.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).☐

36.2.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

36.2.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

36.2.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

36.2.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port.
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

36.2.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

36.2.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

36.2.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

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The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

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- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

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- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

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- The system should be capable of transferring data at RSSI levels of - 90dBm.

☐

- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

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- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

☐

- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

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- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

☐

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

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- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below; ☐
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:

- The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
- The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
- With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
- Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐

- Antenna Selection:

- Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
- The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
- A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
- In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
- An 8dBi Patch antenna should also be offered optional. ☐

36. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:
36.3 WITHOUT DISPLAY, WITH SATELLITE DATA TRANSMISSION CAPABILITIES;

36.3.1 Hardware Requirements:

- Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
Storage: -50° C to +85° C ☐
Operating: -40° C to +70° C ☐
Modem -30° C to +70° C ☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

- Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ±8 seconds per month, operating under the environmental conditions listed above. ☐

- Memory:

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
- Data must still be available after being read out. ☐
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port;
- Host USB interface;
- Device USB interface.

☐

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus;
- SDI-12 (via RS485);
- CREX code (satellite communication);
- Terminal Mode;
- FTP;

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36.3.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

36.3.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

36.3.4 Input functions and interfacing:

The logger should have as a standard configuration, four (4) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12.☐
- The four (4) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485.☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input.☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

36.3.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions: ☐
 Height - 130mm; Width - 130mm; Depth - 70mm. ☐

36.3.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

36.3.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

36.3.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).☐

36.3.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

36.3.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

36.3.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

36.3.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port. ☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

36.3.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

36.3.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

36.3.15 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

- The transmitter should have the following minimum features: ☐

- Transmitting performance of maximum 10 Watt.
- Power Consumption:
 - Stand-by: < 250 μ A
 - Active Mode: < 250 mA
 - During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

36.3.16 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.



36. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

36.4 WITHOUT DISPLAY, WITH GSM / GPRS / SATELLITE DATA TRANSMISSION CAPABILITIES INCLUDING DATA HOSTING;

36.4.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Internal Modem: -30° C to +70° C☐
- Relative humidity: 5% to 95%, condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- No drives will be allowed, solid state memory only. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters. ☐
- Non-volatile memory for system and station parameters and user defined variables. ☐
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings) ☐
- The data logger shall preferably be provided with a ring memory (first in, first out); ☐
- Data must still be available after being read out. ☐

- Remote data to be stored on memory stick (via USB) or SD memory card. ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

36.4.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes); ☐
- Power for all the sensors will be derived from the main battery via the data logger and will be user definable between 12 V_{DC} or 24 V_{DC} for all Channels. ☐
- Different sets of Power Supply System/s should be offered with the Logger. (Powering different amount of Sensors) ☐

36.4.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

36.4.4 Input functions and interfacing:

The logger should have as a standard configuration, four (4) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
To input either:
 - 0 - 20 mA,
 - 4 - 20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The four (4) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

36.4.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

36.4.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

36.4.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

36.4.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

36.4.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement ☐

for battery management purposes as well as possible identification of early logger malfunctioning.

36.4.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

36.4.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

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- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

36.4.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

36.4.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

36.4.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

36.4.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

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The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

☐

- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

☐

- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

☐

- The system should be capable of transferring data at RSSI levels of - 90dBm.

☐

- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

☐

- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

☐

- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

☐

- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

☐

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

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- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below;
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:

- The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
- The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
- With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
- Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐

- Antenna Selection:

- Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
- The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
- A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
- In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
- A 8dBi Patch antenna should also be offered optional. ☐

36.4.16 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt. ☐
- Power Consumption: ☐



- Stand-by: < 250 μ A
- Active Mode: < 250 mA
- During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

36.4.17 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

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36.4.18 Data hosting

- Control Centre:
 - The control centre should be based on a standard Intel computer with a GSM modem connected to it; ☐
 - One computer/control centre should be capable of recording data from up to 500 field units, depending on the GSM Network Service; ☐
 - Provider's ability to handle the influx of SMS messages each day. ☐
 - The software will be used to receive the SMS data messages from the field and reconstruct the information for display on the computer and export to other software. ☐
 - The tower will be connected to the LAN via an internal network card to provide access to the data received by authorised users. ☐
- Control Centre Specifications:
 - The Control Centre PC tower will be Windows based with the following minimum specifications:
 - Pentium P4
 - 512 Mb RAM
 - 3.0 GHz Processor
 - 2 x 80 GB SATA Hard Drive
 - CD ROM
 - Onboard Video
 - Integral LAN Card (EEPROM or Realtec Chipset)
 - 9-Pin Serial Port for Use with External GSM Modem☐

36. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

36.5 WITH DISPLAY AND NO DATA TRANSMISSION CAPABILITIES;

36.5.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

-	Temperature range:		
	Storage:	-50° C to +85° C	☐
	Operating:	-40° C to +70° C	☐
	Display (On)	-20° C to +70° C	☐

-	Relative humidity:	5% to 95%, non condensing	☐

-	Elevation:	0 - 3 500 m above sea level	☐

-	The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites.	☐

• **Data Processing:**

-	Only intelligent data loggers, equipped with a microprocessor will be considered.	☐

-	The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance.	☐

• **Real time clock:**

-	The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy.	☐

-	The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years.	☐

-	The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above.	☐

• **Memory:**

-	The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings.	☐

-	Data must still be available after being read out.	☐

-	Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired.	☐

-	The logger should have a RTOS operating system ensuring minimum power consumption	☐

- Operator interface:

The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

36.5.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

36.5.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

36.5.4 Input functions and interfacing:

The logger should have as a standard configuration, 2 physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The two channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

36.5.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

36.5.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

36.5.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data: ☐
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

36.5.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values: ☐
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).

36.5.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

36.5.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- The data logger display will indicate when it is busy with data transfer. ☐

36.5.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

36.5.12 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port.
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

36.5.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

36.5.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

36. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

36.6 WITH DISPLAY, WITH GSM / GPRS DATA TRANSMISSION CAPABILITIES;

36.6.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C

☐

- Relative humidity: 5% to 95%, non condensing

☐

- Elevation: 0 - 3 500 m above sea level

☐

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites.

☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered.

☐

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance.

☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy.

☐

- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years.

☐

- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above.

☐

• **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings.

☐

- Data must still be available after being read out.

☐

- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired.

☐

- The logger should have a RTOS operating system ensuring minimum power consumption

☐

- Operator interface:

The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port;
 - Host USB interface;
 - Device USB interface.
- ☐

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus;
 - SDI-12 (via RS485);
 - CREX code (satellite communication);
 - Terminal Mode;
 - FTP;
- ☐
-
- ☐
-
- ☐
-
- ☐
-
- ☐

36.6.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

36.6.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

36.6.4 Input functions and interfacing:

The logger should have as a standard configuration, 2 physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The two channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

36.6.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

36.6.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐

- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

36.6.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and
 - Maximum sampling time of 24 hours. ☐
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

36.6.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

36.6.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

36.6.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐

- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- The data logger display will indicate when it is busy with data transfer. ☐

36.6.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

36.6.12 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port. ☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

36.6.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

36.6.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

36.6.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority) ☐

The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes. ☐
- GSM/GPRS Logger Modem:
 - The system should be designed around receiving data from the probe with a sample period of at least 12 minutes. ☐
 - The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format. ☐
 - The system should be capable of transferring data at RSSI levels of -90dBm. ☐
 - The following indications should be available on the front of the unit:
 - Power;
 - Transmit (TX);
 - Receive (RX);
 - Link Fail. ☐
 - From the above information it should be possible to determine:
 - Power Supply Available;
 - Unit Transmitting;
 - Unit Receiving;
 - Network connection error (e.g. no network, SIM card error) ☐
 - In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre. ☐

- The following protection should be built into the design of the electronic circuit board (PCB)
 - Reverse Polarity Protection ☐
 - Voltage Clamping
 - DC filtering

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;
 - Interface to Data Logger via RS 232 Interface; ☐
 - Read Logged Data at predefined intervals; ☐
 - Configuration changes from Control Centre; ☐
 - Alarm data - battery low, battery critical; ☐
 - RSSI (Radio Signal Strength Indication) ☐

- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐

- Antenna Selection:
 - Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
 - The unit should be offered standard with a 3dBi antenna connected to the unit;
 - A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
 - In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
 - A 8dBi Patch antenna should also be offered optional. ☐

36. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

36.7 WITH DISPLAY, WITH SATELLITE DATA TRANSMISSION CAPABILITIES;

36.7.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C

☐

- Relative humidity: 5% to 95%, condensing

☐

- Elevation: 0 - 3 500 m above sea level

☐

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites.

☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered.

☐

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance.

☐

- No drives will be allowed, solid state memory only.

☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy.

☐

- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years.

☐

- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above.

☐

• **Memory:**

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters.

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- Non-volatile memory for system and station parameters and user defined variables.

☐

- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings)

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- The data logger shall preferably be provided with a ring memory (first in, first out);

☐

- Data must still be available after being read out.

☐

- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **built in** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

36.7.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes); ☐
- Power for all the sensors will be derived from the main battery via the data logger and will be user definable between 12 V_{DC} or 24 V_{DC} for all Channels. ☐
- Different sets of Power Supply System/s should be offered with the Logger. (Powering different amount of Sensors) ☐

36.7.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

36.7.4 Input functions and interfacing:

The logger should have as a standard configuration, four (4) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
To input either:
 - 0 - 20 mA,
 - -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The four (4) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

36.7.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

36.7.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

36.7.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

36.7.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

36.7.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐

- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

36.7.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

36.7.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

36.7.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

36.7.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

36.7.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

36.7.15 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country.

☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system.

☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt. ☐
- Power Consumption:
 - Stand-by: < 250 μ A ☐
 - Active Mode: < 250 mA ☐
 - During Transmission: < 4 A ☐

- The flat antenna should preferably not exceed the following dimensions and weight:

- Dimensions: 600 mm x 600 mm x 150 mm thick; ☐
- Weight: 7,5 kg. ☐

- A commercially available "Yagi" antenna should be offered as an optional extra. ☐
- The input voltage to the system shall preferably be +12 volt DC. ☐
- Communication between the data logger and the modem must be via a RS 232 port. ☐
- The power supply as specified shall be utilised for the system. ☐

36.7.16 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

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36. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

36.8 WITH DISPLAY, WITH GSM / GPRS / SATELLITE DATA TRANSMISSION CAPABILITIES INCLUDING DATA HOSTING;

36.8.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C
- Relative humidity: 5% to 95%, condensing
- Elevation: 0 - 3 500 m above sea level
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites.

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered.
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance.
- No drives will be allowed, solid state memory only.

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy.
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years.
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above.

• **Memory:**

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters.
- Non-volatile memory for system and station parameters and user defined variables.
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings)
- The data logger shall preferably be provided with a ring memory (first in, first out);

- Data must still be available after being read out. ☐
- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **built in** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

36.8.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes); ☐
- Power for all the sensors will be derived from the main battery via the data logger and will be user definable between 12 V_{DC} or 24 V_{DC} for all Channels. ☐
- Different sets of Power Supply System/s should be offered with the Logger. (Powering different amount of Sensors) ☐

36.8.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

36.8.4 Input functions and interfacing:

The logger should have as a standard configuration, four (4) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - To input either:
 - 0 - 20 mA,
 - 4 -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The four (4) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

36.8.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

36.8.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

36.8.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

36.8.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

36.8.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement ☐

for battery management purposes as well as possible identification of early logger malfunctioning.

36.8.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

36.8.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

36.8.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

36.8.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

36.8.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

36.8.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

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The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

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- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

☐

- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

☐

- The system should be capable of transferring data at RSSI levels of - 90dBm.

☐

- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

☐

- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

☐

- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

☐

- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

☐

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

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- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below;
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:

- The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
- The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
- With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
- Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐

- Antenna Selection:

- Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
- The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
- A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
- In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
- A 8dBi Patch antenna should also be offered optional. ☐

36.8.16 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt. ☐
- Power Consumption: ☐

- Stand-by: < 250 μ A
- Active Mode: < 250 mA
- During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

36.8.17 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

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36.8.18 Data hosting

- Control Centre:
 - The control centre should be based on a standard Intel computer with a GSM modem connected to it;
 - One computer/control centre should be capable of recording data from up to 500 field units, depending on the GSM Network Service; ☐
 - Providers ability to handle the influx of SMS messages each day. ☐
 - The software will be used to receive the SMS data messages from the field and reconstruct the information for display on the computer and export to other software. ☐
 - The tower will be connected to the LAN via an internal network card to provide access to the data received by authorised users. ☐
- Control Centre Specifications:
 - The Control Centre PC tower will be Windows based with the following minimum specifications:
 - Pentium P4
 - 512 Mb RAM
 - 3.0 GHz Processor
 - 2 x 80 GB SATA Hard Drive
 - CD ROM
 - Onboard Video
 - Integral LAN Card (EEPROM or Realtec Chipset)
 - 9-Pin Serial Port for Use with External GSM Modem☐

37 SUBMERSIBLE MULTI CHANNEL DATA LOGGER WITH A MINIMUM OF TWO CHANNELS AND:

37.1 WITHOUT DISPLAY AND NO DATA TRANSMISSION CAPABILITIES;

37.1.1 Hardware Requirements:

- Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C ☐
 - Operating: -40° C to +70° C ☐
 - Display (On) -20° C to +70° C ☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The data logger shall meet the requirement of IP68. In particular it shall tolerate submersions to a depth of 1 meter for 12 hours. ☐

- Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

- Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- Memory:

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
- Data must still be available after being read out. ☐
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

37.1.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

37.1.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

37.1.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

37.1.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

37.1.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

37.1.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data: ☐
 - Minimum sampling time of 60 seconds; and
 - Maximum sampling time of 24 hours. ☐
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

37.1.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values: ☐
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).

37.1.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

37.1.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

37.1.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

37.1.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port. ☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

37.1.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

37.1.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

37. SUBMERSIBLE MULTI CHANNEL DATA LOGGER WITH A MINIMUM OF TWO CHANNELS AND:

37.2 WITHOUT DISPLAY, WITH GSM / GPRS DATA TRANSMISSION CAPABILITIES;

37.2.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

-	Temperature range:		
	Storage:	-50° C to +85° C	☐
	Operating:	-40° C to +70° C	☐
	Modem	-30° C to +70° C	☐

-	Relative humidity:	5% to 95%, non condensing	☐

-	Elevation:	0 - 3 500 m above sea level	☐

-	The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites.	☐

-	The data logger shall meet the requirement of IP68. In particular it shall tolerate submersions to a depth of 1 meter for 12 hours.	☐

• **Data Processing:**

-	Only intelligent data loggers, equipped with a microprocessor will be considered.	☐

-	The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance.	☐

• **Real time clock:**

-	The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy.	☐

-	The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years.	☐

-	The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above.	☐

• **Memory:**

-	The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings.	☐

-	Data must still be available after being read out.	☐

-	Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired.	☐

-	The logger should have a RTOS operating system ensuring minimum power consumption	☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port;
- Host USB interface;
- Device USB interface.

☐

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus;
- SDI-12 (via RS485);
- CREX code (satellite communication);
- Terminal Mode;
- FTP;

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37.2.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

37.2.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

37.2.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

37.2.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions: ☐
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

37.2.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

37.2.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

37.2.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).☐

37.2.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

37.2.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

37.2.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

37.2.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port.
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

37.2.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

37.2.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

37.2.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

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The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

☐

- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

☐

- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

☐

- The system should be capable of transferring data at RSSI levels of - 90dBm.

☐

- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

☐

- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

☐

- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

☐

- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

☐

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

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- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below;
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:

- The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
- The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
- With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
- Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐

- Antenna Selection:

- Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
- The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
- A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
- In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
- An 8dBi Patch antenna should also be offered optional. ☐

37. SUBMERSIBLE MULTI CHANNEL DATA LOGGER WITH A MINIMUM OF TWO CHANNELS AND:

37.3 WITHOUT DISPLAY, WITH SATELLITE DATA TRANSMISSION CAPABILITIES;

37.3.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
Storage: -50° C to +85° C ☐
Operating: -40° C to +70° C ☐
Modem -30° C to +70° C ☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The data logger shall meet the requirement of IP68. In particular it shall tolerate submersions to a depth of 1 meter for 12 hours. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
- Data must still be available after being read out. ☐
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port;
 - Host USB interface;
 - Device USB interface.
- ☐

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus;
 - SDI-12 (via RS485);
 - CREX code (satellite communication);
 - Terminal Mode;
 - FTP;
- ☐
-
- ☐
-
- ☐
-
- ☐
-
- ☐

37.3.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

37.3.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

37.3.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

37.3.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions: ☐
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

37.3.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

37.3.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

37.3.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).☐

37.3.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

37.3.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

37.3.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

37.3.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port. ☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

37.3.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

37.3.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

37.3.15 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt.
- Power Consumption:
 - Stand-by: < 250 μ A
 - Active Mode: < 250 mA
 - During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

37.3.16 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.



37. SUBMERSIBLE MULTI CHANNEL DATA LOGGER WITH A MINIMUM OF TWO CHANNELS AND:
37.4 WITHOUT DISPLAY, WITH GSM / GPRS / SATELLITE DATA TRANSMISSION CAPABILITIES
INCLUDING DATA HOSTING;

37.4.1 Hardware Requirements:

- **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 Storage: -50° C to +85° C ☐
 Operating: -40° C to +70° C ☐
 Internal Modem -30° C to +70° C ☐
- Relative humidity: 5% to 95%, condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The data logger shall meet the requirement of IP68. In particular it shall tolerate submersions to a depth of 1 meter for 12 hours. ☐

- **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- No drives will be allowed, solid state memory only. ☐

- **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- **Memory:**

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters. ☐
- Non-volatile memory for system and station parameters and user defined variables. ☐
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings) ☐

- The data logger shall preferably be provided with a ring memory (first in, first out); ☐
- Data must still be available after being read out. ☐
- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

37.4.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes); ☐
- Power for all the sensors will be derived from the main battery via the data logger and will be user definable between 12 V_{DC} or 24 V_{DC} for all Channels. ☐
- Different sets of Power Supply System/s should be offered with the Logger. (Powering different amount of Sensors) ☐

37.4.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

37.4.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
To input either:
 - 0 - 20 mA,
 - 4 -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

37.4.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

37.4.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

37.4.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

37.4.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

37.4.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement ☐

for battery management purposes as well as possible identification of early logger malfunctioning.

37.4.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

37.4.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

37.4.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

37.4.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

37.4.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

37.4.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

☐

The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

☐

- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

☐

- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

☐

- The system should be capable of transferring data at RSSI levels of - 90dBm.

☐

- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

☐

- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

☐

- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

☐

- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

☐

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

☐
☐
☐
☐
☐

- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below; ☐
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:
 - The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
 - The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
 - With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
 - Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐
- Antenna Selection:
 - Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
 - The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
 - A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
 - In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
 - A 8dBi Patch antenna should also be offered optional. ☐

37.4.16 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐
- Design and technical details:
 - The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
 - The equipment shall function satisfactorily between -5°C to +50°C. ☐
 - The equipment must be compact, robust and corrosion-resistant. ☐
 - The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

 - The transmitter should have the following minimum features:
 - Transmitting performance of maximum 10 Watt. ☐
 - Power Consumption: ☐

- Stand-by: < 250 μ A
- Active Mode: < 250 mA
- During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

37.4.17 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

☐

37.4.18 Data hosting

- Control Centre:
 - The control centre should be based on a standard Intel computer with a GSM modem connected to it; ☐
 - One computer/control centre should be capable of recording data from up to 500 field units, depending on the GSM Network Service; ☐
 - Provider's ability to handle the influx of SMS messages each day. ☐
 - The software will be used to receive the SMS data messages from the field and reconstruct the information for display on the computer and export to other software. ☐
 - The tower will be connected to the LAN via an internal network card to provide access to the data received by authorised users. ☐
- Control Centre Specifications:
 - The Control Centre PC tower will be Windows based with the following minimum specifications:
 - Pentium P4
 - 512 Mb RAM
 - 3.0 GHz Processor
 - 2 x 80 GB SATA Hard Drive
 - CD ROM
 - Onboard Video
 - Integral LAN Card (EEPROM or Realtec Chipset)
 - 9-Pin Serial Port for Use with External GSM Modem☐

37. SUBMERSIBLE MULTI CHANNEL DATA LOGGER WITH A MINIMUM OF TWO CHANNELS AND:

37.5 WITH DISPLAY AND NO DATA TRANSMISSION CAPABILITIES;

37.5.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C ☐
 - Operating: -40° C to +70° C ☐
 - Display (On) -20° C to +70° C ☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The data logger shall meet the requirement of IP68. In particular it shall tolerate submersions to a depth of 1 meter for 12 hours. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
- Data must still be available after being read out. ☐
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

37.5.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

37.5.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

37.5.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

37.5.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

37.5.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

37.5.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

37.5.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).☐

37.5.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

37.5.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- The data logger display will indicate when it is busy with data transfer. ☐

37.5.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

37.5.12 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port. ☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

37.5.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

37.5.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

37. SUBMERSIBLE MULTI CHANNEL DATA LOGGER WITH A MINIMUM OF TWO CHANNELS AND:

37.6 WITH DISPLAY, WITH GSM / GPRS DATA TRANSMISSION CAPABILITIES;

37.6.1 Hardware Requirements:

- **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The data logger shall meet the requirement of IP68. In particular it shall tolerate submersions to a depth of 1 meter for 12 hours. ☐

- **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

- **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
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The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus; ☐
- SDI-12 (via RS485); ☐
- CREX code (satellite communication); ☐
- Terminal Mode; ☐
- FTP; ☐

37.6.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
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37.6.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
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 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
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- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
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- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

37.6.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

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General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
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- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
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37.6.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and
 - Maximum sampling time of 24 hours. ☐
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

37.6.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

37.6.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

37.6.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐

- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- The data logger display will indicate when it is busy with data transfer. ☐

37.6.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

37.6.12 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port. ☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

37.6.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

37.6.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

37.6.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority) ☐

The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes. ☐
- GSM/GPRS Logger Modem:
 - The system should be designed around receiving data from the probe with a sample period of at least 12 minutes. ☐
 - The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format. ☐
 - The system should be capable of transferring data at RSSI levels of -90dBm. ☐
 - The following indications should be available on the front of the unit:
 - Power;
 - Transmit (TX);
 - Receive (RX);
 - Link Fail. ☐
 - From the above information it should be possible to determine:
 - Power Supply Available;
 - Unit Transmitting;
 - Unit Receiving;
 - Network connection error (e.g. no network, SIM card error) ☐
 - In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre. ☐

- The following protection should be built into the design of the electronic circuit board (PCB)
 - Reverse Polarity Protection ☐
 - Voltage Clamping
 - DC filtering

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;
 - Interface to Data Logger via RS 232 Interface; ☐
 - Read Logged Data at predefined intervals; ☐
 - Configuration changes from Control Centre; ☐
 - Alarm data - battery low, battery critical; ☐
 - RSSI (Radio Signal Strength Indication) ☐

- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐

- Antenna Selection:
 - Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
 - The unit should be offered standard with a 3dBi antenna connected to the unit;
 - A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
 - In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
 - A 8dBi Patch antenna should also be offered optional. ☐

37. SUBMERSIBLE MULTI CHANNEL DATA LOGGER WITH A MINIMUM OF TWO CHANNELS AND:

37.7 WITH DISPLAY, WITH SATELLITE DATA TRANSMISSION CAPABILITIES;

37.7.1 Hardware Requirements:

- **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C☐
- Relative humidity: 5% to 95%, condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The data logger shall meet the requirement of IP68. In particular it shall tolerate submersions to a depth of 1 meter for 12 hours. ☐

- **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- No drives will be allowed, solid state memory only. ☐

- **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- **Memory:**

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters. ☐
- Non-volatile memory for system and station parameters and user defined variables. ☐
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings) ☐

- The data logger shall preferably be provided with a ring memory (first in, first out); ☐
- Data must still be available after being read out. ☐
- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **built in** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

37.7.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes); ☐
- Power for all the sensors will be derived from the main battery via the data logger and will be user definable between 12 V_{DC} or 24 V_{DC} for all Channels. ☐
- Different sets of Power Supply System/s should be offered with the Logger. (Powering different amount of Sensors) ☐

37.7.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

37.7.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - To input either:
 - 0 - 20 mA,
 - -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

37.7.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

37.7.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

37.7.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

37.7.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

37.7.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐

- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

37.7.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

37.7.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

37.7.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

37.7.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

37.7.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

37.7.15 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country.

☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites.
- The equipment shall function satisfactorily between -5°C to +50°C.
- The equipment must be compact, robust and corrosion-resistant.
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna.
 - Serial interface for data transmission and control.

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The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system.

☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt.
- Power Consumption:
 - Stand-by: < 250 μ A
 - Active Mode: < 250 mA
 - During Transmission: < 4 A

☐☐☐☐

- The flat antenna should preferably not exceed the following dimensions and weight:

- Dimensions: 600 mm x 600 mm x 150 mm thick;
- Weight: 7,5 kg.

☐☐

- A commercially available "Yagi" antenna should be offered as an optional extra.

- The input voltage to the system shall preferably be +12 volt DC.

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- Communication between the data logger and the modem must be via a RS 232 port.

☐

- The power supply as specified shall be utilised for the system.

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37.7.16 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

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37. SUBMERSIBLE MULTI CHANNEL DATA LOGGER WITH A MINIMUM OF TWO CHANNELS AND:

37.8 WITH DISPLAY, WITH GSM / GPRS / SATELLITE DATA TRANSMISSION CAPABILITIES INCLUDING DATA HOSTING;

37.8.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C☐
- Relative humidity: 5% to 95%, condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The data logger shall meet the requirement of IP68. In particular it shall tolerate submersions to a depth of 1 meter for 12 hours. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- No drives will be allowed, solid state memory only. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters. ☐
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- The data logger shall preferably be provided with a ring memory (first in, first out); ☐
- Data must still be available after being read out. ☐
- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **built in** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
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 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

37.8.2 Power supply:

- The supply voltage should be typically +9 V_{DC} to +28 V_{DC}; typically 12V_{DC}; ☐
- Power consumption should be within 25mA to 400mA at 12VDC dependant on sensors and configuration used; ☐
- The logger must have low power consumption on standby mode; ☐
- Logger should have a input Voltage protection of 36 V_{DC}; ☐
- The data logger must be reverse polarity protected; ☐
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- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
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37.8.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - To input either:
 - 0 - 20 mA,
 - 4 -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
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 - Status;
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 - Switch;
 - Serial RS-232;
 - RS-485;
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- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
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 - Extreme value collection and recording;
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 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

37.8.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement ☐

for battery management purposes as well as possible identification of early logger malfunctioning.

37.8.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

37.8.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

37.8.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

37.8.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals;
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals.☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval.☐

37.8.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

37.8.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

☐

The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

☐

- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

☐

- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

☐

- The system should be capable of transferring data at RSSI levels of - 90dBm.

☐

- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

☐

- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

☐

- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

☐

- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

☐

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

☐☐☐☐☐

- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below;
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:
 - The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
 - The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
 - With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
 - Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐
- Antenna Selection:
 - Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
 - The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
 - A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
 - In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
 - A 8dBi Patch antenna should also be offered optional. ☐

37.8.16 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐
- Design and technical details:
 - The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
 - The equipment shall function satisfactorily between -5°C to +50°C. ☐
 - The equipment must be compact, robust and corrosion-resistant. ☐
 - The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

 - The transmitter should have the following minimum features:
 - Transmitting performance of maximum 10 Watt. ☐
 - Power Consumption: ☐

- Stand-by: < 250 μ A ☐
- Active Mode: < 250 mA ☐
- During Transmission: < 4 A ☐
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick; ☐
 - Weight: 7,5 kg. ☐
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC. ☐
- Communication between the data logger and the modem must be via a RS 232 port. ☐
- The power supply as specified shall be utilised for the system. ☐

37.8.17 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid. ☐

37.8.18 Data hosting

- Control Centre:
 - The control centre should be based on a standard Intel computer with a GSM modem connected to it; ☐
 - One computer/control centre should be capable of recording data from up to 500 field units, depending on the GSM Network Service; ☐
 - Providers ability to handle the influx of SMS messages each day. ☐
 - The software will be used to receive the SMS data messages from the field and reconstruct the information for display on the computer and export to other software. ☐
 - The tower will be connected to the LAN via an internal network card to provide access to the data received by authorised users. ☐
- Control Centre Specifications:
 - The Control Centre PC tower will be Windows based with the following minimum specifications:
 - Pentium P4
 - 512 Mb RAM
 - 3.0 GHz Processor
 - 2 x 80 GB SATA Hard Drive
 - CD ROM
 - Onboard Video
 - Integral LAN Card (EEPROM or Realtec Chipset)
 - 9-Pin Serial Port for Use with External GSM Modem ☐

38 LOW POWER MULTI CHANNEL DATA LOGGER WITH A MINIMUM OF TWO CHANNELS AND:

38.1 WITHOUT DISPLAY AND NO DATA TRANSMISSION CAPABILITIES;

38.1.1 Hardware Requirements:

- Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
Storage: -50° C to +85° C ☐
Operating: -40° C to +70° C ☐
Display (On) -20° C to +70° C ☐

- Relative humidity: 5% to 95%, non condensing ☐

- Elevation: 0 - 3 500 m above sea level ☐

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

- Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐

- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐

- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- Memory:

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐

- Data must still be available after being read out. ☐

- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐

- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

38.1.2 Power supply:

- The supply voltage should be typically +6V_{DC}. ☐
- Power consumption should be as follows:
 - Standby: 1.00mA ☐
 - Transmitting: 200mA ☐
- The logger must have low power consumption on standby mode; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

38.1.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

38.1.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

38.1.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

38.1.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

38.1.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

38.1.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).☐

38.1.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

38.1.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

38.1.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

38.1.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port.
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

38.1.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

38.1.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

38. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

38.2 WITHOUT DISPLAY, WITH GSM / GPRS DATA TRANSMISSION CAPABILITIES;

38.2.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

-	Temperature range:		
	Storage:	-50° C to +85° C	☐
	Operating:	-40° C to +70° C	☐
	Modem	-30° C to +70° C	☐

-	Relative humidity:	5% to 95%, non condensing	☐

-	Elevation:	0 - 3 500 m above sea level	☐

-	The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites.	☐

• **Data Processing:**

-	Only intelligent data loggers, equipped with a microprocessor will be considered.	☐

-	The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance.	☐

• **Real time clock:**

-	The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy.	☐

-	The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years.	☐

-	The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above.	☐

• **Memory:**

-	The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings.	☐

-	Data must still be available after being read out.	☐

-	Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired.	☐

-	The logger should have a RTOS operating system ensuring minimum power consumption	☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus; ☐
- SDI-12 (via RS485); ☐
- CREX code (satellite communication); ☐
- Terminal Mode; ☐
- FTP; ☐

38.2.2 Power supply:

- The supply voltage should be typically +6 V_{DC}. ☐
- Power consumption should be as follows:
 - Standby: 1.00mA ☐
 - Transmitting: 200mA
- The logger must have low power consumption on standby mode; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

38.2.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

38.2.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

38.2.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions: ☐
 Height - 130mm; Width - 130mm; Depth - 70mm. ☐

38.2.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

38.2.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data: ☐
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

38.2.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values: ☐
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).

38.2.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

38.2.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

38.2.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

38.2.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port. ☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

38.2.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
Record each sample or average set of samples and store at set intervals.
Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

38.2.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

38.2.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

☐

The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

☐

- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

☐

- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

☐

- The system should be capable of transferring data at RSSI levels of - 90dBm.

☐

- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

☐

- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

☐

- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

☐

- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

☐

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

☐☐☐☐☐

- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below;
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:
 - The design of the system is critical with regard to the current consumption. The system will operate on a $6V_{DC}$ supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
 - The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
 - With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
 - Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐
- Antenna Selection:
 - Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
 - The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
 - A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
 - In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
 - An 8dBi Patch antenna should also be offered optional. ☐

38. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

38.3 WITHOUT DISPLAY, WITH SATELLITE DATA TRANSMISSION CAPABILITIES;

38.3.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
Storage: -50° C to +85° C ☐
Operating: -40° C to +70° C ☐
Modem -30° C to +70° C ☐

- Relative humidity: 5% to 95%, non condensing ☐

- Elevation: 0 - 3 500 m above sea level ☐

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐

- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐

- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐

- Data must still be available after being read out. ☐

- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐

- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus; ☐
- SDI-12 (via RS485); ☐
- CREX code (satellite communication); ☐
- Terminal Mode; ☐
- FTP; ☐

38.3.2 Power supply:

- The supply voltage should be typically +6 V_{DC}. ☐
- Power consumption should be as follows:
 - Standby: 1.00mA ☐
 - Transmitting: 200mA
- The logger must have low power consumption on standby mode; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

38.3.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

38.3.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

38.3.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions: ☐
 Height - 130mm; Width - 130mm; Depth - 70mm. ☐

38.3.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

38.3.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data: ☐
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours. ☐
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

38.3.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values: ☐
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient).

38.3.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

38.3.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐

38.3.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

38.3.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port. ☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

38.3.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. If Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

38.3.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

38.3.15 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt.
- Power Consumption:
 - Stand-by: < 250 μ A
 - Active Mode: < 250 mA
 - During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

38.3.16 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.



38. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

38.4 WITHOUT DISPLAY, WITH GSM / GPRS / SATELLITE DATA TRANSMISSION CAPABILITIES INCLUDING DATA HOSTING;

38.4.1 Hardware Requirements:

- **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C ☐
 - Operating: -40° C to +70° C ☐
 - Internal Modem: -30° C to +70° C ☐
- Relative humidity: 5% to 95%, condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- No drives will be allowed, solid state memory only. ☐

- **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- **Memory:**

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters. ☐
- Non-volatile memory for system and station parameters and user defined variables. ☐
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings) ☐
- The data logger shall preferably be provided with a ring memory (first in, first out); ☐
- Data must still be available after being read out. ☐

- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **optional extra** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

38.4.2 Power supply:

- The supply voltage should be typically +6 V_{DC}. ☐
- Power consumption should be as follows:
 - Standby: 1.00mA ☐
 - Transmitting: 200mA ☐
- The logger must have low power consumption on standby mode; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

38.4.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

38.4.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - To input either:
 - 0 - 20 mA,
 - 4 -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12.☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485.☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input.☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

38.4.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

38.4.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

38.4.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

38.4.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

38.4.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement ☐

for battery management purposes as well as possible identification of early logger malfunctioning.

38.4.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

38.4.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

38.4.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

38.4.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

38.4.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

38.4.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

☐

The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

☐

- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

☐

- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

☐

- The system should be capable of transferring data at RSSI levels of - 90dBm.

☐

- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

☐

- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

☐

- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

☐

- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

☐

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

☐
☐
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☐

- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below;
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:
 - The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
 - The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
 - With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
 - Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐
- Antenna Selection:
 - Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
 - The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
 - A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
 - In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
 - A 8dBi Patch antenna should also be offered optional. ☐

38.4.16 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐
- Design and technical details:
 - The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
 - The equipment shall function satisfactorily between -5°C to +50°C. ☐
 - The equipment must be compact, robust and corrosion-resistant. ☐
 - The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

 - The transmitter should have the following minimum features:
 - Transmitting performance of maximum 10 Watt. ☐
 - Power Consumption: ☐

- Stand-by: < 250 μ A
- Active Mode: < 250 mA
- During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

38.4.17 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

☐

38.4.18 Data hosting

- Control Centre:
 - The control centre should be based on a standard Intel computer with a GSM modem connected to it; ☐
 - One computer/control centre should be capable of recording data from up to 500 field units, depending on the GSM Network Service; ☐
 - Provider's ability to handle the influx of SMS messages each day. ☐
 - The software will be used to receive the SMS data messages from the field and reconstruct the information for display on the computer and export to other software. ☐
 - The tower will be connected to the LAN via an internal network card to provide access to the data received by authorised users. ☐
- Control Centre Specifications:
 - The Control Centre PC tower will be Windows based with the following minimum specifications:
 - Pentium P4
 - 512 Mb RAM
 - 3.0 GHz Processor
 - 2 x 80 GB SATA Hard Drive
 - CD ROM
 - Onboard Video
 - Integral LAN Card (EEPROM or Realtec Chipset)
 - 9-Pin Serial Port for Use with External GSM Modem☐

38. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

38.5 WITH DISPLAY AND NO DATA TRANSMISSION CAPABILITIES;

38.5.1 Hardware Requirements:

- Environmental Conditions:

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
Storage: -50° C to +85° C ☐
Operating: -40° C to +70° C ☐
Display (On) -20° C to +70° C ☐

- Relative humidity: 5% to 95%, non condensing ☐

- Elevation: 0 - 3 500 m above sea level ☐

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- Data Processing:

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐

- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

- Real time clock:

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐

- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐

- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- Memory:

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐

- Data must still be available after being read out. ☐

- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐

- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port; ☐
- Host USB interface;
- Device USB interface.

38.5.2 Power supply:

- The supply voltage should be typically +6 V_{DC}. ☐
- Power consumption should be as follows:
 - Standby: 1.00mA ☐
 - Transmitting: 200mA ☐
- The logger must have low power consumption on standby mode; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

38.5.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

38.5.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

38.5.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

38.5.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

38.5.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and
 - Maximum sampling time of 24 hours. ☐
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

38.5.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

38.5.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

38.5.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- The data logger display will indicate when it is busy with data transfer. ☐

38.5.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

38.5.12 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port; ☐
 - USB port.
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

38.5.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
 - Sample at set intervals:
 - Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
 - Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

38.5.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

38. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

38.6 WITH DISPLAY, WITH GSM / GPRS DATA TRANSMISSION CAPABILITIES;

38.6.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C
 - Modem -30° C to +70° C☐
- Relative humidity: 5% to 95%, non condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

- The data logger shall preferably be provided with a ring memory (first in, first out) for buffered storage capacity of at least 4 MB for up to 500 000 readings. ☐
- Data must still be available after being read out. ☐
- Option to clear memory after configuration, with user level restricted option controlled by user defined password if so desired. ☐
- The logger should have a RTOS operating system ensuring minimum power consumption ☐

- Operator interface:

The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
- Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐

- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via the following ports:

- 9-pin RS 232 or USB serial port;
- Host USB interface;
- Device USB interface. ☐

- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

- Modbus; ☐
- SDI-12 (via RS485); ☐
- CREX code (satellite communication); ☐
- Terminal Mode; ☐
- FTP; ☐

38.6.2 Power supply:

- The supply voltage should be typically +6 V_{DC}. ☐
- Power consumption should be as follows:
 - Standby: 1.00mA ☐
 - Transmitting: 200mA ☐
- The logger must have low power consumption on standby mode; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

38.6.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

38.6.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐

- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐
- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

38.6.5 Enclosure and Housing:

- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line, satellite telephone link and cellular telephone link, through a plug connector. ☐
- The housing will preferably house an operator interface, keypad / jog shuttle and LCD. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

38.6.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐

- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

38.6.7 Data acquisition:

- The data logger shall operate with a fixed interval logging sequences. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

38.6.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

38.6.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

38.6.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the display-unit or laptop/palmtop. ☐

- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- A time-out shall be provided, so that the display will go into a sleeping mode if no keyboard activity is detected for a period. ☐
- The data logger display will indicate when it is busy with data transfer. ☐

38.6.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Logger configuration Settings - user must be able to be set:
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001;
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof;
 - Date and time settings.
 - Each sensor must have user adjustable number and name
 - Each sensor must have user adjustable display and recording units
 - Each sensor must be separately configurable - logging and sampling intervals ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐
- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of a dial-up telephone connection, SMS text messages or GPRS transmission. ☐

38.6.12 Data retrieval:

- Data shall be retrieved by a PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port. ☐
- The following procedures shall be available to the operator using a PDA, laptop or tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐

38.6.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

38.6.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

38.6.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority) ☐

The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes. ☐
- GSM/GPRS Logger Modem:
 - The system should be designed around receiving data from the probe with a sample period of at least 12 minutes. ☐
 - The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format. ☐
 - The system should be capable of transferring data at RSSI levels of - 90dBm. ☐
 - The following indications should be available on the front of the unit:
 - Power;
 - Transmit (TX);
 - Receive (RX);
 - Link Fail. ☐
 - From the above information it should be possible to determine:
 - Power Supply Available;
 - Unit Transmitting;
 - Unit Receiving;
 - Network connection error (e.g. no network, SIM card error) ☐
 - In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre. ☐

- The following protection should be built into the design of the electronic circuit board (PCB)
 - Reverse Polarity Protection ☐
 - Voltage Clamping
 - DC filtering

- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;
 - Interface to Data Logger via RS 232 Interface; ☐
 - Read Logged Data at predefined intervals; ☐
 - Configuration changes from Control Centre; ☐
 - Alarm data - battery low, battery critical; ☐
 - RSSI (Radio Signal Strength Indication) ☐

- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐

- Antenna Selection:
 - Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
 - The unit should be offered standard with a 3dBi antenna connected to the unit;
 - A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
 - In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
 - A 8dBi Patch antenna should also be offered optional. ☐

38. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

38.7 WITH DISPLAY, WITH SATELLITE DATA TRANSMISSION CAPABILITIES;

38.7.1 Hardware Requirements:

• **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On) -20° C to +70° C ☐
 - Modem -30° C to +70° C ☐
- Relative humidity: 5% to 95%, condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

• **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- No drives will be allowed, solid state memory only. ☐

• **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

• **Memory:**

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters. ☐
- Non-volatile memory for system and station parameters and user defined variables. ☐
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings) ☐
- The data logger shall preferably be provided with a ring memory (first in, first out); ☐
- Data must still be available after being read out. ☐

- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **built in** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

38.7.2 Power supply:

- The supply voltage should be typically +6 V_{DC}. ☐
- Power consumption should be as follows:
 - Standby: 1.00mA ☐
 - Transmitting: 200mA ☐
- The logger must have low power consumption on standby mode; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

38.7.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

38.7.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - To input either:
 - 0 - 20 mA,
 - -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12.☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485.☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input.☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

38.7.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

38.7.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

38.7.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

38.7.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

38.7.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐

- Power supply or consumption monitoring and recording thereof are a requirement for battery management purposes as well as possible identification of early logger malfunctioning. ☐

38.7.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

38.7.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

38.7.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

38.7.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

38.7.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

38.7.15 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country.

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- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites.
- The equipment shall function satisfactorily between -5°C to +50°C.
- The equipment must be compact, robust and corrosion-resistant.
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna.
 - Serial interface for data transmission and control.

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The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system.

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- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt.
- Power Consumption:
 - Stand-by: < 250 μ A
 - Active Mode: < 250 mA
 - During Transmission: < 4 A

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- The flat antenna should preferably not exceed the following dimensions and weight:

- Dimensions: 600 mm x 600 mm x 150 mm thick;
- Weight: 7,5 kg.

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- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

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38.7.16 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

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38. MULTI CHANNEL DATA LOGGER WITH A MAXIMUM OF FOUR CHANNELS AND:

38.8 WITH DISPLAY, WITH GSM / GPRS / SATELLITE DATA TRANSMISSION CAPABILITIES INCLUDING DATA HOSTING;

38.8.1 Hardware Requirements:

- **Environmental Conditions:**

The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -50° C to +85° C
 - Operating: -40° C to +70° C
 - Display (On): -20° C to +70° C
 - Modem: -30° C to +70° C☐
- Relative humidity: 5% to 95%, condensing ☐
- Elevation: 0 - 3 500 m above sea level ☐
- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐

- **Data Processing:**

- Only intelligent data loggers, equipped with a microprocessor will be considered. ☐
- The data logger shall be equipped with a CPU watchdog circuit that will automatically restart the system in case of a severe electrical or electromagnetic disturbance. ☐
- No drives will be allowed, solid state memory only. ☐

- **Real time clock:**

- The data loggers shall be equipped with battery backed hardware real time clock system with a minimum of 5 years life expectancy. ☐
- The real time clock system shall provide time (24 hour system) and date information and shall make provision for leap years. ☐
- The accuracy and stability of the real time clock shall be better than ± 8 seconds per month, operating under the environmental conditions listed above. ☐

- **Memory:**

The data loggers shall be provided with three types of memory systems:

- EEPROM for system programs and default parameters. ☐
- Non-volatile memory for system and station parameters and user defined variables. ☐
- Battery backed RAM for intermediate data storage and processing. (Minimum 4 MB for up to 500 000 readings) ☐
- The data logger shall preferably be provided with a ring memory (first in, first out); ☐

- Data must still be available after being read out.
- Remote data to be stored on memory stick (via USB) or SD memory card. ☐
- Operator interface:

The data logger shall be provided with the following minimum **built in** facilities, to be used by operating and maintenance staff:

 - A LCD unit (graphical dot matrix: 122 x 32 pixels), capable of displaying the full ASCII character set with LED backlight. ☐
 - Jog shuttle controlled, onboard rotating operation and command selection button enabling the user to access menu's and perform sensor calibration without interfacing aids like a laptop, PDA or tablet. ☐
 - In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. The logger must control sufficient warm-up and stabilisation time for sensors. ☐
 - During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Communication ports:

Each data logger shall preferably be equipped to allow bi-directional communication with outside equipment (laptop) via one of the following ports:

 - 9-pin RS 232;
(Allow user selection of the Number of data bits, start and stop bits and parity bits in accordance with the laid down standard. Baud rates of 300, 600, 1200, 2400, 4800 and 9600 baud shall be available for selection.) ☐
 - USB serial port; ☐
 - Host USB interface; ☐
 - Device USB interface; ☐
 - Infrared interface; ☐
 - TCP/IP ☐
- Communication protocols:

The data logger shall have the following protocols available on each of the above mentioned communication ports:

 - Modbus; ☐
 - SDI-12 (via RS485); ☐
 - CREX code (satellite communication); ☐
 - Terminal Mode; ☐
 - FTP; ☐
 - The logger shall have the facility to interface with transmission equipment. ☐

38.8.2 Power supply:

- The supply voltage should be typically +6 V_{DC}. ☐
- Power consumption should be as follows:
 - Standby: 1.00mA ☐
 - Transmitting: 200mA ☐
- The logger must have low power consumption on standby mode; ☐
- The data logger must be reverse polarity protected; ☐
- Each data logger shall be provided with an internal source that would prevent equipment shutdown or loss of data when the main battery is either disconnected for a short period or exchanged. (±15 minutes) ☐

38.8.3 Surge Protection:

- The Bidder shall make provision for and bid separately for surge protection equipment on all system input/output circuits and power supply input (dc, mains) circuits. ☐
- The following equipment shall be included as an absolute minimum requirement:
 - On all analog / digital input and output circuits - DEHN BLITZDUCTORS TYPE LZ or equivalent with appropriate voltage ratings. ☐
 - On all mains power supply circuits - DEHN type VA-280 surge arrestors or equivalent. ☐
 - The Employer may allow the use of alternative types of surge arrestors, provided that equivalent or superior protection levels will be achieved. SABS and/or CSIR test reports to substantiate claims shall be provided for the alternative offers. ☐
 - It is not anticipated that the stated equipment will be used on its own, necessarily, provide the required level of protection and the Bidder shall implement additional measures deemed necessary to achieve the required protection level. ☐

38.8.4 Input functions and interfacing:

The logger should have as a standard configuration, minimum of two (2) physical input channels with the following sensor interface capabilities:

- Input or Output Interface:
 - Analog;
 - To input either:
 - 0 - 20 mA,
 - 4 -20 mA,
 - 0 - 10 V,
 - 1 - 10 V,
 - -2 +2V,
 - 0.....5V,
 - 15V
 - Status;
 - Pulse;
 - Switch;
 - Serial RS-232;
 - RS-485;
 - SDI-12. ☐
- The minimum of two (2) channels on the logger should be configurable for any of the following interface types as required by the user:
 - Analog;
 - SDI-12;
 - RS-485. ☐
- The following expansion interface card upgrades to the standard configuration must be available on request from the employer:
 - Analog input;
 - Analog Insulated input;
 - Analog output;
 - Serial input;
 - Barometric input. ☐
- Analogue input signals shall be converted to digital signals using an A - D converter with not less than 12 bits. ☐
- Digital inputs shall be parallel, pulse or V24 signals. ☐
- Dedicated modules or changes to the internal software must be available to accept all types of sensors directly. ☐
- The analogue input signals shall be measured to an overall accuracy of better than 0.1%. The input circuits shall be so designed that no errors will be introduced by ground loops. ☐
- The input channel to be allocated to a specific sensor shall be user selectable and user configurable to any of the above mentioned interface connection types. ☐
- In order to conserve power, the data logger shall control the power supply to each sensor. Sensors shall be switched on in sequence and readings taken under processor control. Sufficient warm-up and stabilisation time for sensors must be controlled by the logger. ☐
- During non-measurement periods power supply to the sensors and signal converter units shall be interrupted for all the analogue channels. ☐
- Full calibration procedures shall be provided for each sensor / signal conditioning unit. ☐

- Input connectors for sensors shall be clearly labelled, shall be polarised to prevent mismatching of connectors and shall be configured so that no damage can occur if a unit is accidentally or intentionally connected to the wrong input channel. Each connector shall make provision for all the necessary signal lines, earth, 0V and 12V (switched) supplied lines. ☐

38.8.5 Enclosure and Housing:

- **Only** compact data loggers will be accepted, therefore all electronic components, wiring, etc., will be fixed / mounted inside the logger housing. ☐
- The data logger shall be enclosed in wall mounted enclosures, for installation in a recorder hut. ☐
- The logger housing shall be water and dust protected and shall comply with rating IP41. ☐
- All connections to be made internally - no external connections. ☐
- The housing shall be manufactured of corrosion resistant material. ☐
- Provision must be made in the housing to enable data transmission via telephone line and cellular telephone link, through a plug connector. ☐
- The data logger housing shall preferably not exceed the following dimensions:
Height - 130mm; Width - 130mm; Depth - 70mm. ☐

38.8.6 Internal software requirements:

General:

- All software packages shall be written and structured in a high level programming language. To conserve memory space and thus power required, the use of a compiled program is recommended. ☐
- The data logger operating software shall be located in ROM (EPROM) and the Bidder shall be responsible for the provision of all the software required to make a complete, operational system. ☐
- It shall not be possible for the operator of any data logger to accidentally or intentionally destroy the database or data recordings by entering faulty or erroneous instructions or messages. ☐
- The data logger SOFTWARE shall allow the equipment to operate in a completely unattended mode and all reasonable precautions shall be taken in the structuring of the error trapping routines to prevent system hang-up. ☐
- The data logger shall have the option to protect unauthorized configuration or entry of operating parameters by means of password protection. ☐
- The software shall have the capability to enable the user to print or view a sensor connection diagram of configured and connected sensors on the logger. ☐
- The supplier shall provide a list of standard error codes for identification of possible faulty wiring, configurations and sensors. ☐

38.8.7 Data acquisition:

- The data logger shall operate with two logging sequences:
 - Fixed interval logging; ☐
 - Variable interval logging ☐
- Each data input channel shall be treated separately and shall have its own scanning interval parameters. At start-up the default parameter set shall be loaded for each channel and it shall be possible for the operator to modify the parameter set at any stage. ☐
- For each input channel the data logger shall provide a scaling factor and offset so that the measured value can be adjusted to the actual reading. For the water level channels the scaling factor will be determined by the transducer selected. This will allow for the transducer being placed above or below the zero thresholds. ☐
- The water level must be sampled at set intervals. The operators shall however be able to select a fixed interval for sample and storing of the data:
 - Minimum sampling time of 60 seconds; and ☐
 - Maximum sampling time of 24 hours.
- The data logger must provide the option of sampling but not storing if user determined variable changes have not been exceeded for any recorded data channel e.g. Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. ☐

38.8.8 Data processing:

- The data logger shall the following options available in the software configuration to process measured values:
 - Mean calculation;
 - Totals information;
 - Delta Storage;
 - Definition of sensor delay time;
 - Extreme value collection and recording;
 - Filtering functions;
 - Linearization;
 - Arithmetic function;
 - Tendency determination;
 - Virtual sensor;
 - Alarm or action management (threshold or gradient). ☐

38.8.9 Data storage:

- Data records shall contain the following information:
 - Station number, Time/Date code and measured value. ☐
 - The measured value shall be given in engineering units. ☐
- Channels shall be numbered numerically. ☐
- Data storage shall be done on a circulating storage system, first in - first out. ☐
- The data must be able to be read out as often as desired, without destroying it. ☐
- The memory contents must be retained in the case of a power supply breakdown. ☐
- Power supply or consumption monitoring and recording thereof are a requirement ☐

for battery management purposes as well as possible identification of early logger malfunctioning.

38.8.10 Data display:

- All communication between the data logger and the operator shall be done via a data reader unit, PDA, laptop or tablet. ☐
- All conversation between the data logger and the operator shall be done via the data reader unit, PDA, laptop or tablet. ☐
- When connecting to the data logger, the following information should be displayed:
 - Measured values, Date, Time, Battery status and minimum and maximum values for the previous 12-minute period. ☐
- The operator shall have the option to password protect the abovementioned data display. ☐

38.8.11 Operator's procedures:

Menu-driven procedures:

- All operator activities shall be menu driven from the set-up software. ☐
- Station Settings:
 - The operator shall have the option to password protect all of the station settings. ☐
 - Alphanumeric station ID, with at least 10 digits. e.g. 0000J1R001; ☐
 - Alphanumeric station name, with at least 40 characters e.g. Prins River at Tygerkloof; ☐
 - Date and time settings. ☐
 - Internal lithium cell voltage. ☐
 - Software version. ☐
 - RAM capacity. ☐
 - Amount of sensors. ☐
 - Last data readout date. ☐
 - Port settings. ☐
 - Language settings (if necessary). ☐

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- Sensor settings:
 - The operator shall have the option to password protect all of the sensor settings. ☐
 - Sensor number. ☐
 - Sensor description. ☐
 - Display units. ☐
 - Show minimum and maximum values for the last 24 hours. ☐
 - Sample intervals. ☐
 - Storage intervals. ☐
 - Delta values for event logging. ☐
 - Each sensor must have user adjustable display and recording units ☐
 - Each sensor must be separately configurable - logging and sampling intervals. ☐
- Service settings:
 - The operator shall have the option to password protect all of the service settings. ☐
 - Install additional channels. ☐
 - Remove unused channels. ☐
 - Erase selective channel data. ☐
 - System reset / start-up date. ☐
 - Restore Factory Settings ☐
- General settings:
 - When scanning the current, active parameter list, the operator shall have access to read the parameters as listed in the abovementioned Station- and Sensor settings. ☐
 - With the seen input channel facility the operator shall be able to select any input channel and the data logger shall measure and display the current input value (or a "non-selected" message if the channel is not activated). ☐
 - Where single channel, non-expandable, dedicated units can be used, it must be supplied so. ☐
- The operator shall have the option to set and adjust port settings as required; ☐
- The operator shall have the ability to add or remove channels in the configuration as required; ☐
- The operator shall have the option to do a system reset or restore factory settings if required; ☐
- The operator shall have the option to upgrade firmware if required means of a laptop on site ☐

- The operator shall have the option to change any of the above mentioned configuration settings on site by means of an external communication device or remotely by means of Satellite transmission. ☐

38.8.12 Data retrieval:

- Data shall be retrieved by a data reader unit, PDA, laptop, tablet or USB data storage device via any of the following interface connections:
 - RS-232 port;
 - USB port;
 - SD card;
 - TCP/IP☐
- The following procedures shall be available to the operator using a data reader unit, PDA, laptop, tablet:
 - View and alter time and date information of period to be retrieved. ☐
 - Option to select individual sensors for data retrieval. ☐
 - Period of data retrieved to be displayed in a graphic and text format, with options to scroll through the data and zoom in and out in the graphic display. ☐
- The storage of measured data records shall be done in such a way that the data retrieval process at the station can be done without operator intervention. This means that the messages and data recorded shall be coded in different groups. ☐
- The operator shall have the option to password protect all of the abovementioned data retrieval procedures. ☐

38.8.13 Determination of sampling intervals:

- Procedure:
 - Time Recording:
Sample at set intervals:
Record each sample or average set of samples and store at set intervals. Minimum of 5 seconds and a maximum of 24 hours, for setting of sample and store intervals. ☐
 - Delta recording for water levels:
Compare measured value with previous stored value at set time intervals. If it exceeds the pre-set difference, it must store the value, in addition to the last value. If not, it must ignore the value. Wait for next time interval. ☐

38.8.14 Future Extension:

The Bidder shall make provision in the system to accommodate for future extensions and ensure all future developments to be compatible with the current product for the term of the contract. These developments include Operating Software, Firmware and Hardware extensions. ☐

38.8.15 GSM/GPRS Modem

- Application:

The data-transferring network shall provide the required services for 24 hours per day. The cellular telephone modems shall be GSM type based on a pan-European specification by ETSI. The offered modems must be approved by S.A.T.R.A. (South African Telecommunications Regulatory Authority)

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The GSM Data Logger Telemetry System should provide the user with a simple method of transferring data recorded by field loggers back to a central computer for integration into the Departments software programmes.

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- GSM/GPRS Logger Modem:

- The system should be designed around receiving data from the probe with a sample period of at least 12 minutes.

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- The data should be able to be downloaded at specific user defined time intervals and will be transferred to a control centre using a standard GSM 900/1800MHz modem, in an SMS format.

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- The system should be capable of transferring data at RSSI levels of - 90dBm.

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- The following indications should be available on the front of the unit:

- Power;
- Transmit (TX);
- Receive (RX);
- Link Fail.

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- From the above information it should be possible to determine:

- Power Supply Available;
- Unit Transmitting;
- Unit Receiving;
- Network connection error (e.g. no network, SIM card error)

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- In standard operation the system should be placed in "sleep" mode until the predetermined time when it powers itself up, reads the data from the probe and transmits the data to the control centre.

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- The following protection should be built into the design of the electronic circuit board (PCB)

- Reverse Polarity Protection
- Voltage Clamping
- DC filtering

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- The GSM Logger Unit should control the following aspects using the Short Message Service (SMS) function;

- Interface to Data Logger via RS 232 Interface;
- Read Logged Data at predefined intervals;
- Configuration changes from Control Centre;
- Alarm data - battery low, battery critical;
- RSSI (Radio Signal Strength Indication)

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- The GSM Logger Modem should initiate the following alarms:
 - Power Supply Low Alarm - this alarm will be initiated approximately when the battery shall operate for one week before require charging; ☐
 - Power Supply Critical Alarm - this alarm will be initiated approximately 1 day prior to the battery requiring charging. ☐
 - The unit should also include 2 digital input points, which can be used for monitoring other systems in the vicinity of the unit. ☐
- System Configuration:
 - The operator should be able to configure various parameters of the system as listed below; ☐
 - Updating of main Call Handling Centre number; ☐
 - Control enable/disable alarm conditions; ☐
 - Set status reporting period and time; ☐
 - Graphical representation of data ; ☐
 - Alarm if data not received within 36 hrs; ☐
 - Export Data in predefined formats; ☐
 - Monitor RSSI signal level; ☐
 - Request the retransmission of data from field units; ☐
- Reliability & Maintainability:
 - The field units should be designed to have a Mean Time between Failure (MTBF) of at least 15 000 hours under normal operating conditions. ☐
 - LED's should be used to indicate the operational status of the electronic module, thus aiding the maintenance technician in diagnosing fault conditions. TX, RX, Power ON and Link Fail functions are displayed on the electronic housing. ☐

- Current Consumption:

- The design of the system is critical with regard to the current consumption. The system will operate on a 6V_{DC} supply, which should typically be provided via a 6V, 12A/H Sealed Lead Acid Battery. ☐
- The Current Consumption should be as follows:
 - Standby Current: 1.00mA ☐
 - Transmitting Current: 200mA ☐
- With regard to the above information and assuming one transmission every 24 hours, a standard 6V, 12A/H battery should last 120 days. ☐
- Should the frequency of data transmission increase to every 4 hours the battery should last at least 80 days. ☐

- Antenna Selection:

- Depending on the GSM Network signal strength at the site, several options should exist for obtaining the minimum RSSI value of -90dBm: ☐
- The unit should be offered standard with a 3dBi antenna connected to the unit; ☐
- A 6dBi (bee sting) dipole antenna with a 1m lead should also be offered which could be mounted within the field station to offer a higher sensitivity than the standard integrated antenna. ☐
- In very bad signal strength areas a 12dBi Yagi directional antenna should be offered. This antenna will preferably be mounted external to the station and will be directed to the closest GSM tower. ☐
- A 8dBi Patch antenna should also be offered optional. ☐

38.8.16 Satellite Transmitter:

- Application:

The satellite transmitter system is required at remote stations (where no GSM signal is available) to transmit data to various Offices in the country. ☐

- Design and technical details:

- The equipment shall be designed to operate without degradation under dusty conditions experienced at exposed sites. ☐
- The equipment shall function satisfactorily between -5°C to +50°C. ☐
- The equipment must be compact, robust and corrosion-resistant. ☐
- The system shall comprise of the following components:
 - Satellite transmitter integrated inside a flat antenna. ☐
 - Serial interface for data transmission and control. ☐

The Bidder shall offer any or all other additional components necessary to produce a fully operational data collection and transmission system. ☐

- The transmitter should have the following minimum features:

- Transmitting performance of maximum 10 Watt. ☐
- Power Consumption: ☐

- Stand-by: < 250 μ A
- Active Mode: < 250 mA
- During Transmission: < 4 A
- The flat antenna should preferably not exceed the following dimensions and weight:
 - Dimensions: 600 mm x 600 mm x 150 mm thick;
 - Weight: 7,5 kg.
- A commercially available "Yagi" antenna should be offered as an optional extra.
- The input voltage to the system shall preferably be +12 volt DC.
- Communication between the data logger and the modem must be via a RS 232 port.
- The power supply as specified shall be utilised for the system.

38.8.17 Satellite Operator's Authority:

The Bidder must submit proof from the Satellite Operator of accreditation and authorization to use said satellite system. Proof of satellite and system back-up should also be provided. Failure to submit this certificate will invalidate the Bid.

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38.8.18 Data hosting

- Control Centre:
 - The control centre should be based on a standard Intel computer with a GSM modem connected to it;
 - One computer/control centre should be capable of recording data from up to 500 field units, depending on the GSM Network Service; ☐
 - Providers ability to handle the influx of SMS messages each day. ☐
 - The software will be used to receive the SMS data messages from the field and reconstruct the information for display on the computer and export to other software. ☐
 - The tower will be connected to the LAN via an internal network card to provide access to the data received by authorised users. ☐
- Control Centre Specifications:
 - The Control Centre PC tower will be Windows based with the following minimum specifications:
 - Pentium P4
 - 512 Mb RAM
 - 3.0 GHz Processor
 - 2 x 80 GB SATA Hard Drive
 - CD ROM
 - Onboard Video
 - Integral LAN Card (EEPROM or Realtec Chipset)
 - 9-Pin Serial Port for Use with External GSM Modem☐

39 COMPACT MULTI-CHANNEL DATA LOGGER FOR THE MEASUREMENT OF WEATHER PARAMETERS, WITH INTEGRATED WEATHER SENSORS WITH OPTIONAL DATA TRANSMISSION CAPABILITIES;

39.1 APPLICATION:

39.1.1 This system will consist of a LC Console / Receiver for readings and a separate integrated sensor suite measuring the weather parameters outdoors. ☐

39.1.2 A Data Logger with application software and connection cables will also be offered. ☐

39.1.3 Adequate surge protection will be offered with this equipment. ☐

39.2 DESIGN AND TECHNICAL DETAILS OF CONSOLE AND DATA LOGGER:

39.2.1 The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -10° C to +60° C ☐
 - Operating: -10° C to +70° C ☐
 - Relative humidity: 30% to 95%, Condensing ☐
 - Elevation: 0 - 3 500 m above sea level ☐

39.2.2 The Console will have the following approximate dimensions:

- 250 mm Long x 150 mm High x 40 mm Deep/Thick; ☐
- Backlit LC Display of 150 x 90 mm. ☐

39.2.3 The Console will operate with AC power as standard but should also be able to be operated by commercially available dry alkaline batteries during power failures. ☐

39.2.4 As standard this system will communicate (from the sensors to the console) via a cable of at least 30 m long with an option to order longer lengths. ☐

39.2.5 A wireless system with a transmitter and transceiver, capable of communicating at least 100 m, (Line of Sight) will be offered as an option. ☐

39.2.6 The following parameters/features should be able to be viewed on the LC Display of the Console:

- Compass Rose to view wind direction or wind speed. ☐
- Scalable Graph to view the latest trends of all measured parameters. ☐
- Time & Date. ☐
- Fixed Display area showing the most important weather variables at all times. ☐
- View Daily Rainfall or Rainfall for a specific storm/period. ☐
- View Monthly or Annual Rainfall, Rain Rate, Evapo-transpiration or Rate of Solar Radiation. ☐

- 39.2.7 The data logger shall also be equipped with an easy accessible RS 232 interface for data transmission via a communication facility (Telephone line, Cellular telephone link, Satellite Transmitter or Satellite telephone link) ☐
- 39.2.8 The data logger shall have a user-selectable storage interval, typical 1, 5, 10, 15, 30, 60 or 120 minutes. ☐
- 39.2.9 The Application Software will have the following minimum facilities:
- View all the current conditions immediately. ☐
 - View Graphs on a daily, weekly, monthly or yearly basis. ☐
 - View multiple weather variables at the same time to see their relationship. ☐
 - Be able to create your own reports ☐
- 39.2.10 Additional Console/Receivers to view data in more than one location should be offered additional. ☐
- 39.3 DESIGN AND TECHNICAL DETAILS OF INTEGRATED SENSOR SUITE:
- 39.3.1 The following minimum sensors will be offered standard with the following accuracy, resolution and range:
- Time/Date:
 - Time:
 - Resolution: 1 minute
 - Range: 24 hours
 - Accuracy: 8 seconds/month ☐
 - Date:
 - Resolution: day/month
 - Accuracy: 8 seconds/month ☐
 - Sunrise & Sunset:
 - Resolution: 1 minute ☐
 - Tipping Bucket Rain Gauge:
 - Rainfall:
 - Resolution: 0.2 mm ☐
 - Range:
 - Day: 0 to 9999 mm
 - Month: 0 to 19.999 mm ☐
 - Year: 0 to 19.999 mm
 - Accuracy: 5 % ☐
 - Rainfall Intensity:
 - Resolution: 0.1 mm
 - Range: 0 to 1999.9 mm/hour
 - Accuracy: 5 % ☐

- Wind:
 - Wind Direction:
 - Resolution: 1°
 - Range: 0° - 360°
 - Accuracy: 4°☐
 - Compass Rose:
 - Resolution: 22.5°
 - Range: 16 Compass Points
 - Accuracy: 4°☐
 - Wind Speed:
 - Resolution: 0.1 m/s or 1 km/hr
 - Range: 1 - 67 m/s or 3 - 241 km/hr
 - Accuracy: 5%☐
 - Direction of High Speed:
 - Resolution: 22.5°
 - Range: 16 Compass Points
 - Accuracy: 4°☐
- Humidity:
 - Inside Humidity:
 - Resolution: 1%
 - Range: 10% - 90%
 - Accuracy: 5%☐
 - Outside Humidity:
 - Resolution: 1%
 - Range: 0% - 100%
 - Accuracy: 3%☐
 - Dew Point:
 - Resolution: 1°C
 - Range: -76° to +54°C
 - Accuracy: 1.5°C☐
- Temperature:
 - Inside Temperature:
 - Resolution: 0.1°C
 - Range: 0° - 60°C
 - Accuracy: 0.5°C☐
 - Outside Temperature:
 - Resolution: 1°C
 - Range: -40° to +65°C
 - Accuracy: 0.5°C☐

- Soil or Water Temperature:
 - Resolution: 1°C
 - Range: -40° to +65°C
 - Accuracy: 0.5°C☐
- Outside Temperature / Humidity Index:
 - Resolution: 1°C
 - Range: -40° to +57°C
 - Accuracy: 1.5°C☐
- Temperature / Humidity / Sun / Wind Index:
 - Resolution: 1°C
 - Range: -68° to +64°C
 - Accuracy: 2°C☐
- Wind Chill:
 - Resolution: 1°C
 - Range: -79° to +54°C
 - Accuracy: 1°C
 -☐

39.3.2 The following additional sensors will be offered with the following accuracy, resolution and range:

- Barometric Pressure:
 - Resolution: 0.1mm Hg
 - Range: 660 to 810 mm Hg
 - Accuracy: 0.8 mm Hg☐
- Solar & UV:
 - Solar Radiation:
 - Resolution: 1 W/m²
 - Range: 0 - 1 800 W/m²
 - Accuracy: 5%☐
 - Solar Energy:
 - Resolution: 0.1 Ly
 - Range: 1 999.9 Ly
 - Accuracy: 5%☐
 - UV Dose:
 - Resolution: 0.1 MED's
 - Range: 0 - 199 MED's
 - Accuracy: 5%☐
 - UV Index:
 - Resolution: 0.1
 - Range: 0 - 16
 - Accuracy: 5%☐

- Agricultural:

- Evapo-transpiration:

- Resolution: 0.1 mm ☐
- Range:
 - Day: To 999.9 mm
 - Month: To 1 999.9 mm ☐
 - Year: To 1 999.9 mm
- Accuracy: 5% ☐

- Growing Degree-Days:

- Resolution: 0.1 Degree-Day ☐
- Range: Unlimited

- Leaf Wetness:

- Resolution: 1
- Range: 0 - 15 ☐
- Accuracy: 0.5

- Soil Moisture:

- Resolution: 1 cb
- Range: 0 - 200 cb ☐

40 MULTI-CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE TRANSDUCER AND WATER VELOCITY MEASUREMENT FOR USE IN LARGE STREAMS;

40.1 APPLICATION:

40.1.1 The data logger will be mounted on the side of the river, channel or canal and should make use of the "Doppler Sonar" method to determine the water velocity and depth. ☐

40.1.2 The data logger will have an integrated pressure transducer to measure depths of water up to a maximum of 15 metres. ☐

40.2 DESIGN AND TECHNICAL DETAILS:

40.2.1 The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -10° C to +60° C ☐
 - Operating: -5° C to +40° C ☐

40.2.2 The data logger must be powered by direct current of 12 V and have a low power consumption of less than 2.0 Watt. ☐

40.2.3 An external battery pack for autonomous operation must be offered optional. ☐

40.2.4 The instrument must be able to measure water velocities of up to 5 m/s with a resolution of at least 1 cm/s and an accuracy of at least 1% of the measured velocity. ☐

40.2.5 A RS 232 communication protocol should be a standard feature or USB connection. ☐

40.2.6 The data logger shall have an internal memory of a minimum of 2 Mb to provide up to at least 100 000 samples. ☐

40.2.7 A larger memory of at least 4 Mb will be offered optional. ☐

40.2.8 The instrument should not exceed the following dimensions and weight:

- Dimensions: 400 mm Long x 250 mm High x 200 mm Deep; ☐
- Weight: 7.5 kg. ☐

40.2.9 The measuring unit shall have 2-beams (horizontal) for the measurement of 2D water velocities. ☐

40.2.10 The measuring unit shall have a measuring range of at least 2 m – 100 m. ☐

41 MULTI-CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE TRANSDUCER AND WATER VELOCITY MEASUREMENT FOR USE IN MEDIUM STREAMS;

41.1 APPLICATION:

41.1.1 The data logger will be mounted on the side of the river, channel or canal and should make use of the "Doppler Sonar" method to determine the water velocity and depth. ☐

41.1.2 The data logger will have an integrated pressure transducer to measure depths of water up to a maximum of 8 metres. ☐

41.2 DESIGN AND TECHNICAL DETAILS:

41.2.1 The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -10° C to +60° C ☐
 - Operating: -5° C to +40° C ☐

41.2.2 The data logger must be powered by direct current of 12 V and have a low power consumption of less than 2.0 Watt. ☐

41.2.3 An external battery pack for autonomous operation must be offered optional. ☐

41.2.4 The instrument must be able to measure water velocities of up to 5 m/s with a resolution of at least 1 cm/s and an accuracy of at least 1% of the measured velocity. ☐

41.2.5 A RS 232 communication protocol should be a standard feature or USB connection. ☐

41.2.6 The data logger shall have an internal memory of a minimum of 2 Mb to provide up to at least 100 000 samples. ☐

41.2.7 A larger memory of at least 4 Mb will be offered optional. ☐

41.2.8 The instrument should not exceed the following dimensions and weight:

- Dimensions: 300 mm Long x 200 mm High x 100 mm Deep; ☐
- Weight: 6 kg. ☐

41.2.9 The measuring unit shall have 2-beams (horizontal) for the measurement of 2D water velocities. ☐

41.2.10 The measuring unit shall have a measuring range of at least 0.5m – 15 m. ☐

42 MULTI-CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE TRANSDUCER AND WATER VELOCITY MEASUREMENT FOR USE IN SMALL STREAMS;

42.1 APPLICATION:

42.1.1 The data logger will be mounted on the side of the river, channel or canal and should make use of the "Doppler Sonar" method to determine the water velocity and depth. ☐

42.1.2 The data logger will have an integrated pressure transducer to measure depths of water up to a maximum of 5 metres. ☐

42.2 DESIGN AND TECHNICAL DETAILS:

42.2.1 The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:
 - Storage: -10° C to +60° C ☐
 - Operating: -5° C to +40° C ☐

42.2.2 The data logger must be powered by direct current of 12 V and have a low power consumption of less than 2.0 Watt. ☐

42.2.3 An external battery pack for autonomous operation must be offered optional. ☐

42.2.4 The instrument must be able to measure water velocities of up to 5 m/s with a resolution of at least 1 cm/s and an accuracy of at least 1% of the measured velocity. ☐

42.2.5 A RS 232 communication protocol should be a standard feature or USB connection. ☐

42.2.6 The data logger shall have an internal memory of a minimum of 2 Mb to provide up to at least 100 000 samples. ☐

42.2.7 A larger memory of at least 4 Mb will be offered optional. ☐

42.2.8 The instrument should not exceed the following dimensions and weight:

- Dimensions: 300 mm Long x 100 mm High x 75 mm Deep; ☐
- Weight: 3 kg. ☐

42.2.9 The measuring unit shall have 2-beams (horizontal) for the measurement of 2D water velocities. ☐

42.2.10 The measuring unit shall have a measuring range of at least 0.2m – 4 m. ☐

43 MULTI-CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE TRANSDUCER AND WATER VELOCITY MEASUREMENT FOR USE IN SHALLOW STREAMS;

43.1 APPLICATION:

43.1.1 The data logger will be mounted on the bottom of the stream, channel, canal or pipe (full or partially full) and should make use of the "Doppler Sonar" method to determine the water velocity.

☐

43.1.2 The data logger will have an integrated pressure transducer to measure depths of water between 0.250 m and 5.000 m.

☐

43.2 DESIGN AND TECHNICAL DETAILS:

43.2.1 The equipment shall be designed to function satisfactorily under the following conditions:

- Temperature range:

-	Storage:	-10° C to +50° C	☐
-	Operating:	-5° C to +40° C	

43.2.2 The data logger must be powered by direct current of 12 V and have a low power consumption of less than 650 mW.

☐

43.2.3 The instrument must be able to measure water velocities of up to 5 m/s with a resolution of at least 1 cm/s and an accuracy of at least 1% of the measured velocity.

☐

43.2.4 A RS 232 communication protocol should be a standard feature.

☐

43.2.5 The data logger shall have an internal memory of a minimum of 3 Mb to provide up to at least 50 000 samples.

☐

43.2.6 The instrument should not exceed the following dimensions and weight:

• Dimensions:	250 mm Long x 100 mm wide x 75 mm Deep;	☐
• Weight:	1.5 kg.	☐

43.2.7 The measuring unit shall have at least 5-beams; 1-beam for vertical depth measurement and the other 4-beams for velocity measurements.

☐

43.2.8 The measuring unit shall have a measuring range of at least 0.3 m - 5 m.

☐

43.2.9 The data logger must have flow algorithms for open channels or closed pipes

☐

43.2.10 A LCD display capable of connecting to the data logger could be specified as an accessory.

☐

43.2.11 A standard feature must include all necessary cables, mounting bracket and software.

☐

43.2.12 All equipment should be packed in suitable robust instrument carry case.

☐

44 GSM / GPRS CELLULAR TELEPHONE MODEM;

44.1 APPLICATION

44.1.1 The modem must be a rugged cellular Plug and Play Wireless CPU offering state-of-the-art GSM/GPRS connectivity for machine to machine applications. The product must be reliable, stable performance on wireless networks in southern hemisphere. The offered modems must be approved by ICASA (Independent Communication Authority of South Africa).

☐

44.1.2 This Item could also be offered as an Accessory together with any of the Data Loggers on condition that the specifications below are adhered to and completed.

☐

44.2 DESIGN AND TECHNICAL DETAILS

44.2.1 The modems shall comprise of the following components:

- GSM transceiver;
- Serial interface for data transmission and control;
- External antenna and audio signals.

☐☐☐

44.2.2 The identity cards used on the terminal must be the plug-in type SIM cards.

☐

44.2.3 The module shall offer a transparent data transmission at 2 400, 4 800 9 600 and 14400 bits per second.

☐

44.2.4 The module shall support the following transmissions

- Data;
- Fax;
- Short messages (point to point and Cell Broadcast);
- Voice calls.

☐☐☐☐

44.2.5 The housing must be a robust and compact unit bundled with a GSM card holder;

☐

44.2.6 Operating temperature range to be at least between -10°C to +50°C

☐

44.2.7 Memory:

Flash and SRAM

☐

44.2.8 The input voltage to the module shall preferably be between +5 to +32 volt DC.

☐

44.2.9 The nominal voltage should not exceed 13.3 volt DC.

☐

44.2.10 The input current should not exceed 500 mA

☐

44.2.11 V24 Interface:

- Logic: V24 asynchronous ☐
- Baud Rates: 2400 to 19200 baud, auto ☐
- Parity: None ☐
- Character Format: 8 Data Bits ☐
- Stop Bits: 1 ☐

44.2.12 GSM Module Data:

- GSM Rec.: E-GSM compliant; ☐
- Info transfer mode: 3.1 kHz (PSTN) / V.110 (ISDN) ☐
- Clock mode: Real Time; ☐
- Connection element: Transparent and Non Transparent; ☐
- Layer 2 Protocol: NAV; ☐
- Data bits: 8; ☐
- Parity bits: None; ☐
- Stop bits: 1; ☐
- Radio Channel: Full rate; ☐
- User Rate: 2 400, 4 800 or 9 600 bit/s. ☐

44.2.13 Communication between the data logger and the modem must be via a RS 232 port. ☐

44.2.14 The mass of the unit should not exceed 120g ☐

44.2.15 The dimensions of the unit should preferably not exceed: 110 mm Wide x 60 mm Deep x 30 mm High ☐

44.2.16 The enclosure should preferably be manufactured from aluminium profile, or better ☐

SENSORS - DETAIL SPECIFICATIONS:

45 SCOPE

This part of the specification covers the detail requirements for all the different types of sensors as set out in Paragraph 1.3. These sensors will be connected to the various data loggers as set out in Paragraphs 13 - 17 and should have an adequate output signal and interfacing as discussed in those Paragraphs. Sensors with separate data loggers could be considered.

- 45.1 The equipment will also be utilised at remote measuring stations to collect data, mainly hydrological and meteorological data. Operation will be in a totally unattended mode, with inspections by staff on a 7 to 60 day cycle.
- 45.2 The equipment will be mounted in their respective positions for best results, ie. On masts, on recorder huts, in streams, etc., and will be subjected to a harsh environment.
- 45.3 Only high quality equipment capable of offering extended service under arduous conditions on unmanned sites shall be offered.

46 SHAFT ENCODER

46.1 APPLICATION:

46.1.1 The shaft encoder will operate with a float and counterweight system.

☐

46.1.2 The shaft encoder must preferably have a standard resolution of 1mm or 1cm and must preferably be capable of measuring water levels from 0 - 30m (mm or cm resolution). Desired resolution must be able to be scaled by the user.

☐

46.2 DESIGN AND TECHNICAL DETAILS:

46.2.1 The shaft encoder must be compact, robust and corrosion-resistant.

☐

46.2.2 Power supply to shaft encoder must be between 9 – 30 Volts direct current.

☐

46.2.3 The shaft encoder unit must have RS 232 and/or SDI 12 interface output, so that it could be connected directly to a data logger.

☐

46.2.4 The sense of rotation must be able to be selected by the user for left- or right hand rising.

☐

46.2.5 The shaft encoder must be able to process an extremely high rotation speed. At least 1m rise or fall in 20 seconds, or better.

☐

46.2.6 The pulley of the shaft encoder must be able to accommodate 1 mm Ø float cable.

☐

46.2.7 The float cable must not slip on the encoder pulley.

☐

46.2.8 A corrosion-resistant bracket for stand-alone operation must be available.

☐

47 PRESSURE TRANSDUCER FOR WATER LEVEL MEASUREMENT USING THE “CAPACITIVE CERAMIC” METHOD WITH 1 – 5 V OR 4 – 20 MA OUTPUT SIGNAL;

47.1 APPLICATION:

- 47.1.1 Pressure transducers must be capable of measuring water levels from 0 - 100 m, the range of each transducer being determined by the Employer and pre-set in the factory. Typical ranges could be: 0 - 5 m; 0 - 10,00 m; 0 - 20,00 m, 0 - 40,00 m and >40 m on request. ☐
- 47.1.2 The pressure transducers must have a high reliability and ensure a large range of application for pressure measurement in all fields of water level measurement. ☐
- 47.1.3 Transducers must be suitably protected against lightning, and the necessary test results must be available on request of the Engineer. ☐

47.2 DESIGN AND TECHNICAL DETAILS:

47.2.1 Transducer housing:

- The transducer housing must be robust, corrosion-resistant, insensitive to impact and vibration and watertight up to at least 40 m of water column. (>40 m on request). ☐
- ☐
- The transducer housing shall preferably not exceed the following dimensions and weight:
- - Length: 150 mm; ☐
 - Diameter: 40 mm; ☐
 - Weight: 500g. ☐
- The transducer housing can be fitted with a watertight plug for connection to the transducer cable. ☐

47.2.2 Pressure sensor:

- The measuring cell must be chemically and thermally resistant. ☐
- The pressure measuring cell must operate, using the capacitive ceramic method. ☐
- The pressure sensor shall be designed and calibrated to function satisfactorily under the following:
 - Temperature range: -10°C to +50°C ☐
- The pressure sensor shall have a built-in temperature compensator. ☐

47.2.3 Transducer cable:

The transducer cable must have the following characteristics:

- Flexible and have at least a double sheathing with interposed tinned copper-braiding, or better, with an outer diameter of not more than 10 mm; ☐
- As the transducer cable shall be used as the carrying rope, it shall preferably feature, for longitudinal stability, an internal kevlar core assembly, or equivalent. ☐
- A polyamide pressure-compensation capillary tube for measuring the reference pressure, with an inside diameter of preferably 3 mm, but not less than 1,0 mm. ☐

- End of cable connected by terminal box with additional Teflon coated filters and exchangeable humidity absorber. ☐
- A fixing clamp for exact positioning of the pressure probe in a stilling well or tube must be available, manufactured of non-corrosive material. ☐
- The pressure transducer and transducer cable shall be designed to function satisfactorily with a cable length of 250 m. ☐
- The transducer cable must be provided with a watertight plug for connection to the transducer housing. ☐

47.2.4 Temperature sensor:

- The pressure transducer should preferably have an integrated temperature sensor, preferably of the platinum resistor type. The sensitivity of the measuring element shall be approximately 0,1 °C between a temperature range of at least -5°C to +40°C. ☐

47.2.5 Output signal:

- The voltage output signal for each measuring range should be: 0 to 10 V or 4-20mA. ☐

47.2.6 Measuring accuracy:

- The overall measuring accuracy of the pressure transducer must be better than, or equal to 0,1 % of the full scale. ☐

47.3 HUMIDITY ABSORBER AND PRESSURE COMPENSATION:

47.3.1 The capillary tube in the probe cable is intended to vent the measuring cell to atmospheric pressure. In order to avoid humid air passing along this capillary tube, it is necessary to remove moisture at the vented side. This should preferably be done in a humidity absorber housing using silica gel crystals. The humidity absorber housing should preferably also house the connecting block for the power and signal cables between the data logger and pressure sensor. ☐

47.3.2 The pressure compensation box should be compact, wall mountable, provide easy access for the changing of the desiccant silica gel cartridge. ☐

47.3.3 The pressure compensation box must preferably also consist of the following:

- Two screw and clamping connections with core-end sleeves for:
 - Pressure probe cable, and ☐
 - Data line for the transfer of measured values to the data logger. ☐

48 PRESSURE TRANSDUCER FOR WATER LEVEL MEASUREMENT USING THE “CAPACITIVE CERAMIC” METHOD WITH SDI12 INTERFACE OR 4 – 20 MA OR RS485 OUTPUT SIGNAL;

48.1 APPLICATION:

- 48.1.1 Pressure transducers must be capable of measuring water levels from 0 - 100 m, the range of each transducer being determined by the Employer and pre-set in the factory. Typical ranges could be: 0 - 5 m; 0 - 10,00 m; 0 - 20,00 m, 0 - 40,00 m and >40 m on request. ☐
- 48.1.2 The pressure transducers must have a high reliability and ensure a large range of application for pressure measurement in all fields of water level measurement. ☐
- 48.1.3 Transducers must be suitably protected against lightning, and the necessary test results must be available on request of the Engineer. ☐

48.2 DESIGN AND TECHNICAL DETAILS:

48.2.1 Transducer housing:

- The transducer housing must be robust, corrosion-resistant, insensitive to impact and vibration and watertight up to at least 100 m of water column. ☐
- The transducer housing shall preferably not exceed the following dimensions and weight:
 - Length: 200 mm; ☐
 - Diameter: 25 mm; ☐
 - Weight: 300g. ☐
- The transducer housing can be fitted with a watertight plug for connection to the transducer cable. ☐

48.2.2 Pressure sensor:

- The measuring cell must be chemically and thermically resistant. ☐
- The pressure measuring cell must operate, using the capacitive ceramic method. ☐
- The pressure sensor shall be designed and calibrated to function satisfactorily under the following:
 - Temperature range: -10°C to +50°C ☐
- The pressure sensor shall have a built-in temperature compensator. ☐

48.2.3 Transducer cable:

- The transducer cable must have the following characteristics:
 - Flexible and have at least a double sheathing around 6 conductors with interposed tinned copper- braiding, or better, with an outer diameter of not more than 10 mm; ☐
 - As the transducer cable shall be used as the carrying rope, it shall preferably feature, for longitudinal stability, an internal Kevlar core assembly, or equivalent. ☐
 - Nylon, Etfе extrusion tube, or better should be offered for measuring the reference pressure. The vent tube should preferably have a minimum inner diameter of 1,0 mm and an outer diameter of not more than 2,5 mm. ☐
 - End of cable connected by terminal box with additional Teflon coated filters and exchangeable humidity absorber. ☐
 - A fixing clamp for exact positioning of the pressure probe in a stilling well or tube must be available, manufactured of non-corrosive material. ☐
 - The pressure transducer and transducer cable shall be designed to function satisfactorily with a cable length of 200 m in fresh water with dissolved mineral content or salt water with contaminants. The cable and the connector/s will be 100 % watertight in a water column of 200 m. ☐

48.2.4 Temperature sensor:

- The pressure transducer should preferably have an integrated temperature sensor, preferably of the platinum resistor type. The sensitivity of the measuring element shall be approximately 0,15 °C between a temperature range of at least -15°C to +60°C. ☐

48.2.5 Output signal:

- The voltage output signal for each measuring range should be: 4 - 20 mA or SDI 12 Interface. ☐
- When using the SDI 12 interface, the water temperature should also be able to be recorded. ☐

48.2.6 Measuring accuracy:

- The overall measuring accuracy of the pressure transducer must be better than, or equal to 0,05 % of the full scale. ☐

48.3 HUMIDITY ABSORBER AND PRESSURE COMPENSATION:

- 48.3.1 The capillary tube in the probe cable is intended to vent the measuring cell to atmospheric pressure. In order to avoid humid air passing along this capillary tube, it is necessary to remove moisture at the vented side. This should preferably be done in a humidity absorber housing using silica gel crystals. The humidity absorber housing should preferably also house the connecting block for the power and signal cables between the data logger and pressure sensor. ☐
- 48.3.2 The pressure compensation box should be compact, wall mountable, provide easy access for the changing of the desiccant silica gel cartridge. ☐
- 48.3.3 The pressure compensation box must preferably also consist of the following:
- Two screw and clamping connections with core-end sleeves for:
 - Pressure probe cable, and ☐
 - Data line for the transfer of measured values to the data logger. ☐
 - A transparent sealing cover, to inspect/change the cartridge. ☐
- 48.3.4 The silica gel must preferably be treated with a colour indicator, which changes when saturation occurs. ☐
- 48.3.5 The saturated silica gel should preferably be housed such that it can be dried by baking and be re-usable. ☐
- 48.3.6 The operational system shall be designed to function satisfactorily with a data cable length of 500 m (4 – 20 mA) and 100 m (SDI 12). ☐

49 PRESSURE TRANSDUCER FOR WATER LEVEL MEASUREMENT USING THE “PIEZO-RESISTIVE” METHOD (STAINLESS STEEL SENSOR) WITH 1 – 5 V OR 4 – 20 MA OUTPUT SIGNAL;

49.1 APPLICATION:

- 49.1.1 Pressure transducers must be capable of measuring water levels from 0 -100 m, the range of each transducer being determined by the Employer and pre-set in the factory. Typical ranges could be: 0 - 5 m; 0 - 10,00 m; 0 - 20,00 m, 0 - 40,00 m and >40 m on request. ☐
- 49.1.2 The pressure transducers must have a high reliability and ensure a large range of application for pressure measurement in all fields of water level measurement. ☐
- 49.1.3 Transducers must be suitably protected against lightning, and the necessary test results must be available on request of the Engineer. ☐

49.2 DESIGN AND TECHNICAL DETAILS:

49.2.1 Transducer housing:

- The transducer housing must be robust, corrosion-resistant, insensitive to impact and vibration and watertight up to at least 40 m of water column. (>40 m on request) ☐
- The transducer housing shall preferably not exceed the following dimensions and weight:
 - Length - 300 mm
 - Diameter - 50 mm
 - Weight - 1 kg☐
- The transducer housing can be fitted with a watertight plug for connection to the transducer cable. ☐

49.2.2 Pressure sensor:

- The measuring cell must be chemically and thermically resistant. ☐
- The pressure measuring cell must operate, using the piezo-resistive method. ☐
- The pressure sensor shall be designed and calibrated to function satisfactorily under the following:
 - Temperature range: -5°C to +45°C ☐
- The pressure sensor shall have a built-in temperature compensator. ☐

49.2.3 Transducer cable:

The transducer cable must have the following characteristics:

- Flexible and have at least a double sheathing with interposed tinned copper-braiding, or better, with an outer diameter of not more than 12 mm; ☐
- As the transducer cable shall be used as the carrying rope, it shall preferably feature, for longitudinal stability, an internal kevlar core assembly, or equivalent. ☐
- A polyamide pressure-compensation capillary tube for measuring the reference pressure, with an inside diameter of preferably 3 mm, but not less than 1,0 mm. ☐
- End of cable connected by terminal box with additional Teflon coated filters and exchangeable humidity absorber. ☐

- A fixing clamp for exact positioning of the pressure probe in a stilling well or tube must be available, manufactured of noncorrosive material. ☐
- The pressure transducer and transducer cable shall be designed to function satisfactorily with a cable length of 250 m. ☐
- The transducer cable must be provided with a watertight plug for connection to the transducer housing. ☐

49.2.4 Temperature sensor:

- The pressure transducer should preferably have an integrated temperature sensor, preferably of the platinum resistor type. The sensitivity of the measuring element shall be approximately 0,1 °C between a temperature range of at least -5°C to +40°C. ☐

49.2.5 Output signal:

- The voltage output signal for each measuring range should be: 1 to 5 V or 4 - 20 mA. ☐

49.2.6 Measuring accuracy:

- The overall measuring accuracy of the pressure transducer must be better than, or equal to 0,1 % of the full scale. ☐

49.3 HUMIDITY ABSORBER AND PRESSURE COMPENSATION:

49.3.1 The capillary tube in the probe cable is intended to vent the measuring cell to atmospheric pressure. In order to avoid humid air passing along this capillary tube, it is necessary to remove moisture at the vented side. This should preferably be done in a humidity absorber housing using silica gel crystals. The humidity absorber housing should preferably also house the connecting block for the power and signal cables between the data logger and pressure sensor. ☐

49.3.2 The pressure compensation box should be compact, wall mountable, provide easy access for the changing of the desiccant silica gel cartridge. ☐

49.3.3 The pressure compensation box must preferably also consist of the following:

- Two screw and clamping connections with core-end sleeves for:
 - Pressure probe cable, and ☐
 - Data line for the transfer of measured values to the datalogger. ☐
- A transparent sealing cover, to inspect/change the cartridge. ☐

49.3.4 The silica gel must preferably be treated with a colour indicator, which changes when saturation occurs. ☐

49.3.5 The saturated silica gel should preferably be housed such that it can be dried by baking and be re-usable. ☐

49.3.6 The operational system shall be designed to function satisfactorily with a data cable length of 250 m. ☐

50 PRESSURE TRANSDUCER FOR WATER LEVEL MEASUREMENT USING THE “PIEZO-RESISTIVE” METHOD WITH 4 - 20 MA OUTPUT SIGNAL OR SDI 12 INTERFACE;

50.1 APPLICATION:

- 50.1.1 Pressure transducers must be capable of measuring water levels from 0 - 100 m, the range of each transducer being determined by the Employer and pre-set in the factory. Typical ranges could be: 0 - 5 m; 0 - 10,00 m; 0 - 20,00 m, 0 - 40,00 m and >40 m on request. ☐
- 50.1.2 The pressure transducers must have a high reliability and ensure a large range of application for pressure measurement in all fields of water level measurement. ☐
- 50.1.3 Transducers must be suitably protected against lightning, and the necessary test results must be available on request of the Engineer. ☐

50.2 DESIGN AND TECHNICAL DETAILS:

50.2.1 Transducer housing:

- The transducer housing must be robust, corrosion-resistant, insensitive to impact and vibration and watertight up to at least 100 m of water column. ☐
- The transducer housing shall preferably not exceed the following dimensions and weight:
 - Length: 200 mm; ☐
 - Diameter: 25 mm; ☐
 - Weight: 300g. ☐
- The transducer housing can be fitted with a watertight plug for connection to the transducer cable. ☐

50.2.2 Pressure sensor:

- The measuring cell must be chemically and thermically resistant. ☐
- The pressure measuring cell must operate, using the piezo-resistive method. ☐
- The pressure sensor shall be designed and calibrated to function satisfactorily under the following:
 - Temperature range: -10°C to +50°C ☐
- The pressure sensor shall have a built-in temperature compensator. ☐

50.2.3 Transducer cable:

- The transducer cable must have the following characteristics:
 - Flexible and have at least a double sheathing around 6 conductors with interposed tinned copper- braiding, or better, with an outer diameter of not more than 10 mm; ☐
 - As the transducer cable shall be used as the carrying rope, it shall preferably feature, for longitudinal stability, an internal kevlar core assembly, or equivalent. ☐
 - Nylon, Ete extrusion tube, or better should be offered for measuring the reference pressure. The vent tube should preferably have a minimum inner diameter of 1,0 mm and an outer diameter of not more than 2,5 mm. ☐
 - End of cable connected by terminal box with additional Teflon coated filters and exchangeable humidity absorber. ☐
 - A fixing clamp for exact positioning of the pressure probe in a stilling well or tube must be available, manufactured of non-corrosive material. ☐
 - The pressure transducer and transducer cable shall be designed to function satisfactorily with a cable length of 200 m in fresh water with dissolved mineral content or salt water with contaminants. The cable and the connector/s will be 100 % watertight in a water column of 200 m. ☐

50.2.4 Temperature sensor:

- The pressure transducer should preferably have an integrated temperature sensor, preferably of the platinum resistor type. The sensitivity of the measuring element shall be approximately 0,15 °C between a temperature range of at least -15°C to +60°C. ☐

50.2.5 Output signal:

- The voltage output signal for each measuring range should be: 4 - 20 mA or SDI 12 Interface. ☐
- When using the SDI 12 interface, the water temperature should also be able to be recorded. ☐

50.2.6 Measuring accuracy:

- The overall measuring accuracy of the pressure transducer must be better than, or equal to 0,05 % of the full scale. ☐

50.3 HUMIDITY ABSORBER AND PRESSURE COMPENSATION:

- 50.3.1 The capillary tube in the probe cable is intended to vent the measuring cell to atmospheric pressure. In order to avoid humid air passing along this capillary tube, it is necessary to remove moisture at the vented side. This should preferably be done in a humidity absorber housing using silica gel crystals. The humidity absorber housing should preferably also house the connecting block for the power and signal cables between the data logger and pressure sensor. ☐
- 50.3.2 The pressure compensation box should be compact, wall mountable, provide easy access for the changing of the desiccant silica gel cartridge. ☐
- 50.3.3 The pressure compensation box must preferably also consist of the following:
- Two screw and clamping connections with core-end sleeves for:
 - Pressure probe cable, and ☐
 - Data line for the transfer of measured values to the data logger. ☐
 - A transparent sealing cover, to inspect/change the cartridge. ☐
- 50.3.4 The silica gel must preferably be treated with a colour indicator, which changes when saturation occurs. ☐
- 50.3.5 The saturated silica gel should preferably be housed such that it can be dried by baking and be re-usable. ☐
- 50.3.6 The operational system shall be designed to function satisfactorily with a data cable length of 500 m (4 – 20 mA) and 100 m (SDI 12). ☐

51 BUBBLE SENSOR FOR WATER LEVEL MEASUREMENT;

51.1 APPLICATION:

- 51.1.1 This sensor will output water level by means of indirect pressure measurements with no electrical components installed in water. ☐
- 51.1.2 The unit must be able to measure up to 30 m of water depth. ☐
- 51.1.3 A Housing for the unit will be standard and should not exceed the following dimensions:
- Length: 205 mm;
 - Height: 165 mm;
 - Depth: 115 mm. ☐
- 51.1.4 The unit will use standard communication protocols and outputs, so that it could be connected directly to a data logger all settings made via DIP switches on the unit.
- Power supply to the unit must be between 10 – 30 Volts direct current. ☐
 - The output signal should be: 4 - 20 mA and/or SDI 12 Interface. ☐

51.2 DESIGN AND TECHNICAL DETAILS:

51.2.1 Compressor:

- The compressor for generating air bubbles should be a built-in feature of the unit. ☐
- The compressed air should preferably be generated by a maintenance free piston-pump using the indirect bubble-in principle – no system, using an external compressor or external gas bottles, will be considered. ☐

51.2.2 Bubble chamber:

- The bubble chamber must be robust, corrosion-resistant and insensitive to impact and vibration. ☐
- The bubble chamber must be fitted with an easy push-on connector for the measuring tube. ☐
- The bubble chamber will preferably be a screw-on type, suitable for at least a 25 mm Ø protection tube ☐

51.2.3 Measuring Tube:

- The measuring tube should preferably be flexible and manufactured of age-resistant pvc material. ☐
- The measuring tube should preferably not exceed an outer diameter of 4mm. ☐
- Together with the measuring tube, a suitable non-stretch, age resistant rope, for fixing the bubble chamber in wells, must be available. ☐

51.3 ADDITIONAL EQUIPMENT:

- 51.3.1 All replacement spares and accessories, needed for complete installation should be listed under "Accessories" in the Price Schedule. ☐

52 RADAR SENSOR FOR WATER LEVEL MEASUREMENT;

52.1 APPLICATION:

Non-contact water level measurement, radar sensor must be capable of measuring water levels from at least 1 m – 30 m, from the point of installation to the water level. This sensor will mainly be used where the water surface fluctuates a lot, where lots of silt occurs and where lots of debris is swept downstream during floods.

The sensor must be suitably protected against lightning.

52.2 DESIGN AND TECHNICAL DETAILS:

52.2.1 Sensor housing:

- The sensor housing must be robust, corrosion resistant, UV resistant, insensitive to vibration and be water and dust protected to comply with IP68 rating. ☐
- The sensor housing shall preferably not exceed the following dimensions and weight:
 - Height: 200 mm; ☐
 - Weight: 2 kg ☐
- The sensor housing must be fitted with a watertight plug for connection to the data transmission cable. ☐

52.2.2 Measuring Sensor:

- The sensor shall be designed to function satisfactorily under the following:
 - Temperature range: -10°C to +60°C ☐
- The sensor must preferably have a standard resolution of 1 mm and an accuracy of 10 mm, or better, over the full measuring range. ☐
- The sensor should have a measuring interval of at least 60 seconds. ☐

52.2.3 Data transmission cable:

- The data transmission cable should function satisfactorily with a cable length of up to 1000 m. ☐
- The outer diameter of the cable should preferably not exceed 8 mm. ☐

52.2.4 Power Supply:

- The power supply for the sensor should be from 10 - 28 volt. ☐
- The power consumption of the sensor should preferably not exceed 15 mA during measurement mode, and not exceed 0.05 mA during standby mode. ☐

52.2.5 Output Signal:

- The output signal of the sensor should preferably be transmitted via 4 - 20 mA and/or SDI 12 Interface or with RS 485 using SDI 12 protocol. ☐

52.3 ADDITIONAL EQUIPMENT:

- 52.3.1 All replacement spares and accessories like mounting plates and brackets needed for complete installation should be listed under "Accessories" in the Price Schedule. ☐

53 LASER SENSOR FOR WATER LEVEL MEASUREMENT;

53.1 APPLICATION:

The Laser sensor must be capable of measuring water levels from at least 0.3 m-50 m, from the point of installation to the water level. This sensor will mainly be used to measure the distance to solid surfaces, slurries or murky water where the water surface fluctuates a lot, where lots of silt occurs and where lots of debris is swept downstream during floods.

The sensor must also be able to measure distance for gate opening applications with laser point technology

53.2 DESIGN AND TECHNICAL DETAILS:

53.2.1 Sensor housing:

- The sensor housing must be robust, corrosion resistant, UV resistant, insensitive to vibration and be water and dust protected to comply with rating IP68, as defined in IEC144. ☐
- ☐
- The sensor housing shall preferably not exceed the following dimensions and weight:
 - Height: 150 mm; ☐
 - Weight: 1 kg. ☐
- The sensor housing must be fitted with a watertight plug for connection to the data transmission cable. ☐
- The sensor housing must be 303 Stainless Steel. ☐
- The sensor must be suitably protected against lightning. ☐

53.2.2 Measuring Sensor:

- The sensor must preferably have a standard resolution of 1 cm or better, over the full measuring range. ☐
- The sensor should have a measuring interval of at least 5 readings per second. ☐

53.2.3 Environmental Data:

- The sensor shall be designed to function satisfactorily under the following:
 - Temperature range: -20°C to +60°C ☐
- The sensor shall have a beam divergence of < 1° to half power points. ☐
- The sensor shall have Atmospheric pressure Compensation and have an IP 66 rating. ☐

53.2.4 Data transmission cable:

- The data transmission cable should function satisfactorily with a cable length of preferably 100 m. ☐
- The outer diameter of the cable should preferably not exceed 10 mm. ☐

53.2.5 Power Supply:

- The power supply for the sensor should be 24 V_{DC} nominal (12 ... 28 V_{DC}); ☐

- The power consumption of the sensor should preferably not exceed 100 mA nominal during measurement mode

☐

53.2.6 Output Signal:

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- The output signal of the sensor should preferably be transmitted 4- 20 mA compliant self-powered & non-isolated relays

53.2.7 Communication:

- The Communication should be USB at 115200 baud 8-N-1.

☐

54 ULTRASONIC SENSOR FOR FLOW MEASUREMENT;

54.1 APPLICATION:

The sensor will be used for the monitoring of flow volumes for dam balance purposes on releases at reservoirs

54.2 DESIGN AND TECHNICAL DETAILS:

54.2.1 Sensor Features:

- Non-intrusive flow measurement with high measuring accuracy for stationary use. ☐
- Precise bi-directional, highly dynamic flow measurement. ☐
- Water-tight transducers (IP67) are characterized by high robustness. ☐
- Simple retrofitting of measurements in existing networks and systems without interrupting the supply or the need for pipe work. ☐
- For inner pipe diameters of 10...2500 mm ☐
- User-friendly menu navigation - the firmware is specifically adapted to the needs of the water industry ☐

54.2.2 Operator interface:

The data logger shall be provided with the following minimum **built-in** facilities, to be used by operating and maintenance staff:

- A LCD unit, capable of displaying the full ASCII character set. ☐
- A keyboard that would allow the operator to enter parameters, generally interrogate the data logger and preferably, to enter messages. The keyboard shall comply with the following requirements: ☐
 - The construction shall be preferably of the waterproofed, membrane type. ☐
 - Keys providing positive feedback shall be used. ☐
 - The keyboard and LC display will form an integral part of the logger housing and separate units will not be considered. ☐

54.2.3 Measuring Sensor:

- For inner pipe diameters of 10...2500 mm. ☐
- The sensor should have a measuring interval of 0.01 to 25 m/s ☐
- The sensor should have a binary output as pulse value 0.01 to 1000 units ☐
- The sensor should have a accuracy ± 2 % of reading ± 0.01 m/s ☐
- The sensor should be able to measure water and acoustically similar liquids with < 6 % gaseous or solid content by volume ☐

54.2.4 Environmental Data:

- The sensor shall be designed to function satisfactorily under the following:

- Temperature range:

-10°C to +60°C;

☐

- The sensor shall have an IP 66 rating.

☐

54.2.5 Data transmission cable:

- The data transmission cable should function satisfactorily with a cable length of preferably 10 m.

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- The outer diameter of the cable should preferably not exceed 10 mm.

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54.2.6 Power Supply:

- The power supply for the sensor should be:

- 100 to 240 V/50 to 60 Hz or

- 20 to 32 V_{DC};

☐

- The power consumption of the sensor should preferably not exceed 10 W nominal during measurement mode

☐

54.2.7 Output Signal:

- The outputs are galvanically isolated from the transmitter;

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- The output signal of the sensor should preferably be transmitted 4- 20 mA compliant self-powered & non-isolated relays

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54.2.8 Accuracy:

- The outputs accuracy needs to be 0.1 % of reading $\pm 15 \mu\text{A}$

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55 TIPPING BUCKET RAIN GAUGE;

55.1 DESIGN AND TECHNICAL DETAILS.

55.1.1 The rainfall recorder should be manufactured of non –corrosive material. No plastic Rain gauges will be considered. ☐

55.1.2 Environmental Data:

- The sensor shall be designed to function satisfactorily under thefollowing:

- Temperature range (no heating): -5°C to +60°C;
 - Temperature range (heating): -30°C to +60°C;
 - Temperature range (storage): -40°C to +75°C;
- ☐

55.1.3 Depending on the needs, the size of the opening should be between 200 cm² to 1 000 cm². ☐

55.1.4 Dimensions 300mm height, 230mm body diameter, 275mm mounting flange diameter; ☐

55.1.5 The following minimum depth of rainfall to be measured must be offered separately:

- 1.0 mm,
 - 0.5 mm,
 - 0.2 mm,
 - 0.1 mm.
- ☐
-
- ☐
-
- ☐
-
- ☐

55.1.6 The rain gauge should be able to measure an intensity of at least 10mm/minute, or better. ☐

55.1.7 The rain gauge should be offered as a stand-alone unit, (including an optional data logger with a download option via laptop and data transmission unit using a RS 232 or USB interface) or with an impulse output, for the data loggers as specified in this section. ☐

55.1.8 The bidder shall offer a warm-up device as an optional extra. ☐

55.1.9 A calibration certificate shall be produced by the manufacturer, on request of the engineer. ☐

55.1.10 The rain gauge should offer an Anti-freeze option for areas where there is heavy snow. ☐

55.1.11 The rain gauge should offer an alarm need for warning when the funnels or filters are blocked. ☐

55.1.12 The electrical supply should be protected against overloading ☐

55.2 ACCURACY

55.2.1 Accurate to better than 3% up to 200mm/hr and useful to over 500mm/hr. ☐

☐☐

55.3 ACCESSORIES

55.3.1 Data Cable (per meter);

55.3.2 Bird Protection Ring;

55.3.3 Battery 12 V 18Ah;

55.3.4 Solar panel 20W;

55.3.5 Mounting Bracket;

55.3.6 Heating Unit.

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56 WEIGHING TYPE RAIN GAUGE;

56.1 DESIGN AND TECHNICAL DETAILS:

- 56.1.1 The rain gauge should be manufactured of non-corrosive material. ☐
- 56.1.2 Operating temperature range to be at least between -5°C to +50°C, without any heating device. ☐
- 56.1.3 The size of the opening should be 200 cm². ☐
- 56.1.4 The rainfall bucket should be able to handle 250 mm of rainfall. An automatic drain-off system (Siphon) will be offered as an option. ☐
- 56.1.5 The rain gauge should be able to measure an intensity of at least 20mm/minute, or better. ☐
- 56.1.6 The rain gauge should be offered as a stand-alone unit, (including a optional data logger with a download option via laptop and data transmission unit using a RS 232 interface) or with an impulse output, for the data loggers as specified in this section. ☐
- 56.1.7 Software for the interpretation of the graphs and tables related to the stored values will be offered. ☐

57 LASER OPTICAL TYPE RAIN GAUGE;

57.1 APPLICATION:

The laser optical type rain gauge should be a modern system, operating with a laser based optical system to measure all types of precipitation reliably. Primary data should be the size and velocity of each single hydrometeor, from which the size spectrum, the amount of rainfall the equivalent radar reflectivity, the visibility, the precipitation kinetic energy and precipitation type are derived.

57.2 DESIGN AND TECHNICAL DETAILS:

57.2.1 The rain gauge should be manufactured of non-corrosive material. ☐

57.2.2 Operating temperature range to be at least between -10°C to +50°C, without any heating device. ☐

57.2.3 The size of the rain gauge should not exceed the following dimensions and weight:

- Dimensions: 600 x 500 x 150 mm; ☐
- Weight: 5 kg. ☐

57.2.4 The rain gauge should be able to be mounted on a 50 mm diameter tube. ☐

57.2.5 The rainfall bucket should be able to handle 250 mm of rainfall. An automatic drain-off system (Siphon) will be offered as an option. ☐

57.2.6 The rain gauge should be able to measure a minimum intensity of 0.01 mm/hour and a maximum intensity of at least 500 mm/hour, or better. ☐

57.2.7 The rain gauge should be offered as a stand-alone unit, (including a optional data logger with a download option via laptop and data transmission unit using a RS 232 / RS 485 interface) or with an impulse output, for the data loggers as specified in this section. ☐

57.2.8 Software for the interpretation of the graphs and tables related to the stored values will be offered. ☐

57.2.9 The optical sensor should have a wave length of at least 650 nm with a laser diode of at least 3 mW output power. ☐

57.2.10 The optical beam should have a measuring area of at least 50 cm². ☐

57.2.11 The power supply for the rain gauge should be from 10 – 36 volt DC, reverse polarity protected with a power consumption of not more than 6 W at 24 volt DC. ☐

58 HUMIDITY AND AIR TEMPERATURE SENSOR;

58.1 DESIGN AND TECHNICAL DETAILS – HUMIDITY SENSOR:

- 58.1.1 The probe must have a measuring range of 0 – 100%RH. ☐
- 58.1.2 Operating temperature range to be at least between -5°C to +50°C. ☐
- 58.1.3 The humidity measurement accuracy must not be less than 3% over the full measuring range. ☐
- 58.1.4 The typical long-term stability should be better than 1% RH per year. ☐

58.2 DESIGN AND TECHNICAL DETAILS – AIR TEMPERATURE SENSOR:

- 58.2.1 The probe should be of the Platinum type “T100 type”. ☐
- 58.2.2 Temperature measurement range to be at least between -20°C to +50°C. ☐
- 58.2.3 The sensitivity of the measuring element should be about 0.1 °C, or better. ☐
- 58.2.4 The probe shall be designed to allow measurement at 1.5 m above the ground, sheltered from the sun. ☐

59 BAROMETRIC PRESSURE SENSOR

59.1 DESIGN AND TECHNICAL DETAILS:

- 59.1.1 The “Baro-transmitter” should measure the barometric ambient pressure and emit the measured value as an electrical voltage value of 1.....5 volt and have an operating voltage of 10 – 30 v DC. ☐
- 59.1.2 The measurement range should be at least between 600 1 060 hPa. ☐
- 59.1.3 The accuracy of measurement should be about 0.5 hPa, or better. ☐
- 59.1.4 The transmitter resolution should be at least 0.1 hPa. ☐

60 ANEMOMETER

60.1 DESIGN AND TECHNICAL DETAILS:

- 60.1.1 An anemometer with a 3-cup anemo transmitter, with pulsed output proportional to rotation speed, should be offered. ☐
- 60.1.2 The measurement range of the anemometer should range from 0.5 m/s to at least 50 m/s, (180 km/hour) but should withstand a wind speed of up to 60 m/s. ☐
- 60.1.3 Operating temperature range to be at least between -5°C to +50°C. ☐
- 60.1.4 The accuracy shall be better than 0.5 m/s, under 20 m/s and better than 0.3 m/s, over 20 m/s. ☐
- 60.1.5 The threshold wind speed value shall be better than 0.5 m/s. ☐

61 WIND DIRECTION INDICATOR

61.1 DESIGN AND TECHNICAL DETAILS:

- 61.1.1 The measurement of the direction of the wind shall be with a continuous rotation transmitter. ☐
- 61.1.2 Operating temperature range to be at least between -5°C to +50°C. ☐
- 61.1.3 The range of measurement shall be 360° (mechanical) and 355° (electrical). ☐
- 61.1.4 The accuracy shall be better than 3° and the threshold value better than 1 m/s all over the displacement range. ☐

62 NET RADIATION

62.1 DESIGN AND TECHNICAL DETAILS:

- 62.1.1 The pyranometer shall be calibrated for the daylight spectrum and preferably provide an output of 4 – 20 mA with an accuracy better than 5%. ☐
- 62.1.2 The measurement range of the radiometer should range from 0 to at least 1 500 W/m². ☐
- 62.1.3 Operating temperature range to be at least between -5°C to +50°C. ☐
- 62.1.4 Its stability shall be less than 1% change per year. ☐
- 62.1.5 The temperature dependence shall not exceed 0.1% per °C. ☐
- 62.1.6 The Cosine response shall be less than 3% of the value with a zenith angle of 0° to 80°. ☐
- 62.1.7 The azimuth error shall be less than 3% of the value. ☐
- 62.1.8 The sensor shall be housed in a waterproof case. ☐

63 MINIATURE FIELD CAMERA;

63.1 APPLICATION:

Stand alone miniature camera that may be used for surveillance at monitoring sites for flood events or as an alarm device, utilizing the GSM network at river gauging Stations for flood purposes

63.2 DESIGN AND TECHNICAL DETAILS:

63.2.1 Camera housing:

- The Camera housing must be robust, corrosion resistant, UV Resistant, insensitive to vibration and be water and dust protected to comply with rating IP68, as defined in IEC144. ☐
- All printed circuit boards (PCB's) are enclosed in rugged anodized aluminum housing and of strong construction. ☐
- The size of the camera should not exceed the following dimensions and weight:
 - Dimensions: 70mm (H) x 85.5mm (HW) x 30mm (D); ☐
 - Weight: 0.2 kg. ☐

63.2.2 Features:

- Images needs to obtained by phoning the Camera (no cost); ☐
- The need to be programmable to accept a Maximum of 3 users including a control center number; ☐
- The field Camera unit need also to be able to be programmed for a control center computer to request images in high flood events (no cost); ☐
- Images need to obtained, by activation of a sensor e.g. switch or motion sensor; ☐
- All images need to be date and time stamped. ☐
- Need to be able to take pictures with Flash for night photographing. ☐
- Built in GSM modem. ☐
- The Field camera need to have at least 2 Year Warranty from date of Purchase. ☐

63.2.3 Environmental Data:

- Operating Temperature: -20°C to +70°C; ☐
- IP68 rating including all fittings and connectors ☐

63.2.4 Interfaces:

- USB Communication Port (communications and charging). ☐
- 3 way pluggable connector (solar panel input and switch input). ☐
- The Miniature Camera needs Built in GSM modem. ☐

63.2.5 Power Supply:

- The Unit needs a 3-way pluggable connector for a solar panel or external battery and switch input); ☐
- The unit need to charge either with a solar Panel 12V 150 watt or 220v reduced charger or external battery; ☐
- The $\pm 1mA$ - A fully charged battery will last approximately one week taking one or two images per day. The possibility to use larger external batteries ☐

63.2.6 Output Images:

- Still Images need to be mms to registered users Cell Phones or Control Center; ☐

63.2.7 Software:

- Set-up software needs to be supplied. This enables the following functions:
 - A Maximum of three telephone numbers to which the images are sent may be programmed to enable final position adjustment of the camera unit with assistance of a zoom capability. ☐
 - During set-up, test images can be sent from the unit to verify that the required image is correct, and that all telephone numbers stored are correct and in fact receiving the images ☐

64 CONTACT GAUGE;

64.1 APPLICATION:

The contact gauge must be portable and it will be used for the measurement of water levels, especially in boreholes and stilling wells.

64.2 DESIGN AND TECHNICAL DETAILS:

64.2.1	The contact gauge should have an electrode inside the measuring probe, when the probe makes contact with the water surface, an acoustic beep should be sounded.	☐
64.2.2	The frame of the contact gauge should also consist of a signal lamp that lights up when the probe makes contact with the water surface.	☐
64.2.3	The measuring tape should preferably be white or yellow and must not be able to stretch conductor manufacture from high strength rust resistant steel.	☐
64.2.4	The graduations on the tape should be clearly marked in metres, decimetres and centimetres.	☐
64.2.5	The probe body should be manufactured from corrosive resistant material and should not exceed an outer diameter of 20 mm.	☐
64.2.6	The contact gauge should offer the possibility to measure/determine the depth of a well or borehole.	☐
64.2.7	The contact gauge should make use of commercially available dry alkaline batteries.	☐
64.2.8	Operating temperature range to be at least between -5°C to $+40^{\circ}\text{C}$.	☐
64.2.9	The contact gauge must cover measuring ranges from 15-750m.	☐
64.2.10	The contact gauge should offer the possibility to measure the water temperature and/or conductivity optional.	☐
64.2.11	The temperature and/or conductivity reading will be displayed on a LCD display.	☐
64.2.12	All replacement parts, like replacement probes should be listed under "Replacement Parts" in the Price Schedule.	☐
64.2.13	All accessories like protective carrier case, probe weights, bottom sensors etc. should be listed under "Accessories" in the Price Schedule.	☐

65 SINGLE BODY MULTI PARAMETER (pH, OPTICAL OXYGEN, ELECTRICAL CONDUCTIVITY, TEMPERATURE, DEPTH) WATER QUALITY SENSOR;

65.1 APPLICATION:

The sensor will be connected to existing on site data loggers.

65.2 DESIGN AND TECHNICAL DETAILS:

65.2.1 The sensor must communicate to external loggers via SDI 12, MODBUS and RS-485. ☐

65.2.2 The multi parameter sensor must come standard with a removable pH sensor, optical oxygen sensor, depth sensor, temperature sensor and electrical conductivity sensor. TDS and salinity must be a standard calculated output. ☐

65.2.3 USB Laptop communication cable for calibration purposes must offered as a standard optional extra. ☐

65.2.4 The communication cable and connectors must offered be as an additional extra and be priced per running metre. ☐

65.2.5 The sensor may not have an internal battery, internal logger or be upgradable to a logging unit. ☐

65.2.6 Maximum dimension: 300mm (length) x 50mm diameter ☐

65.2.7 If a compatible compact logger/telemetry system for groundwater monitoring is available, the unit may be offered as an additional extra. The unit must be from the same manufacturer. ☐

65.2.8 Extras, spares and additional cable lengths to be listed and priced as sub items. ☐

66 WATER TEMPERATURE SENSOR.

66.1 APPLICATION:

66.1.1 The sensor will be offered as standard with temperature sensor and 10 m cable.

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66.2 DESIGN AND TECHNICAL DETAILS:

66.2.1 The sensor shall have a 4-20 mA output.

☐

66.2.2 Operating voltage must be within 10-24 V_{DC} range.

☐

66.2.3 The sensor must have a durable permanently fixed marine grade communication cable with a maximum length of no less than 150 metres.

☐

66.2.4 The sensor may not have an internal logger or be upgradable to a logging unit.

66.2.5 Maximum dimension: 150mm (length) x 20mm diameter.

☐

66.2.6 The sensitivity of the measuring element shall be approximately 0,2 °C between a temperature range of at least -15°C to +50°C.

☐

66.2.7 Extras, spares and additional cable lengths to be listed and priced as sub items.

☐

WATER QUALITY

67 SCOPE

67.1 MINIMUM SPECIFICATION FOR WATER QUALITY VARIABLES ON OFFER:

67.1.1 Dissolved Oxygen: (% Saturation)

- Range: 0 to 400 %
- Resolution: 0.1 %
- Accuracy: 0 – 400 %; ± 6 % air sat.

☐

67.1.2 Dissolved Oxygen: (mg/L)

- Range: 0 to 30 mg/L
- Resolution: 0.01 mg/L
- Accuracy: 0 – 30 mg/L; ± 15 mg/L

☐

67.1.3 Conductivity:

- Range: 0 to 100 000 $\mu\text{S}/\text{cm}$ (100mS/cm)
- Resolution: 0.5 $\mu\text{S}/\text{cm}$
- Accuracy: ± 0.5 % of reading

☐

67.1.4 Temperature:

- Range: -5°C to $+45^{\circ}\text{C}$
- Resolution: 0.02°C
- Accuracy: $\pm 0.15^{\circ}\text{C}$

☐

67.1.5 pH:

- Range: 1 to 13 units
- Resolution: 0.01 unit
- Accuracy: ± 0.2 unit

☐

67.1.6 Salinity:

- Range: 0 to 42 ppt/PSU
- Resolution: 0.01 ppt
- Accuracy: ± 1 % of reading

☐

68 MULTI-PARAMETER HANDHELD WATER QUALITY SYSTEM (WITH PH-, DISSOLVED OXYGEN-, ELECTRICAL CONDUCTIVITY- AND TEMPERATURE SENSOR);

68.1 APPLICATION:

68.1.1 This multi-parameter handheld system must include as standard a sensor bulkhead, 10m cable, display unit with barometer, laptop communication cable, serial to USB port converter (if necessary), pH sensor, oxygen sensor, electrical conductivity sensor, temperature sensor and protective carry case. ☐

68.2 DESIGN AND TECHNICAL DETAILS:

68.2.1 Must display pH mV during calibration;

68.2.2 Must have a screw-on O2 membrane cap (no O-ring or optical sensor);

68.2.3 Sensor bulkhead guard must be weighted for stability;

68.2.4 Display to be connected to sensors via cable;

68.2.5 Cable connectors must be Mil-spec.

68.2.6 No depth sensor required.

68.2.7 The maximum cable length may not be less than 30 metres.

68.2.8 Extras, spares and additional cable lengths to be listed and priced as sub items

69 HANDHELD CONDUCTIVITY AND TEMPERATURE SYSTEM (WITHOUT PH- AND OXYGEN SENSOR);

69.1 APPLICATION:

69.1.1 This multi-parameter system must include as standard a sensor bulkhead, 10m cable, display unit, laptop communication cable, serial to USB port converter (if necessary), electrical conductivity sensor, temperature sensor and protective carry case.

☐

69.2 DESIGN AND TECHNICAL DETAILS:

69.2.1 May not have pH or O2 sensors as standard or optional;

☐

69.2.2 Must have TDS and Salinity as an output.

☐

69.2.3 Sensor bulkhead guard must be weighted for stability

☐

69.2.4 Cable connectors must be Mil-spec.

☐

69.2.5 No depth sensor required.

☐

69.2.6 The maximum cable length may not be less than 30 metres.

☐

69.2.7 Extras, spares and additional cable lengths to be listed and priced as sub items.

☐

70 HANDHELD pH-, CONDUCTIVITY- and TEMPERATURE SENSOR (WITHOUT OXYGEN SENSOR);

70.1 APPLICATION:

70.1.1 This multi-parameter system must include as standard a sensor bulkhead, 10m cable, display unit, laptop communication cable, serial to USB port converter (if necessary), pH sensor, electrical conductivity sensor, temperature sensor and protective carry case. ☐

70.2 DESIGN AND TECHNICAL DETAILS:

70.2.1 May not have a dissolved oxygen sensor as standard or optional. ☐

70.2.2 Must have TDS and Salinity as an output. ☐

70.2.3 Sensor bulkhead guard must be weighted for stability; ☐

70.2.4 Cable connectors must be Mil-spec; ☐

70.2.5 No depth sensor required. ☐

70.2.6 The maximum cable length may not be less than 30 metres. ☐

70.2.7 Extras, spares and additional cable lengths to be listed and priced as sub items. ☐

71 COMPACT WIRELESS TEMPERATURE, CONDUCTIVITY AND DEPTH PROFILER

71.1 APPLICATION:

The product should be lightweight, easy to use instrument with easy access accurate conductivity, temperature, and depth profiles. The product must have a 6 electrode conductivity cell and thermistor. It should be relatively palm-sized and be deployed from a boat. Whenever the instrument is dropped into the water there should be a built in reference both time and GPS location by means of a built in GPS receiver. The purpose of the instrument is to view immediate plots of conductivity, temperature, salinity and sound speed versus depth must be viewed immediately on the instruments integrated colour LCD screen in the field. The housing should be rugged and non corrosive. The instrument will be used for live samples in dams, boreholes, rivers and estuaries.

71.2 SPECIFICATIONS:

- 71.2.1 Built in memory of at least 10 MB; ☐
- 71.2.2 Bluetooth wireless data download; ☐
- 71.2.3 Internal batteries with a minimum of 30 hours continuous use; ☐
- 71.2.4 Data output to laptop should be- ASCII (CSV) /Hypack /Matlab; ☐
- 71.2.5 Depth range: 0-80 m; ☐
- 71.2.6 Measuring temperature range: -5° to 40° C; ☐
- 71.2.7 Point sample (moving the unit back and forth); ☐
- 71.2.8 Compatible with Windows XP/Vista/7; ☐
- 71.2.9 GPS-referenced; ☐
- 71.2.10 Data plots, filtering, import/export; ☐
- 71.2.11 Rugged plastic storage/shipping case; ☐
- 71.2.12 Bluetooth dongle; ☐
- 71.2.13 magnetic stylus pens; ☐
- 71.2.14 Sampling rate 5 Hz ; ☐
- 71.2.15 Mass – not more than 600g; ☐
- 71.2.16 No calibration must be required; ☐
- 71.2.17 Cleaning tool to clean the instrument. ☐

71.3 PARAMETERS TO BE MEASURED:

- 71.3.1 Conductivity 0 to 80,000 µS/cm (accuracy ± 0.25% ± 5 µS/cm) ☐
- 71.3.2 Temperature -5° - 40° C (accuracy ± 0.05° C) ☐
- 71.3.3 Pressure 0 to 80 dBar (accuracy ± 0.25% FS) ☐

72 HANDHELD WATER QUALITY PROFILING SYSTEM (with DEPTH-, pH-, OXYGEN-, ELECTRICAL CONDUCTIVITY- and TEMPERATURE SENSOR);

72.1 APPLICATION:

72.1.1 This multi-parameter system must include as standard a sensor bulkhead, 10m cable, display unit, smart pH sensor, smart optical oxygen sensor, smart electrical conductivity sensor, temperature sensor, pressure sensor and protective carry case. ☐

72.2 DESIGN AND TECHNICAL DETAILS:

72.2.1 Must display pH mV during calibration; ☐

72.2.2 Calibration data must be stored on individual smart sensors; ☐

72.2.3 Sensor bulkhead guard must have a stackable weighing system; ☐

72.2.4 Sensor bulkhead may not contain a battery compartment or have logging capability. ☐

72.2.5 Display to be connected to sensors via cable; ☐

72.2.6 Cable connectors must be Mil-spec; ☐

72.2.7 The maximum cable length may not be less than 95 metres; ☐

72.2.8 Extras, spares and additional cable lengths to be listed and priced as sub items. ☐

73 MULTI-PARAMETER HANDHELD WATER QUALITY SYSTEM WITH WIRELESS SMART DEVICE DISPLAY

73.1 APPLICATION:

73.1.1 This multi-parameter system must include as standard a sensor bulkhead, 8-10m cable, android display device (including app), battery pack, pH sensor, optical oxygen sensor, electrical conductivity sensor, temperature sensor, level sensor and protective carry case. ☐

73.2 DESIGN AND TECHNICAL DETAILS:

73.2.1 Must have an optical DO sensor; ☐

73.2.2 Must have water level sensor; ☐

73.2.3 Must report on salinity; ☐

73.2.4 Must have Bluetooth communication to android handheld display device; ☐

73.2.5 Communication to handheld device via cable may not be an option; ☐

73.2.6 Maximum cable length must be more than 70m; ☐

73.2.7 Extras, spares and additional cable lengths to be listed and priced as sub items. ☐

74 MULTI-PARAMETER WATER QUALITY SONDE WITH pH-, ELECTRICAL CONDUCTIVITY-, TEMPERATURE-, DEPTH and OPTICAL OXYGEN SENSORS (BLUETOOTH COMMUNICATION CAPABILITY) – DIAMETER LESS THAN FIVE CENTIMETRES;

74.1 APPLICATION:

74.1.1 This sonde will be offered standard with sonde main body, pH sensor, optical DO sensor, temperature sensor, electrical conductivity sensor, operating software, carry case.

☐

74.2 DESIGN AND TECHNICAL DETAILS:

74.2.1 Bluetooth and SDI 12 communication to android handheld device must be standard;

☐

74.2.2 The sonde must have a minimum immersion depth of 145m;

☐

74.2.3 Must have internal memory of at least 10MB and include a user replaceable SD card;

☐

74.2.4 The sonde main body must contain a battery compartment and be fully programmable for unattended deployment with no cables attached;

☐

74.2.5 Sonde diameter must be less than 5cm;

☐

74.2.6 A fixed central sensor wiper must be offered as an additional extra;

☐

74.2.7 Extras, spares and additional cable lengths to be listed and priced as sub items

☐

75 DEEP WATER (MINIMUM 245M) MULTI-PARAMETER WATER QUALITY SONDE WITH OPTICAL AND SMART SENSOR TECHNOLOGY - DIAMETER LESS THAN FIVE CENTIMETRES;

75.1 APPLICATION:

75.1.1 This Sonde will be offered as standard with sonde main body, smart pH sensor, smart optical Oxygen sensor, smart temperature sensor, smart electrical conductivity sensor, depth sensor, laptop communication cable, operating software, carry case.

☐

75.2 DESIGN AND TECHNICAL DETAILS:

75.2.1 All calibration data must be stored on individual smart sensors;

☐

75.2.2 The sonde must have a minimum immersion depth of 245m;

☐

75.2.3 The sonde must have on-board memory to store at least 500 000 readings;

☐

75.2.4 The sonde main body must contain a battery compartment and be fully programmable for unattended deployment with no cables attached;

☐

75.2.5 Sonde diameter must be less than 5cm;

☐

75.2.6 Extras, spares and additional cable lengths to be listed and priced as sub items

☐

76 DEEP WATER (MINIMUM 245M) MULTI-PARAMETER WATER QUALITY SONDE WITH OPTICAL AND SMART SENSOR TECHNOLOGY - DIAMETER LESS THAN NINE CENTIMETRES;

76.1 APPLICATION:

76.1.1 This sonde will be offered standard with sonde main body, smart pH sensor, smart optical DO sensor, smart temperature sensor, smart electrical conductivity sensor, depth sensor, central anti fouling wiper, laptop communication cable, operating software, carry case.

☐

76.2 DESIGN AND TECHNICAL DETAILS:

76.2.1 All calibration data must be stored on individual smart sensors.

☐

76.2.2 The Sonde must contain a central anti-fouling wiper.

☐

76.2.3 The sonde must have a minimum immersion depth of 245m.

☐

76.2.4 The sonde must have onboard memory to store at least 500 000 readings.

☐

76.2.5 The sonde main body must contain a battery compartment and be fully programmable for unattended deployment with no cables attached.

☐

76.2.6 Sonde diameter must be less than 9cm;

☐

76.2.7 Extras, spares and additional cable lengths to be listed and priced as sub items.

☐

77 EXTREME DEPTH PROFILING (MINIMUM 1500M) MULTI PARAMETER ONLINE/MEMORY PROBE WITH CALCULATED DATA OUTPUT – UP TO 16-CHANNELS FOR PHYSICAL, CHEMICAL AND OPTICAL PARAMETERS;

77.1 APPLICATION:

- 77.1.1 Main Multi Parameter Probe for deep well and mine shaft water quality applications. The probe (sonde) will be offered as standard with pH, temperature, depth and electrical conductivity sensors. ☐

77.2 DESIGN AND TECHNICAL DETAILS:

- 77.2.1 Probe must weigh less than 3.6kg; ☐
- 77.2.2 Length of probe must not exceed 1m (1000mm) and diameter not larger than 76mm for core boreholes. ☐
- 77.2.3 Body material must be made of Titanium in order for the housing to be inert against all chemical compounds and corrosion free. ☐
- 77.2.4 Must be able to handle depths of not less than 1500m. ☐
- 77.2.5 Large internal memory for data storing – minimum 128M Bytes for 500 000 readings or more; ☐
- 77.2.6 Fast readout of data via USB port or communication interface. ☐
- 77.2.7 Probe must be equipped with an 8-16 Channel data acquisition system with an 8 – 20 bit resolution for fast data recording. ☐
- 77.2.8 Probe must be provided with minimum 3 fixed measuring channels consisting of a Pressure (depth) sensor (range minimum 1000dBar), Temperature sensor (range -2-36°C) and Conductivity sensor (range 0...70mS/cm (7000µS/cm)). ☐
- 77.2.9 It must have provision for 4 or more external measuring channels for additional sensors, namely pH, ORP, DO. ☐
- 77.2.10 Contain internal rechargeable batteries or capable to use Alkaline 1.5V or Lithium non rechargeable batteries and should have an operating time of at least 300hrs. ☐
- 77.2.11 It must have a maximum sampling rate of 20ms per channel and a minimum of 1 reading/day per channel. ☐
- 77.2.12 It should be equipped with an automatic self-calibration digital converter. ☐
- 77.2.13 Calibration coefficients must be stored inside the probes internal memory. ☐

77.3 EXTRAS:

- 77.3.1 Communication cable for Telemetry operation and suspension rope Memory Mode (un-supervised) offered per 100m; ☐
- 77.3.2 Operating software, portable readers, interface unit, depth display unit and spares to be listed and priced as sub items; ☐
- 77.3.3 External power supply interface, cable winch or cable drum and all optional accessories required for field operations to be listed and specified as extras. ☐

78 THREE CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE, TEMPERATURE AND CONDUCTIVITY SENSORS – FOR UNATTENDED DEPLOYMENT WITH NO CABLES ATTACHED

78.1 APPLICATION

78.1.1 This logger will be offered standard with integrated temperature sensor, electrical conductivity sensor, pressure sensor and communication port water proofing cap.

☐

78.2 DESIGN AND TECHNICAL DETAILS:

78.2.1 The logger must have Salinity and TDS as standard data outputs.

☐

78.2.2 The logger must have a factory sealed internal battery with a battery life of at least 5 years.

☐

78.2.3 The logger must be fully programmable for unattended deployment with no cable attached.

☐

78.2.4 The logger may not have a fixed communication cable.

☐

78.2.5 Logger diameter must be less than 2 cm with the length less than 32 cm;

☐

78.2.6 Extras, communication cable, operating software and spares to be listed and priced as sub items.

☐

79 THREE CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE, TEMPERATURE AND CONDUCTIVITY SENSORS – FOR PERMANENT SUBMERGED DEPLOYMENT WITH FIXED (NON REMOVABLE) COMMUNICATION CABLE AND VENTED TUBE.

79.1 APPLICATION:

79.1.1 This logger will be offered as standard with integrated temperature sensor, electrical conductivity sensor, pressure sensor, 5 meters fixed cable.

☐

79.2 DESIGN AND TECHNICAL DETAILS:

79.2.1 The logger must have Salinity and TDS as standard data outputs.

☐

79.2.2 The battery compartment and communication port must be on the non-submersible side of the communication cable.

☐

79.2.3 The logger must be fully programmable to log at a fixed rate or multiple logging intervals from 5 seconds to 24 hours for unattended deployment.

☐

79.2.4 The data logger shall preferably be provided with a EEPROM ring memory (first in, first out) for buffered storage capacity of at least to 500 000 readings.

☐

79.2.5 The logger must have a fixed communication cable with integrated vented tube.

☐

79.2.6 Logger diameter must be less than 2 cm;

☐

79.2.7 Extras, Laptop communication cable, additional cable length, operating software and spares to be listed and priced as sub items.

☐

80 THREE CHANNEL DATA LOGGER WITH INTEGRATED PRESSURE TRANSDUCER, TEMPERATURE- AND CONDUCTIVITY SENSORS – FOR PERMANENT DEPLOYMENT WITH FIXED (NON REMOVABLE) COMMUNICATION CABLE, VENTED TUBE AND BUILT-IN SIM TELEMETRY SYSTEM (GSM STANDARD, GSM QUAD BAND, GPRS).

80.1 APPLICATION:

80.1.1 This logger will be offered as standard with integrated temperature, electrical conductivity, pressure sensors; built-in SIM telemetry system (GSM Standard, GSM Quad band, GPRS) and 5 meters fixed cable.

☐

80.2 DESIGN AND TECHNICAL DETAILS:

80.2.1 The logger must have Salinity and TDS as standard data outputs.

☐

80.2.2 The battery compartment and integrated SIM telemetry system must be on the non-submersible side of the communication cable.

☐

80.2.3 Logger housing must be robust, corrosion-resistant, and insensitive to impact and vibration and watertight up to at least 100 m water pressure depth (10 Bar).

☐

80.2.4 The data logger shall be provided with a EEPROM ring memory (first in, first out) for buffered storage capacity of at least to 500 000 readings.

☐

80.2.5 The logger must be fully programmable to log at a fixed rate or multiple logging intervals from 5 seconds to 24 hours for unattended deployment.

☐

80.2.6 The logger must have a fixed communication cable with integrated vented tube.

☐

80.2.7 Logger/telemetry side of the instrument must be less than 5.3 cm x 53 cm with the probe (sensor) side being less than 2.3 cm x 32 cm.

☐

80.2.8 Extras, Laptop communication cable, additional cable length, operating software and spares to be listed and priced as sub items.

☐

POWER SUPPLY EQUIPMENT:

81 SCOPE;

- 81.1 This part of the specifications needs to be completed by all bidders who offer power supply systems together with their equipment. The power supply systems **will not** be awarded to a single bidder and should the bidder offer a logger and not offer power supply system/s, his/her **complete offer could be invalidated**.
All power supply systems offered will comply with the detail specifications in this Section.
- 81.2 In most cases, no mains power supplies will be available to power the data loggers. Provision shall be made to power the equipment from external rechargeable batteries, equipped with solar panels and regulators. In the case of mains power supplies, a power control unit or mains transformer will be used
- 81.3 The equipment will also be utilised at remote measuring stations and operation will be in a totally unattended mode, with inspections by staff on a 7 to 60 day cycle.
- 81.4 Only high quality equipment capable of offering extended service under arduous conditions on unmanned sites shall be offered.
- 81.5 The offered equipment shall be designed to function satisfactorily under the following conditions:

Temperature Range: -5° C to +60° C

82 SOLAR PANELS;

82.1 NORMAL/RIGID PANELS:

82.1.1 The solar panel shall preferably meet the following specifications:

- The solar panel must preferably be of the "crystalline" Photovoltaic Module type or better. ☐
- The "crystalline" cells must be encapsulated between a tempered glass cover. ☐
- Adjustable (between 0 and 45 degrees) horizontal mounting brackets for all offered solar panels should be offered as an accessory. ☐

82.1.2 The following solar panels shall be offered:

ELECTRICAL & PHYSICAL CHARACTERISTICS	SOLAR PANEL 1	SOLAR PANEL 2	SOLAR PANEL 3	SOLAR PANEL 4	SOLAR PANEL 5
Maximum Power (Watts)	20	40	50	60	80
Maximum Length (mm)	600	600	650	800	1 000
Maximum Width (mm)	600	700	700	700	700
Maximum Depth (mm)	50	50	50	50	50
Maximum Weight (kg)	4	6	7	8	10
Electrical wire colour code	Positive (+) Red / Negative (-) Black				

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82.2 FLEXIBLE PANELS:

82.2.1 The solar panel shall preferably meet the following specifications:

- The solar cells should be deposited with multi layers of silicon alloy materials onto a thin stainless steel substrate in a roll-to-roll process. ☐
- The cell assembly need to be laminated in flexible and durable weather resistant polymers that provide long life and high reliability. ☐

82.2.2 A Flexible solar panel must be offered and should not exceed the following power, dimensions and weight:

- Maximum Power (Watts) 32 Watts
- Maximum Length (mm) 1 500
- Maximum Width (mm) 500
- Maximum Depth (mm) 50
- Maximum Weight (kg) 4

☐

82.3 SOLAR CHARGE CONTROLLER:

82.3.1 The solar charge controller shall meet the following specifications:

- The controller shall be capable of maintaining the output voltage to the battery within the required limits with a $\pm 25\%$ fluctuation of the input voltage. This shall apply to the total temperature range specified for the instrument. ☐
- The controller shall contain suitable circuitry to protect itself, to limit the current supplied to the battery, for in the event of malfunctioning of any of the major modules supplied from the regulator or in the event of what is commonly known as "thermal runaway". ☐
- No damage shall be caused to either the instrument or the controller if the input voltage polarity to the controller is accidentally or intentionally reversed. ☐
- The polarity of the supply voltage to the controller shall be clearly marked either on the associated connector or next to it on the instrument's cabinet. ☐
- To protect the batteries from irreversible damage, a load shedding facility should be incorporated, in case of power supply failure. ☐
- The controller should preferably display two LED's; one to indicate that the regulator is charging the back-up battery, the other to indicate whether or not the load-shed facility is in operation. ☐

82.3.2 The following two controllers shall be offered:

TECHNICAL CHARACTERISTICS		CONTROLLER 1	CONTROLLER 2
Nominal Voltage 12 Volt	Maximum Module Current (Amp)	4	8
	Maximum Load Current (Amp)	4	8
	Maximum Own Consumption (mAmp)	6	6
Maximum Dimensions		100 x 150 x 50 mm	
Connection Terminal (Maximum size)		2,5 mm ²	

83 BATTERIES;

83.1 LITHIUM BATTERY:

83.1.1 The battery shall preferably meet the following specifications:

- The battery shall be a corrosion-free sealed lithium-thionyl chloride (Li-SOCl₂) type Lithium battery. ☐
- Maintenance free with a low self-discharge rate, and ability to operate under extreme conditions.
- Operating temperature range: -60°C to +85°C ☐
- The bidder will offer batteries and battery packs with correct terminal connections for each instrument as specified by manufacture. ☐
- Batteries and battery packs needs to carry the approval of the manufacture of the instruments and should not invalidate the guarantee on the instrument. ☐
- The following batteries must be offered:
 - 1.5V LR6/FR6, AA size cells. ☐
 - 3.6V LR6/FR6, AA size cell; ☐
 - 3.6V LS, D size 26Ah standard 2 cell stick battery pack with connector plug. ☐
 - 3.6V LSH, D size cell with connector plug. ☐

83.2 ALKALINE BATTERY:

83.2.1 The battery shall preferably meet the following specifications:

- The battery shall be an Alkaline Manganese Dioxide Battery. ☐
- Maintenance free with a low self-discharge rate, and ability to operate under extreme conditions. ☐
- Temperature range:
 - Operating: -20°C up to +50°C; ☐
 - Storage: 5°C up to +30°C. ☐
- The following sizes of Nominal Voltage 1.5V must be offered separately:
 - Size AA (LR6); ☐
 - Size AAA (LR03); ☐
 - Size C (LR 14); ☐
 - Size D (LR 20). ☐
- The following sizes of Nominal Voltage 9.0V must be offered separately:
 - Size MN1604 (6LR61). ☐

84 POWER CONTROL UNIT OR MAINS TRANSFORMER;

84.1 The power control unit and/or mains transformer shall meet the following specifications:

84.1.1 The power control unit shall be a combination between a solar charge controller and a mains transformer. ☐

84.1.2 The power control unit shall be able to handle an input range of a maximum of 250 volt, with an output of at least 12 volt. ☐

84.1.3 The power control unit shall have a fuse as well as a LED indicator. ☐

84.1.4 The mains transformer shall be able to handle an input range of a maximum of 250 volt, with an output of at least 12 volt. ☐

84.2 Lightning and surge protection

84.2.1 The mains supply shall be equipped with adequate surge protection to prevent the equipment from damage caused by switching transients and static discharges. The following shall be a minimum requirement: ☐

- Fine protection : type VM 280 Dehnbliitsductor or similar ☐

NOTE: Course protection should already be provided by the Isolation Transformer ☐

85 PORTABLE POWER BACK-UP;

85.1 APPLICATION:

85.1.1 the portable power back-up shall be a unique portable power back-up system that is designed for any situation when power fails or when power is needed in field work. ☐

85.1.2 This system must supply emergency power in the office as well as in the field where Laptops must be utilized for a whole working day as well as charging of batteries of equipment utilized during field work. This system must have no noise or consume any type of fuel. ☐

85.1.3 This system can be utilized to supply power to the following:

- Laptop computers; ☐
- Desktop computers; ☐
- Printers; ☐
- Radios; ☐
- Modems; ☐
- Routers; ☐
- Hubs; ☐
- Lights. ☐

85.2 DESIGN AND TECHNICAL DETAILS:

85.2.1 Design:

- Fully portable trolley design; ☐
 - Maintenance Free; ☐
 - Silent operation; ☐
 - Microprocessor based design; ☐
-
- No Fuel required (Petrol, Diesel, etc.) ☐
 - Excellent protection features ☐
 - Audible alarms / DB9 RS232 and USB output ☐
 - Comprehensive LED status indicators ☐
 - Powerful fully automatic battery charger ☐
 - Up to 10Hr Back-up (With internal batteries) ☐
 - Up to 24Hr Back-up (With additional battery connected) ☐
 - Fully sealed internal batteries. ☐

85.2.2 Output:

- Pure Sine wave;
- Very fast smooth automatic change over in <5mSec;
- Inverter can start without power available;
- Powerful Output 1500VA / 1000W continuous;
- Fully sealed lead Acid long life battery;
- Dual AC output circuit breaker;
- Resettable output circuit breaker;
- Excellent output regulation;
- External fused 2nd battery connector;
- Suitable for solar application with external regulator.

86 BATTERY CHARGERS;

86.1 INTELLIGENT AUTOMATIC 8 STAGE 12V BATTERY CHARGER:

86.1.1 Application

- The charger will be a fully automatic 8 step smart charger and battery support unit, it will be easily portable. The charger should be suitable for all types of lead-acid batteries, and should be able to test whether a battery is able to take and hold a charge. ☐

86.1.2 Design and technical details

- The charger shall be portable and supplied with not less than 4 meter extended charge cable and a protective rubber bumper for maximum convenience and versatility. ☐
 - The charger shall be portable and supplied with not less than 4 meter extended charge cable and a protective rubber bumper for maximum convenience and versatility. ☐
 - The charger cable will be designed so that additional connector cables may be connected for different applications. ☐
 - The charger should have an automatic diagnostic function that test whether the battery is able to take and hold a charge. ☐
 - The charger should have a supply function that allows it to be used as a power supply to support vehicle electronic during sensitive battery changeovers. ☐
 - The mass of the unit should not exceed 900g ☐
 - The dimensions of the unit should preferably not exceed: 200 mm long x 100 mm wide x 50 mm High ☐
 - The following minimum specifications will apply:
 - Volt: 12V; ☐
 - Rated Voltage AC: 220-240VAC, 50-60HZ; ☐
 - Min battery voltage: 2.0V; ☐
-
- Charging current: 10A max; ☐
 - Current, mains: 1.0Arms (at full charging current); ☐
 - Black current drain: <1Ah/month; ☐
 - Ripple: <4%; ☐
 - Ambient temperature: -20°C to +50°C, with automatic reduction in output power at high temperature; ☐
 - Charger type: 8 step, fully automatic charging cycle; ☐
 - Battery types: All types of 12V lead-acid batteries (WET, MF, Ca/Ca, AGM and Gel); ☐
 - ☐
 - Battery capacity: 20-200Ah, up to 300Ah for maintenance; ☐
 - Insulation class: IP65 ☐

85. BATTERY CHARGERS;

86.2 12 VOLT CHARGER

86.2.1 TECHNOLOGY:

86.2.2 Functions must include the following:

- Fully automatic charging cycle; ☐
- Power ON indicator; ☐
- Error Indicator: Correctly connected; ☐
- Temperature sensor and indicator: The sensor will adjust the voltage to ambient temperature; ☐
- Charging in cold conditions; ☐
- Charging AGM (Absorbed Glass Mat), WET, MF (Maintenance free), Ca/Ca and GEL 12 Volt lead acid batteries; ☐
- Recondition deeply discharged batteries; ☐
- Use the charger as a power supply. ☐

86.3 DESIGN AND TECHNICAL DETAILS:

86.3.1 Specifications:

- Rated voltage: 220-240VAC, 50-60Hz ☐
- Charging voltage:
 - Vehicle: 14.4 V
 - AGM: 14.7 V ☐
 - Reconditioning: 15.8 V
 - Power supply: 13.6 V
- Start voltage: 2.0 V ☐
- Charging current: 10A max ☐
- Ripple charge: Less than 4% ☐
- Battery capacity: 20 – 300Ah ☐
- Insulation type: IP65 ☐
- Ambient temperature: -20°C to +50°C ☐

