28 October 2013

AURECON GROUP

Proposal for Development and Implementation of Groundwater Management Plan in D73A and D41J Quaternary Drainage Regions

Submitted to:
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1 Copy: GAA (unbound)
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The main role-players will be the mines, farmers, communities, and sector Departments.

3.0 STUDY OBJECTIVES
The primary aims of the project are to develop and implement a groundwater resource management plan for quaternary drainage regions D73A and D41J in the Northern Cape Province.

The specific objectives are outline below:
- To manage the groundwater resources in the study area sustainably;
- To determine the extent of groundwater use in the area;
- To set-up measures to mitigate the existing impacts on the groundwater resource;
- To capacitate and create awareness amongst all water users about the importance of protecting the water resources

4.0 TERMS OF REFERENCE
The Terms of Reference for the development and implementation of a groundwater resource management plan is contained in the document compiled by RN Mazwi of DWA, dated June 2013.

The project will involve the following key aspects/deliverables:
Task 1: Develop a water resource situational assessment
Task 2: Identify the key stakeholders of the project
Task 3: Investigations of groundwater recharge
Task 4: Review existing monitoring programmes and networks
Task 5: Creating awareness of groundwater protection and use
Task 6: Capacity building of DWA officials in undertaking basic monitoring activities
Task 7: Development of the groundwater resource management plan

DWA indicated a project timeframe of about 18 months with a limited budget of R1 million (VAT inclusive).

5.0 METHODOLOGY
The proposed methodology is determined by:
- Delivery of key aspects of the project – 7 tasks
- Project time frame of 18 months with limited budget
- Availability of existing data, hydrogeological information and water supply strategies
GROUNDWATER MANAGEMENT PLAN - D73A AND D41J

In view of the detailed dolomite aquifer characterisation in the close proximity to the Postmasburg area (Vaal-Gamagara SD2) and planned development of a 3D numerical model, it is proposed that the site will be used for the injection well tests. Excessive mine dewatering exists currently form the Kolomela mine south of Postmasburg.

The planned site will be located at a dyke with high yielding boreholes in the dolomite aquifer on both sides, to allow one side to be pumped and water injected into the other side at high yielding boreholes with at least two monitoring boreholes. The planned injection will be below water level at cavity or karts horizons in the borehole. In view of the high hydraulic conductivity of the aquifer the available water level depth (~20m) will not require design of special constructed pressure wells. Cost provision is made to conduct an injection test for up to 7 days and monitor the aquifer response.

Assessing the viability of groundwater injection (artificial recharge) for the purpose of Aquifer Storage and Recovery (ASR) into a borehole in the dolomites of the Postmasburg region will be based on a combination of field investigations, hydraulic testing, and groundwater flow modelling using a finite element model to simulate various injection scenarios.

**Water Quality**

Although there are numerous factors that affect the viability of artificial recharge schemes, it appears that, in most international cases, an understanding and an ability to deal with water quality and clogging issues are essential for the successful operation of a scheme. Recharge water quality is the key factor and suspended solids are listed as the main criterion for both surface infiltration schemes and borehole injection. The natural quality of groundwater will also determine the extent to which blending with compatible water is possible without affecting the aquifer and the usability of the water. As part of the viability study the intended artificial recharge scheme should be tested through a detailed water quality monitoring strategy to predict and quantify the hydrogeochemical impact and sustainability of the proposed artificial recharge scheme. These water quality monitoring objectives include:

- Provide detailed information on recharge water quality
- Provide details of background water quality in the aquifer
- Determine the need for pre-treatment processes
- Demonstrate that groundwater quality in the aquifer is maintained or improved
- Monitor the recovered water quality according to criteria for the intended use (After implementation or during pilot study)

**Hydraulic Tests**

Two main physical characteristics determine whether or not an aquifer is suitable for accepting, storing and recovering artificially recharged water. These are the aquifer’s hydraulic conductivity and its storage capacity. Both of these parameters are determined during the analysis of hydraulic (pumping) tests.

**Modelling component**

The hydraulic tests will be used to calibrate the locally refined finite element model. The model will then be applied to simulate a range of recharge conditions and operational constraints to estimate:

- injection capacities of the major aquifer,
- resultant changes in groundwater elevations,
- and the fate of injected water.
- A mass transport (based on the calibrated flow model) model will be used to assess the spread of soluble substances to determine the impact of the proposed injected water with the groundwater present in the injection zone (dolomite aquifer).
Step 3: Assessment of Water Use, aquifer performance and compliance, these are outlined in previous section of the proposal.

Step 4: Review control and license conditions, this will be done in conjunction with the DWA representatives and interventions recommended if required;

Step 5: Review Licensing conditions and RQOs

Step 6: Recommend remedial actions to mitigate risks that will be identified;

Step 7: Review and confirm remedial actions with on-going monitoring;

Step 8: Prepare actions plans for catchment level management which includes construction of methodology, key success factors, time frames for implementation and monitoring criteria.

Step 9: Collate information into a management report, this will include;
- Summary of catchment management strategy and goals,
- Presentation of water level, water use and water quality trends, and comparison against RQO’s
- Details of new licences issued,
- Details/update of monitoring frequency for all users in the drainage regions
- Recommendations for adjusting management objectives to ensure sustainability

The management report will be distributed to all stakeholders and the national office. In view of the available catchment committees and forums within the region, the technical study team will form part of the steering committee aiming at contributing on technical and specialist study issues.

A summarized study report will be compiled on completion of Task 7 and final stakeholder presentation.

Study progress reporting will be done monthly. Study reports (draft) will be send to Aurecon and DWA for review. Comments will be revised and the final draft submitted to the client at the end of the contract term.

6.0 PROJECT TEAM

Golder Associates Africa currently employs over 300 staff in Africa which comprises of a multi-disciplinary team of Water Experts, Environmentalists, Engineers, Technicians, Administration, Health and Safety support staff and Finance personnel. If required, Golder Associates Africa can also call on a resource base of over 7,000 employees located worldwide. In addition to its full time employees, the company has short-term specialist consultants of various disciplines on its panel.

We draw your attention to our team’s specific capabilities and experience that are particularly suited to this project:
- Proven record on water supply projects encompassing the full project life cycle i.e. from the feasibility stage (resource determination) to implementation stage
- Extensive experience and a proven track record on similar projects in Africa and internationally
- Proven experience in the technology selection for similar projects
- Ability to work to agreed, tight deadlines.

The CVs for the Golder proposed team can be provided on request.

It is proposed that Collen Monokofala (Hydrogeologist, Division of Groundwater and Geochemistry) of Golder’s Pretoria Office will be responsible for managing the project with Frans Wiegmans as the Project

Golder

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7.0 PROJECT EXPERIENCE

The experience record for Golder Associates on some relevant projects is given in the Table 2 below.

Table 2: List of relevant projects and project experience executed by Golder Associates

<table>
<thead>
<tr>
<th>Item</th>
<th>Project Name</th>
<th>Description</th>
<th>Engineering Disciplines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kumba Iron Ore – Sishen mine</td>
<td>Rehabilitation of the hydrocarbon sites at Sishen mines</td>
<td>Environmental Technology, Groundwater and Geochemistry</td>
</tr>
<tr>
<td>2</td>
<td>Vaal Gamagara (VGG) Bulk Water Supply – Groundwater Development for augmentation of water supplies - current</td>
<td>Assessment of groundwater resources in four identified areas (SD1 to SD4) to augment water supply (short/long term) to the VGG pipeline. Regional dolomite and BIF resources comprising several dolomite compartments are being investigated to potentially establish a sustainable supply of 20 million m$^3$/annum. Artificial recharge to be investigated in areas SD2 and SD3. Value: R44 000 000</td>
<td>Environmental Technology, groundwater and Geochemistry</td>
</tr>
<tr>
<td>3</td>
<td>Resource Assessment of the Kathu and Khai-appel Aquifers for water supply to the planned Bestwood Housing Project - Kathu.</td>
<td>Groundwater Resource Assessment for WULA. Sustainable yield assessment of existing boreholes and resource assessment of the Kathu and Kai-Appel aquifers. Resource sustainability is based on lateral groundwater. Value: R300,000</td>
<td>Environmental Technology, groundwater and Geochemistry</td>
</tr>
<tr>
<td>4</td>
<td>Water Resources Strategy for the Kgalagadi District Municipality – Groundwater Situation Assessment -2006: VSA/Golder</td>
<td>Delineation of groundwater resources over an area of 28,000 km$^2$ including &gt; 500 dolomite compartments. Analysis of rainfall recharge and sustainable groundwater utilization potential. Identify existing water use. Value: R600,000</td>
<td>Environmental Technology, groundwater and Geochemistry</td>
</tr>
</tbody>
</table>
The project costing is presented in Table 4 in accordance with the 7 main tasks/deliverables with an indicative breakdown between fees and disbursements.

### Table 4: Project Costing and Schedule

<table>
<thead>
<tr>
<th>Name</th>
<th>Fees</th>
<th>Disbursement</th>
<th>Amount</th>
<th>Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>R150,000</td>
<td>R13,000</td>
<td>R163,000</td>
<td>End January 2014</td>
</tr>
<tr>
<td>Task 2</td>
<td>R30,000</td>
<td>R0</td>
<td>R 30,000</td>
<td>End January 2014</td>
</tr>
<tr>
<td>Task 3</td>
<td>R130,000</td>
<td>R90,193</td>
<td>R220,193</td>
<td>Mid March 2014</td>
</tr>
<tr>
<td>Task 4</td>
<td>R60,000</td>
<td>R0</td>
<td>R 60,000</td>
<td>Mid March 2014</td>
</tr>
<tr>
<td>Task 5</td>
<td>R70,000</td>
<td>R18,000</td>
<td>R 88,000</td>
<td>September 2014</td>
</tr>
<tr>
<td>Task 6</td>
<td>R80,000</td>
<td>R18,000</td>
<td>R 98,000</td>
<td>September 2014</td>
</tr>
<tr>
<td>Task 7</td>
<td>R200,000</td>
<td>R20,000</td>
<td>R218,000</td>
<td>November 2014</td>
</tr>
<tr>
<td>Sub Total</td>
<td>R720,000</td>
<td>R167,000</td>
<td>R887,193</td>
<td></td>
</tr>
<tr>
<td>VAT</td>
<td></td>
<td></td>
<td>R122,807</td>
<td></td>
</tr>
<tr>
<td>Total Cost (Vat Incl)</td>
<td></td>
<td></td>
<td>R1,000,000</td>
<td></td>
</tr>
</tbody>
</table>

The project can commence in November 2013 on Tasks 1 and 2. The artificial recharge injection fieldwork is scheduled for mid February and completion of Task 3 mid March 2013. Estimated completion dates for each task is listed in Table 4. The project can be completed end November 2014 (13 months from project start).

Estimated expenditure for financial year (FY) 2013/2014 is R540,000 and the remaining budget of R460,000 for FY 2014/2015.

### 9.0 TERMS AND CONDITIONS

On acceptance of this proposal, as evidenced by the issuing of a purchase order or a letter of acceptance by the Client to Golder, this project will be executed in accordance with the Golder conditions of engagement for consulting services (Version 22) attached hereto, unless a contract or master services agreement has already been agreed upon between the parties hereto or the Client expressly indicates that its Terms and Conditions will apply and provides a copy thereof for Golder’s review and acceptance.

GOLDER ASSOCIATES AFRICA (PTY) LTD.

[Signatures]

Colleen Monokofala (Pr.Sci.Nat) Frans Wiegmans
Senior Hydrogeologist Associate Hydrogeologist

Reg. No. 2002/007104/07
Directors: SAP Brown, L Greyling, RGM Heath, FR Sutherland

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28 October 2013
Proposal No. P3615572
CONDITIONS OF ENGAGEMENT FOR CONSULTING SERVICES

Golder Associates (Pty) Ltd. (hereinafter referred to as “Golder”) and the Client (as described in the attached Proposal document) agree that any professional services, including subsequent services and charges (collectively the Services), to be provided by Golder relating to the Proposal will be on the following Terms and Conditions. Collectively the Proposal and the following Terms and Conditions form the Agreement between the Client and Golder.

1.0 STANDARD OF CARE – Golder shall provide the Services with such reasonable skill, care and diligence as is ordinarily exercised by consultants in similar circumstances at the time the Services are provided. Golder shall provide the Client with an opportunity to provide feedback regarding the provision of the Services at any time during the course of the project.

2.0 SITE DISTURBANCE – Where fieldwork activities are undertaken as part of the Services, the Client understands that in the normal course of work some surface disturbance will occur. Unless expressly described in the Proposal, or required by law, Golder’s responsibility to make good for disturbance caused during Golder investigation activity shall be limited to uncompacted backfilling of test pits and surface-plugging of boreholes not otherwise capped. Any other repair or re-instatement of pavements or other surface finishes shall be the Client’s responsibility and is not part of this Agreement.

3.0 RIGHT OF ENTRY, PERMITS, SITE INFORMATION AND UTILITIES – The Client shall obtain all necessary permits and licenses and provide right of entry for Golder and its subcontractors to carry out the Services. The Client (at its own cost) shall provide to Golder in advance all relevant and necessary information, documents and other particulars concerning the provision of the Services including but not limited to any on-site hazardous materials and underground utilities. The Client agrees that Golder may rely on such information.

4.0 SAFETY – a) The client is responsible for the site safety of its employees, agents, contractors and subcontractors, consultants and sub consultants. Golder shall only be responsible for Golder’s activities and that of its employees and its sub consultants. Nothing shall imply that Golder has any responsibility for job site safety which is the responsibility of the Client or its agents or contractors.

b) The Client shall in advance provide any environmental, health, or safety policies or procedures it requires Golder to comply with during provision of the Services. If no policies or procedures are provided, Golder shall abide by its own policies and procedures in the provision of the Services.

5.0 PAYMENT – The Client shall pay to Golder the Fees and Expenses as set out in the attached Proposal without set off or deduction. Payment shall be in Rand unless expressly agreed otherwise. If Rand is not the currency of the country in which the Services are provided, the exchange rate for payment from local currency to Rand shall be that at the time of invoice. Where this Agreement has been entered into or authorised by an Agent (or a person purporting to act as an Agent) on behalf of the Client, the Agent and the Client shall be jointly and severally liable for payment of all accounts due to Golder under this Agreement. All monies payable by the Client to Golder shall be paid within thirty (30) days of the date of the invoice. The final invoice shall be submitted with the submission of the report with the associated data analysis. Monies not paid within that period shall attract interest from the date of the invoice until payment at a rate of 1.5% per month, plus debt collection fees where applicable. Client shall notify Golder within ten (10) days of receipt of any invoice of any dispute with the invoice and the parties will promptly meet to resolve the dispute. Unless such notification is received by Golder, the Client agrees the invoice will be deemed valid and payment is due under the terms of this Condition.

6.0 RATES – The rates set out in the Proposal are applicable for 6 months after acceptance of the Proposal or the duration of the Services, whichever is lesser. Thereafter the Rates shall be reviewed and adjusted with respect to market conditions. Insofar as Golder may provide plant and any specialist equipment to be used for the Client’s benefit, the specific rates and liabilities associated therewith will be dealt with in a separate agreement between the parties.

7.0 LIMITATION OF LIABILITY - To the maximum extent permitted by law:

a) Subject to paragraphs (b) and (c) below, the liability of Golder, its employees, officers and directors arising out of the performance or non-performance of the Services, whether under law of contract, tort, delict or otherwise, shall be limited in aggregate to the cost of rectifying the works the subject of the Services or twice the amount of the Fees, whichever is the lesser of the two.

b) Golder shall not be liable for any damages or consequential losses caused by incomplete or inaccurate information provided by the Client. Golder shall not under any condition be liable to the Client in respect to any indirect, consequential or special losses incurred directly or indirectly by the Client arising from this agreement (including but not limited to loss of profit, loss of business opportunity and payment of liquidated sums or damages under any other agreement), unless such losses arise from negligence or wilful misconduct of Golder or any of its employees, officers, directors or sub-contractors.

c) Golder shall be deemed discharged from all liability in respect of the services, whether under the law of contract, tort, delict, or otherwise, on the expiration of three (3) years from the completion of the Services, the date of invoice in respect of the final amount claimed by Golder pursuant to Clause 5 above, or the termination of this Agreement, whichever is earliest. The Client shall not be entitled to commence any action or claim whatsoever against Golder or any employee, agent or sub-consultant of Golder in respect of the Services after that date.
c) The Party not claiming Force Majeure shall have a period of ten (10) Days from the day after the day of receipt of the notice to contest the content of it, failing which the constitution of Force Majeure shall be considered accepted.
d) In the event that Force Majeure continues, the Party invoking it must provide every ten (10) Days from the receipt of the first notice the other Party with supplemental briefs regarding Force Majeure, its effects on the execution of its obligations as well as a predictive assessment of the duration of Force Majeure.
e) The Party invoking Force Majeure shall make every effort and take all necessary measures to limit the scope and thus protect the interests of the other Party by protecting it from further delays and losses. f) In case of any delay by either Party in the execution of its contractual obligations due to a case of Force Majeure, the prescribed time for the execution thereof shall be extended automatically for a period equal to the related delay, provided all previous invoices have been paid.
g) The extension thus made shall entail no penalty at the expense of the Parties. However, when Force Majeure is invoked by Golder thereby preventing it from fulfilling its obligations under the Agreement, the Client will be entitled to suspend its payments until the effective resumption of the Services by Golder.
h) When Force Majeure represents a final obstacle to the execution of the Agreement or when Force Majeure preventing the execution of the Agreement lasts beyond a limit of thirty (30) Days, the Parties agree to consult together to consider its termination. The most prompt Party shall notify the other Party in writing of its desire to meet to consider a possible termination. The meeting will take place within ten (10) Days from the day after the receipt by the other Party of such notice. Should the Parties not meet within this period and unless the Parties agree in writing to extend such period, the Party not invoking Force Majeure may then request the termination of the Agreement by notifying the other Party in writing of its intention by a ten (10) days’ notice.

17.0 MISCELLANEOUS
a) This Agreement shall be subject to the laws of the Republic of South Africa. The parties irrevocably agree to submit to the non-exclusive jurisdiction of the courts of the Republic of South Africa.
b) This Agreement is the entire Agreement between the parties for the provision of the Services in the attached proposal and supersedes all other agreements, representations, correspondence, and discussions in connection with the Services. In particular, no terms incorporated into or referenced by any Purchase Order, however and whenever presented, shall at any time operate to amend or substitute for the terms of this Agreement.
c) If any Clause of this Agreement is found to be inoperable due to illegality, such Clause is severed from the Agreement and the rest of the Agreement remains in force. If any issue arises between the parties on which this agreement is silent, or a Clause is found to be inoperable, the relevant terms and conditions of the South African Association of Consulting Engineers, and failing that the Client/Consultant Agreement of FIDIC, shall be applied to the extent required to remedy that silence or inoperability.
d) Nothing in this Agreement nor in the performance of the Services, shall be construed as creating a relationship of agency, partnership, or other relationship other than that of Client and Consultant between the parties.
e) This Proposal is valid for 60 days from the date of submission that appears on the Proposal unless another period is agreed to and confirmed in writing.

GOLDER ASSOCIATES AFRICA (PTY) LTD.