Development of a 'Blue Drop' type Scoring System for Groundwater Management at Municipal Level

Report to the
Water Research Commission

by

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WRC Report No. KV 311/12
ISBN 978-1-4312-0388-8

March 2013

The publication of this report emanates from a project entitled *Development of a "Blue Drop"-type scoring system for groundwater management at municipal level* (WRC Project No. K8/1001)

1. INTRODUCTION

Riemann et al. (2011) developed a Groundwater Management Framework under a WRC funded project (K5/1971). This framework outlines the activities required by different authorities, but mainly the Water Services Authorities, to ensure integrated and sustainable groundwater management. Although this framework still needs to be rolled out to the municipalities for implementation, most municipalities that utilise groundwater as a water resource already undertake some of the activities described in the Groundwater Management Framework.

It was therefore proposed to develop a scoring system that allows for tracking the progress in implementing of the Groundwater Management Framework and acknowledging the successful and sustainable groundwater management at municipal level.

2. PROPOSED NAME OF SCORING SYSTEM

It is proposed to call the scoring system for groundwater management at municipal level the

SILVER DROP

Silver is a precious metal found underground. Hence, the colour is linked to the earth and subsurface, but without having negative associations, such as Gold.

3. SCORING SYSTEM

A scoring system was developed based on the structure of the Blue Drop system for Drinking Water Quality. The scoring system contains a number of criteria, indicators and requirements that are linked to the different aspects of the Groundwater Management Framework and promote sustainable groundwater management at municipal level.

The criteria of the proposed scoring system are:

- Aquifer Management Plan
- Integration of groundwater into municipal planning
- Monitoring Protocol
- Operation and Maintenance Plan
- Institutional arrangements
- Authorisation of water use

The six criteria and their indicators, requirements and proposed weightings are described below and summarised in Table 1. Comments, received on the draft scoring system during the development of the system, are listed in Appendix A.

3.1 AQUIFER MANAGEMENT PLAN

It is recommended in the Groundwater Management Framework that groundwater management plans be developed for all relevant aquifers in the jurisdiction of the WSA to facilitate the sustainable management of the aquifers from an aquifer protection and aquifer utilisation perspective. Such an 'Aquifer Management Plan' must entail the vision for the aquifer management, which should be linked to the Catchment Management Strategy and or the Water Resource Classification / Reserve determination, and clearly defined actions to ensure sustainable management or improve performance, where needed.

The Aquifer Management Plan should preferably be based on and underpinned by a groundwater assessment at a suitable level of investigation, a conceptual understanding of the aquifer characteristics, a numerical model of different scenarios and an economic valuation of the groundwater resource and its contribution / significance with respect to maintaining or supporting the economic situation in the region.

Hence, the indicators under this criterion are:

- Aquifer Management Plan & annual action plan
- Groundwater assessment
- Numerical model
- Groundwater resource valuation

The required level of investigation for these three aspects depends upon the envisaged aquifer use and the aquifer characteristics, and needs to be determined by the assessor prior to completing the 'Silver Drop' assessment. The rule of thumb is that extensive utilisation and vulnerable aquifers require a more detailed investigation.

3.2 INTEGRATION OF GROUNDWATER INTO MUNICIPAL PLANNING

To ensure that the Aquifer Management Plan is utilised and supported by all relevant municipal departments, groundwater aspects need to be integrated into the municipal planning. This relates mainly to the regular process to develop an Integrated Development Plan (IDP), which also encompasses the Water Services Development Plan (WSDP), the Spatial Development Framework (SDF) and the Integrated Water Resource Management Plan (IWRMP). Groundwater must be considered in all of these municipal planning documents:

- WSDP: current and future aquifer utilisation, sustainability of groundwater use
- SDF: landuse activities that could impact on groundwater recharge or water quality
- IWRMP; all aspects of integrated water resource management, waste, waste water etc.

Other relevant documents to promote or enforce sustainable groundwater management are the Water Conservation and Water Demand Management Strategy and water services bylaws. For all actions identified in these plans, budget must be assigned and evidence provided for their implementation.

3.3 MONITORING PROTOCOL

It is only possible to manage something, if changes, whether intentionally or not, are measured and analysed. Hence, a monitoring protocol should be developed that describes the monitoring network, type and frequency of monitoring and responsibilities for data collection and data analysis. The monitoring network must cater for both groundwater quantity and groundwater quality related parameters and must be sufficient in its spatial distribution and applied technology to allow for establishing cause and effect relationships.

Monitoring data are only useful for this exercise, if the sampling and analysis is credible and reliable, and a strict data management protocol is followed to ensure consistency and accuracy in the data that are used for further analysis and decision making. The results of the monitoring activities must be used for updating the Aquifer Management Plan and or any other relevant plan that supports the groundwater management.

Hence, the indicators under this criterion are:

- Monitoring network
- Regular sampling and measurements
- Credibility of sample analysis
- Data management
- Adaptive management
- Budget for monitoring

3.4 OPERATION AND MAINTENANCE PLAN

Where an aquifer is used for water supply, either for potable water or private agricultural use, the wellfield operation and maintenance (O&M) plays a vital role in ensuring sustainable groundwater management and avoiding over abstraction and or detrimental impacts on other users or the environment. Hence, an Operation & Maintenance Plan is required that describes the operational rules under different conditions (e.g. standard conditions, drought, equipment breakdown) and provides details for regular and ad-hoc maintenance actions for all relevant equipment.

The operational rules should be flexible enough to be adjusted as per the monitoring results. Hence, it is recommended to have an early warning system built in to the monitoring network to allow for timeous adjustments to the wellfield operation. Both elements require sufficient budget to cater for ongoing supervision and ad-hoc interventions.

3.5 INSTITUTIONAL ARRANGEMENTS

Correct institutional arrangements and qualified staff are often seen as the most important aspects for ensuring sustainable groundwater management. The Water Services Act prescribes that WSA and WSP functions are clearly split within the municipality, if the WSP function is not outsourced. This allows for the planning and regulatory function of the WSA and strengthens the supervisory role with respect to water resource management.

Groundwater management is a highly complex issue and requires qualified staff at technical management and operational level. The WSA manager or technical director should have a relevant qualification or at least experience in groundwater management, while the operational staff must be sufficiently trained to understand the different technical challenges and adhere to the O&M Plan. The use of external groundwater specialists as well as ongoing training in groundwater related aspects is encouraged.

Usually, the WSA is not the only water user from the respective aquifer. Hence, engagement and liaison with other users, stakeholders and interested and affected parties (I&AP) is required. Preferably, the WSA should be part of a Water Users Association for the specific aquifer or catchment. In addition, an aquifer monitoring committee should be established, comprising I&APs, stakeholders and authorities, to ensure that the aquifer is managed in an integrated manner, based on monitoring data that all stakeholders agree upon. Both aspects become now conditions in new licences for water use, as stipulated by the DWA.

The public perception on groundwater use and its sustainability must be managed as well. Hence, the monitoring results and groundwater management performance by the municipality should be published in several media, similar to the publication of drinking water quality compliance or dam level situation.

3.6 AUTHORISATION OF WATER USE

Any activity that could impact negatively on the groundwater resources should be authorised prior to commencing with such an activity. This refers to the required licence from the DWA for groundwater abstraction, as well as environmental authorisation by the Department of Environmental Affairs (and permit by the DWA, if applicable) for potentially harmful landuse activities, such as waste water treatment, waste deposits, irrigation with effluent water, industrial site development, significant change of landuse etc.

Any licence, permit or Record of Decision has usually conditions attached to it that need to be adhered to. The compliance with these conditions must be reported on, and should be regularly reviewed and updated, where monitoring data requires to do so.

Table 1 Proposed Scoring System for groundwater management at municipal level ('Silver Drop')

Criteria	Weighting	Indicators	Requirements	Score
Aquifer Management Plan	20	• Annual Action Plan	• Is the Aquifer Management Plan formulated and aligned to the CMS? • Does it contain a list of actions to improve performance?	40%
		• Groundwater Assessment	• Does a groundwater assessment for the relevant aquifer exist as basis for an aquifer management plan? • Is the level of assessment sufficient wrt to the aquifer use? • Assessment carried out by groundwater professional?	30%
		• Numerical model	• Is the aquifer behaviour conceptually understood? • Is a regional numerical aquifer model developed? • Is the model updated regularly?	20%
		• Groundwater resource valuation	• Are the different ecosystem services of the aquifer considered? • Are the full groundwater economics taken into account in decision making, tariffs etc.?	10%
Integration of GW into municipal planning	20	• Integration in IDP Process, (WSDP, SDF, IWRMP)	• Are the aquifers and groundwater management issues addressed in the IDP process and documents? o WSDP o SDF o IWRMP	40%
		• WC/WDM Strategy	• Does a WC/WDM Strategy exist that promotes groundwater use and management?	10%
		• Bylaws	• Are groundwater related or aquifer specific bylaws in place?	20%
		• Implementation of plans and bylaws	• Evidence of plans and bylaws being implemented • Budget assigned for implementation	30%
Monitoring Protocol	20	• Monitoring network	• Groundwater quality and quantity monitoring network defined and agreed upon by WSA, relevant authority and stakeholders • Monitoring network and technology considered sufficient	20%
		• Regular sampling and measurements	• Continuous monitoring of water level at strategic sites • Sampling as per Monitoring Protocol	20%
		• Credibility of sample analysis	• Chemical analysis carried out by accredited laboratory	10%
		• Data management	• Data capture and data storage in suitable electronic format • Data exchange with regional and national databases possible • Results submitted to relevant authority as agreed upon	10%
		• Adaptive management	• Do monitoring results influence the Aquifer Management Plan, the IDP and or the O&M Plan?	20%
		• Budget for monitoring	• Budget assigned for monitoring as per monitoring protocol	20%

Criteria	Weighting	Indicators	Requirements	Score
O&M Plan	20	• Operational Rules	• Operational rules for wellfield management are clearly defined and aligned with licence conditions and aquifer management plan • Special operational rules for emergency situations; e.g. breakdown or drought, are defined • Early warning system, telemetry etc. in place	40%
		• Maintenance Plan	• Asset Management system exists for all wellfield components, especially mechanical and electrical • Maintenance plan for all relevant equipment is in place and implemented, including, *inter alia*: o Borehole yield testing and rehabilitation, if required o Inspection of pumps and repair/replacement, if required o Inspection of pipework and cleaning, if required o Inspection of electrical supply and controls o Calibration of monitoring equipment, and repair, if required	40%
		• Budget for O&M	• Budget assigned for wellfield operation & maintenance	20%
Institutional arrangements for groundwater management	10	• Split of responsibilities between WSA and WSP	• Split of responsibilities between WSA and WSP functions within the municipality, or WSP function outsourced?	10%
		• Groundwater knowledge / expertise at management level	• WSA manager, technical director or similar with qualification / knowledge / expertise in groundwater management • Use of external groundwater specialist / consultant	20%
		• Trained and skilled operational staff	• Operational staff sufficiently skilled • Ongoing training provided for operational staff	30%
		• Official stakeholder forum	• Municipality is part of a Water Users Association • Monitoring Committee of I&AP and stakeholders established	30%
		• Publication of groundwater management performance	• Monitoring results are published in papers or website • Groundwater management performance published	10%
Authorisation of water use	10	• Groundwater abstraction	• Licence for groundwater use is applied for • Groundwater use is licensed	50%
		• Landuse activities	• Environmental authorisation and permits for potentially harmful land use activities obtained	20%
		• Compliance	• Licence and permit conditions are adhered to • Regular licence review	30%

4. TEST APPLICATION

A questionnaire was developed and sent to selected municipalities, to test the applicability of the scoring system. The questionnaire is attached as Appendix B.

The following municipalities were selected for testing the scoring system:

- Overstrand Municipality for the aquifers in Hermanus and Stanford,
- Oudtshoorn Municipality for the Klein Karoo Water Supply System (KKRWSS),
- City of Cape Town for the Atlantis Aquifer,
- City of Tshwane for the different springs supplying Pretoria, and
- Baviaans Municipality for the aquifers supplying Willowmore and Steytlerville.

By end of May, only the responses from the Overstrand Municipality and the Oudtshoorn Municipality have been received (see Appendix C). These responses, additional documents and in-house knowledge of the status of the aquifer management and municipal planning documents were used to test the criteria and requirements and to apply the scoring system. The detailed scoring is shown in Appendix D, while Table 2 below provides a summary of the results. The ranking of the results follows the structure of the Blue Drop System (see Table 3).

Table 2 **Application of draft scoring system to aquifers in the Overstrand Municipality (Hermanus and Stanford) and a water supply scheme in the Oudtshoorn Municipality (KKRWSS)**

Criteria		Weighting	Hermanus	Stanford	KKRWSS
1	Aquifer Management Plan	20	13.24	11.44	11.24
2	Integration of groundwater into municipal planning	20	14.56	15.28	11.88
3	Monitoring Protocol	20	20.00	19.00	16.60
4	Operation & Maintenance Plan	20	18.80	14.40	11.20
5	Institutional arrangements for groundwater management	10	8.18	6.30	4.50
6	Authorisation of water use	10	10.00	6.00	6.75
	Total	**100**	**84.78**	**72.42**	**62.17**

Table 3 **Ranking and colour coding of scoring results**

Critical state	<33%
Poor performance	33% - 50%
Average performance	50% - 75%
Good status	75% - 90%
Excellent performance	>90%

The main difference between the two aquifers within the Overstrand Municipality lies in the fact that the Stanford Aquifer is currently under development for augmenting the municipal water supply to Stanford. The municipality is awaiting the licence, which will determine the implementation of certain procedures to improve the performance; e.g. the final O&M plan.

The Oudtshoorn Municipality operates the Klein Karoo Rural Water Supply Scheme, providing potable water to rural communities between, but excluding, De Rust and Calitzdorp successfully. However, improvements in the monitoring of impacts and the operation & maintenance of the wellfields would ensure sustainable groundwater utilisation and higher scores in the assessment.

Further improvement is required for three test cases with respect to the Aquifer Management Plan, which needs to be formulated. However, the principles of such a plan are already considered in planning, development and monitoring

5. SILVER DROP VS. BLUE DROP

Some elements of the proposed 'Silver Drop' are already captured during the Blue Drop Certification Assessment by DWA. In discussions with the DWA it became evident that the process of assessment for the different certification processes should be combined to better facilitate the interaction with the WSAs. The groundwater management elements that are already included or could easily be inferred are listed below:

- **Design Capacity:** If water supply comes from boreholes, the borehole yield should be stated
- **Requirement 1.2 – Risk Assessment:** If the water supply comes from boreholes, the risk assessment should include a geohydrological assessment with respect to water quality and yield. Evidence of this risk assessment would be in the form of technical reports, the inclusion of groundwater aspects in the WSDP and SDF, and a water use licence (part of Silver Drop Criteria 1, 2 and 6).
- **Requirement 1.3a – Operational Monitoring:** The requirement states the monitoring of raw water quality, which in the case of borehole supply refers to groundwater (part of Silver Drop Criteria 3).
- **Requirement 1.4 – Credibility of DWQ Data:** This requirement should apply to all relevant chemical analysis (part of Silver Drop Criteria 3).
- **Requirement 5.6 – Design Capacity vs. Operational Capacity:** "Groundwater dependant systems must have an acceptable plan which stipulates abstraction patterns that will prevent aquifer damage" with scoring information "evidence of verified plant capacity / aquifer utilisation plan" and "Providing recorded pumping rate from aquifer but exceeds geohydrological recommendation i.t.o Yield" (part of Silver Drop Criteria 1, 4 and 6).

The Green Drop Assessment caters for groundwater monitoring in the vicinity of waste water treatment plants with evaporation ponds, which covers only a small portion of the required groundwater management with respect to land use and pollution prevention.

In addition to the above requirements, the existing Blue Drop Assessment Form could be further amended to cater for most or all of the Silver Drop Assessment requirements. It is recommended to insert a new requirement under Criteria 1 – Water Safety Planning, which would cater for most aspects of groundwater management.

Requirement	Sub-requirements
(1.6) Groundwater Management	a) Groundwater assessment and aquifer management plan must be in place, where groundwater is utilised for water supply, or identified in the Risk Assessment as critical b) There must be evidence in the WSDP, SDF, WC/WDM Strategy and bylaws that the use and management of groundwater is integrated into municipal planning c) A groundwater monitoring protocol must be developed and implemented according to specification and legal requirements d) The water use and any relevant land use activities must be authorised and evidence provided that conditions are complied with.

The assessors should then use the detailed criteria and indicator list in Table 1 as questionnaire and for the assessment.

Additional amendments are suggested for other criteria in the Blue Drop Assessment Form, as listed in Table 4 below.

Table 4 Suggested amendments to the Blue Drop Assessment Form for inclusion of Silver Drop Criteria

Blue Drop Criteria / Requirements	Suggested amendment to sub-requirements
1.1 Water Safety Planning Process	a.) The Water Safety Planning Process is steered by a group of people that includes the technical, financial and management staff of the municipality. Where a WSP arrangement exist the WSA and WSP should partake in this process. b.) There should be clear indication that the water services institution conducted a water safety planning process and not only drafted a document. c.) There should be clear reference to the specific water supply system at hand and not only global risk management measurements put in place. d.) The Water Safety Plan must be aligned with and reflected in the IDP, WSDP, SDF and IWRMP
1.2 Risk Assessment	ADD: e.) The Risk Assessment must take information and feedback from the groundwater assessment and management into account with respect to aquifer protection and available supply volumes
1.3 Risk-based Monitoring Programme	a.) Prove Operational Monitoring is: i) Informed by the Risk Assessment and Groundwater Management Protocol, if applicable ii) Required sites to monitor: Raw water at source, raw water at plant, after filtration (per process unit) and final water. iii) Determinands: pH, turbidity and disinfectant residual iv) Frequency of analyses: at least once per shift (i.e. every 8 hours) v) Equipment used + Evidence of calibration (or any other means of ensuring credible readings for the past 3 years).

Blue Drop Criteria / Requirements	Suggested amendment to sub-requirements
1.5 Incident Management	Protocol to specify: (1) alert levels, (2) response times, (3) required actions, (4) roles & responsibilities, (5) communication vehicles and (6) must include response on possible risks identified in the Risk Assessment and actions defined in the Groundwater Management Plan of the Water Safety Planning process Incident Register to include : (7) Date, location and description of incident (8) Action taken and date of resolution (9) Outcome of cause investigation
4.1 Management Commitment	Management's commitment to effective Drinking Water Quality Operations and Management as well as Integrated Water Resource Management should be portrayed by setting-up / supporting stakeholder forum and or Water Users Association and Proof of signature approval of the: a) Water Safety Plan; b) DWQ Monitoring Programme c) Water Treatment Plant Logbook d) Operations and Maintenance Budget e) Water Services Development Plan
4.2 Publication of Performance	Evidence should be provided on the various means of drinking water quality and IWRM performance information made public to the constituencies supplied with drinking water from this specific water supply system. Forms of Publication: >Newspaper publication >Municipal Billing >Annual Report >Posters & Pamphlets >Population and Promotion of ""My Water"" >Electronic Webpage The Water Services Authority must ensure that evidence of adequate marketing of Existing Blue Drop Certified water supply systems are presented during the audit.
4.3 Service Level Agreement	Should there be an institutional arrangement between Water Services Authority and Water Services Provider ~~the~~ it is essential that the legislatively required contract stipulate Service Level Agreements between the two entities. A copy of this document is required. OR Should the Water Services Authority fulfil the function of Water Services Provider as per Section 78 arrangements, then it is required that the responsible manager (official) have a Performance Agreement (Workplan) in place which stipulates Drinking Water Quality Management Responsibilities and Groundwater Management Responsibilities. "

Blue Drop Criteria / Requirements	Suggested amendment to sub-requirements
5.1 Annual Process Audit	Process Audit Report on technical inspection/assessment of treatment facility and bulkwater abstraction facilities and evidence of implementation of findings This process assessment should've been done within the 12-month assessment period
5.2 Asset Register	The Institution must present a complete Asset Register for both the treatment plant and the bulkwater supply (e.g. dam, pumpstation, wellfield). The asset register must : a) detail relevant equipment and infrastructure b) indicate asset description c) location d) condition (remaining life) e) replacement value
5.3 Availability and Competence of Maintenance Team	a) The Institution must present evidence of a competent Operations and Maintenance Team for both the treatment plant and the bulkwater supply (e.g. dam, pumpstation, wellfield) (in form of Organogram; Contract or Invoice). Logbook with maintenance entries will serve as adequate evidence. b) Additional prove required on team competency (e.g. Qualification & Experience & Trade-test)
5.4 Operations & Maintenance Manual	O&M manual to contain: a) civil, mechanical, electrical detail of plant, b) design capacity of plant, c) reference to drawings, d) operational schedules, maintenance schedules, e) process detail and control, f) instrumentation specification/type, g) fault finding, h) monitoring, i) pump curves, ~~g~~k) supportive appendices, l) operational rules for the bulk water abstraction for normal and drought conditions m) operational rules for emergency situations, e.g. pump breakdown or pipe burst
5.5 Operations & Maintenance Budget and Expenditure	The Institution must present credible evidence of: a) Maintenance Budget (as part of Operations Budget) b) Maintenance Expenditure (as part of the Operations Expenditure) c) Maintenance Expenditure should be more than 5% of the Operations Expenditure in Total for the preceding Financial Year. d) Monitoring Budget (as part of Operations Budget)
5.6 Design Capacity vs. Operational Capacity	Proof to be submitted of the documented design capacity and documented daily operating capacity over the past 12 months Groundwater supply ~~dependant~~ systems must have an acceptable operational plan which stipulates abstraction patterns that will prevent over-abstraction and detrimental environmental impacts ~~aquifer damage~~ Flow meters must be calibrated at least annually.

6. CONCLUSIONS

The Draft Scoring System was successfully tested and applied to two aquifers in the Overstrand Municipality and a water supply system in the Oudtshoorn Municipality. The scoring system can be used to highlight areas of concern and required improvements.

However, the application of the scoring system requires knowledge of the aquifer system, its potential and vulnerability that often goes beyond the current capacity of the municipality. Furthermore, the municipalities need assistance and guidance in incorporating groundwater related issues into the municipal planning instruments.

It is recommended to test the scoring system with data from other municipalities, as well as with data collated during the recent Blue Drop Assessment. The current Blue Drop Assessment Form should be updated to allow for collecting all relevant data and information for the Silver Drop assessment. However, the Silver Drop Assessment needs to be carried out by experienced groundwater experts.

It is further suggested to introduce a bonus and penalty system in addition to the scoring system to support the efforts some municipalities display. Possible bonus and penalty scores could entail:

- **Penalty** for existing groundwater pollution in the municipal area
- **Penalty** for existing groundwater pollution close to municipal or private water supply boreholes
- **Penalty** for non-compliance with licence or permit conditions
- **Bonus** for training of municipal staff in groundwater related aspects

Appendix A: Comments received on Draft Scoring System

NAME	CRITERIA	COMMENT
Shafick Adams, WRC	Aquifer Management Plan	Add requirement: "Assessment done by a Groundwater professional/company? "
		"Is a regional numerical aquifer model developed?" Change to "regional / local"
	Institutional Arrangements	"Split of responsibilities between WSA and WSP functions within the municipality, or WSP function outsourced?" This should be stated a bit clearer. Work from the ideal situation.
	Missing aspects	Use of appropriate technology? Early warning systems; telemetry. Databases etc. – should be covered under O&M Plan
	General approach	Will the individual questions also have a score making up the 30% in this case?
Mike Smart, DWA Western Cape, Groundwater	General approach	Could this approach not have the effect of isolating us as we groundwater people do our own thing again? Should this not be integrated into a drop that covers water source management as a whole (i.e. combine groundwater and surface water/dam management aspects into a single drop)? That way a Municipality with excellent surface water /dam management would not qualify for their "drop", if they have a single poorly managed borehole. Maybe that would bring more pressure to bear on a Municipality to invest in groundwater management, no matter how small relatively speaking the groundwater supply is.
	Missing aspects	Other aspects to consider: • A well maintained / safe database. • Spare capacity (backup boreholes). • Regular wellfield performance assessments carried out by a hydrogeologist. • Actions are taken in accordance with the hydrogeologists recommendations.
Jane Baron, DWA Eastern Cape, Groundwater	Missing aspects	I am wondering if there should be something about the actual borehole finishing for pollution prevention? Then it would be tracked under O&M.

NAME	CRITERIA	COMMENT
Willem Du Toit, DWA Limpopo, Groundwater	General approach	Our biggest problem in Limpopo is the lack of monitoring and O&M. The scoring system covers all the aspects and is well thought through but I think the weights allocated to monitoring and O&M are too low. Both should be 25 and the ones you have allocated a weight of 15 should be reduced to 10.
Ernst Bertram. DWA D:	Missing aspects	Other aspects to consider: • A well maintained / safe database. Maswuma would like to see the NGA used for this purpose but it will mean some development will have to be done. • Spare capacity (backup boreholes). Or at least potential areas for future development identified. • Regular wellfield performance assessments carried out by a hydrogeologist. This must not happen very often (say once a year) as the municipalities will in the end totally rely on the consultants to do all the work. • Actions are taken in accordance with the hydrogeologists recommendations. This would require a well-kept library with all the relevant reports
Fanus Fourie, DWA D:WRPS	General approach	I see we have 3 options: • Develop a 'silver drop' as a separate drop system or • Upgrade the current 'blue drop' to include IWRM or • A combination of the 2 above. Option 1 is the ideal option but leave us with a few questions: • We then need a home for this in the Department! • Funding • Personnel Option 2 is the easiest but not so visible: • Add to various current criteria of the 'Blue drop" • Structure is in place • Personnel is in place • Funding is in place Option 3 is a win-win option • Upgrade the 'blue drop' criteria with IWRM criteria • From the data, draw out the IWRM data • Award then the 'silver drop' to the best performing LM • 95% of the structure/personnel/funding are been provided by the 'blue drop' system

NAME	CRITERIA	COMMENT
Isa Thompson, DWA D:NWRP	General approach	Where the requirements for each indicator consist of more than one bullet, do all the bullets have equal weight? E.g.: When you have three bullets making up 20% of a weight of 15, this could become tricky to calculate. Otherwise this looks very comprehensive, covering all possible issues.
	Missing aspects	An aspect that could also be brought in is to what extent the municipality is adhering to the recommendations emanating from the All Towns Reconciliation Strategy for the specific town(s).
Tendani Nditwani, DWA D:NWRP	O&M Plan	Under O & M plan there is an Indicator for Operational Rules. There is a mention of clearly defined and special rules for aquifer and emergency. A bullet or addition to these bullets on conjunctive Operational Rules with surface water can be included (not just for aquifer managements and emergency).
Archinton Thobejane, DWA D:NWRP	General approach	Name of the 'DROP': Elaborate why SILVER not say GOLD??
	Aquifer Management Plan	Is the model updated regularly? What will be an appropriate period to update the model???
Sabelo Magaqana, DWA Western Cape	Aquifer Management Plan	Requirements section should be standardized for objective scoring, for example, the list of actions should be clearly defined. Groundwater assessment (level of assessment) instead of asking what is the level of assessment, degrees of what level is expected should be stated then the municipality's assessment level compared against that standard.
	Monitoring Protocol	Monitoring network, for objectivity there should be a specific standard relating to the requirements. The requirements should be stated such that when independently assessed one can arrive to the same conclusion (score).).
	General approach	Another column rating each requirement could be created, for example under sections of requirement where there is more than one requirement percentages should be allocated in relation to significance, i.e. if there is compliance 1out of 3 or 2 out of 3, what percentage should be given. I hope this would add some value

APPENDIX B

Questionnaire - Proposed Scoring System for Groundwater Management at Municipal Level

Aquifer Management Plan

Is there an Aquifer Management Plan formulated and in place? Yes ☐ No ☐

If yes please provide supporting documentation

What is the level of the latest Groundwater Assessment? _____

Kindly provide more details:_____

_____

_____

Please provide supporting documentation

Is Groundwater Resource Valuation carried out? Yes ☐ No ☐

Kindly provide more details:_____

_____

If yes please provide supporting documentation

Is a regional numerical aquifer model developed and updated regularly? Yes ☐ No ☐

Kindly provide more details:_____

_____

_____

If yes please provide supporting documentation

Integration of GW into Municipal Planning

Please provide details of how groundwater is integrated into municipal planning:_____

_____

_____

_____

_____

_____

Please provide latest WSDP, SDF, IWRMP, WC/WDM and Bylaws

Monitoring Protocol

Does the municipality have a groundwater monitoring protocol? Yes ☐ No ☐

Kindly provide more details: _____

_____

_____

If yes please provide supporting documentation (Monitoring Protocol and Monitoring Report)

O&M Plan

Is a Wellfield Operation and Maintenance Plan implemented? Yes ☐ No ☐

If yes please provide supporting documentation

Institutional Arrangements for Groundwater Management

Are the responsibilities of WSA and WSP split within the municipality, or WSP function outsourced?
Yes ☐ No ☐

Kindly provide more details: _____

_____

_____

If yes please provide supporting documentation

What is the level of groundwater knowledge / expertise at management level?

_____

_____

Please provide supporting documentation

Does the municipality make use of external specialists/consultants? Yes ☐ No ☐

How many trained and skilled operational staff are available for groundwater management? Are there any training programmes for the staff?

Please provide supporting documentation

Does the municipality have an official stakeholder forum? Yes ☐ No ☐

Please provide supporting documentation

<u>Authorisation of Water Use</u>

Is the use of groundwater licensed? Yes ☐ No ☐

If yes please provide supporting documentation

Does the municipality comply with the license and permit conditions? Yes ☐ No ☐

Please provide supporting documentation

Does the municipal budget cater for implementation of:

- Aquifer Management Plan? ☐
- Operation and Maintenance? ☐
- Skills Training? ☐
- Bylaws and municipal planning? ☐
- Monitoring? ☐

Please provide supporting documentation

APPENDIX C

STANFORD

Questionnaire - Proposed Scoring System for Groundwater Management at Municipal Level

Aquifer Management Plan

Is there an Aquifer Management Plan formulated and in place? Yes ☐ No ☑

If yes please provide supporting documentation

In process (Umvoto)

What is the level of the latest Groundwater Assessment? Monthly monitoring reports by Umvoto

Kindly provide more details: _____

Please provide supporting documentation

Is Groundwater Resource Valuation carried out? Yes ☐ No ☑

Kindly provide more details: _____

If yes please provide supporting documentation

Is a regional numerical aquifer model developed and updated regularly? Yes ☑ No ☐

Kindly provide more details: Umvoto - in progress

If yes please provide supporting documentation

Integration of GW into Municipal Planning

Please provide details of how groundwater is integrated into municipal planning: Groundwater source and demand monitoring are integrated with with Stanford database on demand trends and projections for future planing requirements and timing

Please provide latest WSDP, SDF, IWRMP, WC/WDM and Bylaws

Monitoring Protocol

Does the municipality have a groundwater monitoring protocol? Yes ☑ No ☐

Kindly provide more details: Approved by Stanford groundwater monitoring Comitte in Sept. 2008.

If yes please provide supporting documentation (Monitoring Protocol and Monitoring Report)

with Uhuvoto

O&M Plan

Is a Wellfield Operation and Maintenance Plan implemented? Yes ☐ No ☑

If yes please provide supporting documentation In progress with Uhuvoto.

Institutional Arrangements for Groundwater Management

Are the responsibilities of WSA and WSP split within the municipality, or WSP function outsourced?
Yes ☑ No ☐

Kindly provide more details: WSA = Directorate Infrastructure + Plg.
WSP = Directorate Security Services.

If yes please provide supporting documentation

organogram - web site

What is the level of groundwater knowledge / expertise at management level?
Various conferences, seminars and short courses attended.

Please provide supporting documentation

Does the municipality make use of external specialists/consultants? Yes ☑ No ☐

How many trained and skilled operational staff are available for groundwater management? Are there any training programmes for the staff?

1x Operational Manager
1x Superintendent
1x Senior Technician.
Training of Process Controllers via Overberg Water and DWA.

Please provide supporting documentation

Does the municipality have an official stakeholder forum? Yes ☑ No ☐

OMAF, Ward Committee, Stanford Groundwater Monitoring Committee.

Please provide supporting documentation

Authorisation of Water Use

Is the use of groundwater licensed? Yes ☐ No ☑

If yes please provide supporting documentation

Licence application submitted to DWA.

Does the municipality comply with the license and permit conditions? Yes ☐ No ☑

Please provide supporting documentation licence not issued yet.

Does the municipal budget cater for implementation of:

- Aquifer Management Plan? ✓
- Operation and Maintenance? ✓
- Skills Training? ✓
- Bylaws and municipal planning? ✓
- Monitoring? ✓

Please provide supporting documentation

Questionnaire - Proposed Scoring System for Groundwater Management at Municipal Level

Aquifer Management Plan

Is there an Aquifer Management Plan formulated and in place? Yes [X] No [ ]

If yes please provide supporting documentation

What is the level of the latest Groundwater Assessment? _____

Kindly provide more details: _____

Please provide supporting documentation

Is Groundwater Resource Valuation carried out? Yes [X] No [ ]

Kindly provide more details: SEE GROSS REPORT 2011
A COPY OF THIS REPORT CAN BE OBTAINED FROM GROSS IN STELLENBOSCH.

If yes please provide supporting documentation

Is a regional numerical aquifer model developed and updated regularly? Yes [ ] No [X]

Kindly provide more details: _____

If yes please provide supporting documentation

Integration of GW into Municipal Planning

Please provide details of how groundwater is integrated into municipal planning:
KKRWSS SCHEME GETS SUPPLIED FROM BOTH GROUNDWATER AND THE SURFACE WATER SOURCE SUPPLYING QUATSTHORN.

Please provide latest WSDP, SDF, IWRMP, WC/WDM and Bylaws

THESE DOCUMENTS ARE BEING DEVELOPED

How many trained and skilled operational staff are available for groundwater management? Are there any training programmes for the staff?

4 X WATER WORKS OPERATORS
4 X MAINTANANCE PERSONELL
2 X MILWRIGTS : 1 X CIVIL TECHNICIAN

Please provide supporting documentation

Does the municipality have an official stakeholder forum? Yes ☐ No ☒

Please provide supporting documentation

Authorisation of Water Use

Is the use of groundwater licensed? Yes ☒ No ☐

If yes please provide supporting documentation

Does the municipality comply with the license and permit conditions? Yes ☐ No ☒

Please provide supporting documentation

SEE OVER ABSTRACTION FROM GEOSS REPORT

Does the municipal budget cater for implementation of:

- Aquifer Management Plan? ✓
- Operation and Maintenance? ✓
- Skills Training? ✓
- Bylaws and municipal planning? X
- Monitoring? ✓

Please provide supporting documentation

Monitoring Protocol

Does the municipality have a groundwater monitoring protocol? Yes ☐ No ☒

Kindly provide more details: SEE GEOSS REPORT AUG 2011

If yes please provide supporting documentation (Monitoring Protocol and Monitoring Report)

O&M Plan

Is a Wellfield Operation and Maintenance Plan implemented? Yes ☒ No ☐

If yes please provide supporting documentation SEE GEOSS REPORT AUG 2011

Institutional Arrangements for Groundwater Management

Are the responsibilities of WSA and WSP split within the municipality, or WSP function outsourced?
Yes ☐ No ☒

Kindly provide more details:

If yes please provide supporting documentation

What is the level of groundwater knowledge / expertise at management level?
NONE OTHER THAN EXPERIENCE IN KKBWSS.

Please provide supporting documentation

Does the municipality make use of external specialists/consultants? Yes ☒ No ☐

HERMANUS

Questionnaire - Proposed Scoring System for Groundwater Management at Municipal Level

Aquifer Management Plan

Is there an Aquifer Management Plan formulated and in place? Yes ☑ No ☐

If yes please provide supporting documentation

Wellfield O&M manual and.

What is the level of the latest Groundwater Assessment? Various monitoring reports (Gateway)

Kindly provide more details: 6 monthly monitoring reports for Gateway.

Please provide supporting documentation

Is Groundwater Resource Valuation carried out? Yes ☐ No ☑

Kindly provide more details: _____

If yes please provide supporting documentation

Is a regional numerical aquifer model developed and updated regularly? Yes ☑ No ☐

Kindly provide more details: Details with Municipality

If yes please provide supporting documentation

Integration of GW into Municipal Planning

Please provide details of how groundwater is integrated into municipal planning: At Hermanus, Stanford Buffeljagsbaai, Boardshurdesbos and Gansbaai (De Kelders), the groundwater sources are integrated with databases on demand trends and demand projections, to determine future requirements and the timing thereof.

Please provide latest WSDP, SDF, IWRMP, WC/WDM and Bylaws

Monitoring Protocol

Does the municipality have a groundwater monitoring protocol? Yes ☑ No ☐

Kindly provide more details: Monitoring protocol was agreed with the Orange Groundwater Monitoring Committee. 6 Monthly monitoring reports to ORC. Includes ecological monitoring.

If yes please provide supporting documentation (Monitoring Protocol and Monitoring Report)

(with Umvoto)

O&M Plan

Is a Wellfield Operation and Maintenance Plan implemented? Yes ☑ No ☐

If yes please provide supporting documentation

(with Umvoto)

Institutional Arrangements for Groundwater Management

Are the responsibilities of WSA and WSP split within the municipality, or WSP function outsourced?
Yes ☑ No ☐

Kindly provide more details: WSA functions performed by Directorate Infrastructure & Planning.
WSP functions performed by Directorate Community Services

If yes please provide supporting documentation

Organogram

What is the level of groundwater knowledge / expertise at management level?
Attendance of various conferences, seminars and short courses on groundwater.

Please provide supporting documentation

Does the municipality make use of external specialists/consultants? Yes ☑ No ☐

How many trained and skilled operational staff are available for groundwater management? Are there any training programmes for the staff?

1x Technician 1x Operational Manager.

2x Superintendent

Training of process controllers through various vehicls, e.g. Overberg Water and DWA.

Please provide supporting documentation

Does the municipality have an official stakeholder forum? Yes ☑ No ☐

1. OMAF = Overstrand Municipal Advisory Forum.
2. Ward Committees in each ward.
3. OMC and SMC for groundwater specific (with Umvoto)

Please provide supporting documentation

Authorisation of Water Use

Is the use of groundwater licensed? Yes ☑ No ☐

If yes please provide supporting documentation

(with Umvoto) - for Gateway.

Hemel-en-Aarde licence application submitted to DWA.

Does the municipality comply with the license and permit conditions? Yes ☑ No ☐

Please provide supporting documentation

Audit of Gateway licence was done - copy with Umvoto

Does the municipal budget cater for implementation of:

- Aquifer Management Plan? ✓
- Operation and Maintenance? ✓
- Skills Training? ✓
- Bylaws and municipal planning? ✓
- Monitoring? ✓

Please provide supporting documentation

APPENDIX D

Silver Drop System for Groundwater Management at Municipal Level

							Hermanus			Stanford		
Criteria	**Weighting**	**Indicators**	**Weight**	**Requirements**	**Weight**	**Total**	**Score**	**Subtotal**	**Total**	**Score**	**Subtotal**	**Total**
Aquifer Management Plan	20	Annual Action Plan	40%	Is the Aquifer Management Plan formulated and aligned to the CMS?	70%	40.0%	40%	28.0%	17.2%	40%	28.0%	17.2%
				Does it contain a list of actions to improve performance?	30%		50%	15.0%		50%	15.0%	
		Groundwater Assessment	30%	Does a groundwater assessment for the relevant aquifer exist as basis for an aquifer management plan?	40%	30.0%	100%	40.0%	30.0%	100%	40.0%	30.0%
				Is the level of assessment sufficient wrt to the aquifer use?	30%		100%	30.0%		100%	30.0%	
				Assessment carried out by groundwater professional?	30%		100%	30.0%		100%	30.0%	
		Numerical model	20%	Is the aquifer behaviour conceptually understood?	50%	20.0%	100%	50.0%	16.0%	100%	50.0%	10.0%
				Is a regional numerical aquifer model developed?	30%		100%	30.0%			0.0%	
				Is the model updated regularly?	20%			0.0%			0.0%	
		Groundwater resource valuation	10%	Are the different ecosystem services of the aquifer considered?	60%	10.0%	50%	30.0%	3.0%		0.0%	0.0%
				Are the full groundwater economics taken into account in decision making, tariffs etc.?	40%			0.0%			0.0%	
					20		**66.2%**	**13.24**		**57.2%**	**11.44**	
Integration of GW into municipal planning	20	Integration in IDP Process, (WSDP, SDF, IWRMP)	40%	Are the aquifers and groundwater management issues addressed in the IDP process and documents?	10%	40.0%	100%	10.0%	14.8%	100%	10.0%	18.4%
				o WSDP	30%		70%	21.0%		70%	21.0%	
				o SDF	30%		20%	6.0%		50%	15.0%	
				o IWRMP	30%			0.0%			0.0%	
		WC/WDM Strategy	10%	Does a WC/WDM Strategy exist that promotes groundwater use and management?	100%	10.0%	80%	80.0%	8.0%	80%	80.0%	8.0%
		Bylaws	20%	Are groundwater related or aquifer specific bylaws in place?	100%	20.0%	100%	100.0%	20.0%	100%	100.0%	20.0%
		Implementation of plans and bylaws	30%	Evidence of plans and bylaws being implemented	60%	30.0%	100%	60.0%	30.0%	100%	60.0%	30.0%
				Budget assigned for implementation	40%		100%	40.0%		100%	40.0%	
					20		**72.8%**	**14.56**		**76.4%**	**15.28**	

Silver Drop System for Groundwater Management at Municipal Level

							Hermanus			Stanford		
Criteria	**Weighting**	**Indicators**	**Weight**	**Requirements**	**Weight**	**Total**	**Score**	**Subtotal**	**Total**	**Score**	**Subtotal**	**Total**
Monitoring Protocol	20	Monitoring network	20%	Groundwater quality and quantity monitoring network defined and agreed upon	50%	20.0%	100%	50.0%	20.0%	100%	50.0%	15.0%
				Monitoring network and technology considered sufficient	50%		100%	50.0%		50%	25.0%	
		Regular sampling and measurements	20%	Continuous monitoring of water level at strategic sites	50%	20.0%	100%	50.0%	20.0%	100%	50.0%	20.0%
				Sampling as per Monitoring Protocol	50%		100%	50.0%		100%	50.0%	
		Credibility of sample analysis	10%	Chemical analysis carried out by accredited laboratory	100%	10.0%	100%	100.0%	10.0%	100%	100.0%	10.0%
		Data management	10%	Data capture and data storage in suitable electronic format	50%	10.0%	100%	50.0%	10.0%	100%	50.0%	10.0%
				Data exchange with regional and national databases possible	20%		100%	20.0%		100%	20.0%	
				Results submitted to relevant authority as agreed upon	30%		100%	30.0%		100%	30.0%	
		Adaptive management	20%	Do monitoring results influence the Aquifer Management Plan, the IDP and or the O&M Plan?	100%	20.0%	100%	100.0%	20.0%	100%	100.0%	20.0%
		Budget for monitoring	20%	Budget assigned for monitoring as per monitoring protocol	100%	20.0%	100%	100.0%	20.0%	100%	100.0%	20.0%
					20		**100.0%**	**20.00**		**95.0%**	**19.00**	
O&M Plan	20	Operational Rules	40%	Operational rules for wellfield management are clearly defined and aligned with licence conditions and aquifer management plan	40%	40.0%	100%	40.0%	34.0%	100%	40.0%	22.0%
				Special operational rules for emergency situations; e.g. breakdown or drought, are defined	30%		50%	15.0%			0.0%	
				Early warning system, telemetry etc. in place	30%		100%	30.0%		50%	15.0%	
		Maintenance Plan	40%	Asset Management system exists for all wellfield components, especially mechanical and electrical	50%	40.0%	100%	50.0%	40.0%	100%	50.0%	30.0%
				Maintenance plan for all relevant equipment is in place and implemented, including, *inter alia* :	50%		100%	50.0%		50%	25.0%	
				o Borehole yield testing and rehabilitation				0.0%			0.0%	
				o Inspection of pumps and repair/replacement				0.0%			0.0%	
				o Inspection of pipework and cleaning, if required				0.0%			0.0%	
				o Inspection of electrical supply and controls				0.0%			0.0%	
				o Calibration of monitoring equipment, and repair				0.0%			0.0%	
		Budget for O&M	20%	Budget assigned for wellfield operation & maintenance	100%	20.0%	100%	100.0%	20.0%	100%	100.0%	20.0%
					20		**94.0%**	**18.80**		**72.0%**	**14.40**	

Silver Drop System for Groundwater Management at Municipal Level

Criteria	Weighting	Indicators	Weight	Requirements	Weight	Total	Hermanus Score	Hermanus Subtotal	Hermanus Total	Stanford Score	Stanford Subtotal	Stanford Total
Institutional arrangements for groundwater management	10	Split of responsibilities between WSA and WSP	10%	Split of responsibilities between WSA and WSP functions within the municipality, or WSP function outsourced?	100%	10.0%	100%	100.0%	10.0%	100%	100.0%	10.0%
		Groundwater knowledge / expertise at management level	20%	WSA manager, technical director or similar with qualification / knowledge / expertise in groundwater management	70%	20.0%	50%	35.0%	13.0%	50%	35.0%	13.0%
				Use of external groundwater specialist / consultant	30%		100%	30.0%		100%	30.0%	
		Trained and skilled operational staff	30%	Operational staff sufficiently skilled	50%	30.0%	75%	37.5%	18.8%	50%	25.0%	15.0%
				Ongoing training provided for operational staff	50%		50%	25.0%		50%	25.0%	
		Official stakeholder forum	30%	Municipality is part of a Water Users Association	50%	30.0%	100%	50.0%	30.0%		0.0%	15.0%
				Monitoring Committee of I&AP and stakeholders established	50%		100%	50.0%		100%	50.0%	
		Publication of groundwater management performance	10%	Monitoring results are published in papers or website	50%	10.0%	100%	50.0%	10.0%	100%	50.0%	10.0%
				Groundwater management performance published	50%		100%	50.0%		100%	50.0%	
					10		**81.8%**	**8.18**		**63.0%**	**6.30**	
Authorisation of water use	10	Groundwater abstraction	50%	Licence for groundwater use is applied for	50%	50.0%	100%	50.0%	50.0%	100%	50.0%	25.0%
				Groundwater use is licensed	50%		100%	50.0%			0.0%	
		Landuse activities	20%	Environmental authorisation and permits for potentially harmful land use activities obtained	100%	20.0%	100%	100.0%	20.0%	100%	100.0%	20.0%
		Compliance	30%	Licence and permit conditions are adhered to	50%	30.0%	100%	50.0%	30.0%	100%	50.0%	15.0%
				Regular licence review	50%		100%	50.0%			0.0%	
					10		**100.0%**	**10.00**		**60.0%**	**6.00**	
Total Score	**100**				**100**		**84.78**			**72.42**		

Silver Drop System for Groundwater Management at Municipal Level

							KKRWSS					
Criteria	**Weighting**	**Indicators**	**Weight**	**Requirements**	**Weight**	**Total**	**Score**	**Subtotal**	**Total**	**Score**	**Subtotal**	**Total**
Aquifer Management Plan	20	Annual Action Plan	40%	Is the Aquifer Management Plan formulated and aligned to the CMS?	70%	40.0%	50%	35.0%	20.0%		0.0%	0.0%
				Does it contain a list of actions to improve performance?	30%		50%	15.0%			0.0%	
		Groundwater Assessment	30%	Does a groundwater assessment for the relevant aquifer exist as basis for an aquifer management plan?	40%	30.0%	100%	40.0%	28.2%		0.0%	0.0%
				Is the level of assessment sufficient wrt to the aquifer use?	30%		80%	24.0%			0.0%	
				Assessment carried out by groundwater professional?	30%		100%	30.0%			0.0%	
		Numerical model	20%	Is the aquifer behaviour conceptually understood?	50%	20.0%	80%	40.0%	8.0%		0.0%	0.0%
				Is a regional numerical aquifer model developed?	30%			0.0%			0.0%	
				Is the model updated regularly?	20%			0.0%			0.0%	
		Groundwater resource valuation	10%	Are the different ecosystem services of the aquifer considered?	60%	10.0%		0.0%	0.0%		0.0%	0.0%
				Are the full groundwater economics taken into account in decision making, tariffs etc.?	40%			0.0%			0.0%	
					20		**56.2%**	**11.24**		**0.0%**	**0.00**	
Integration of GW into municipal planning	20	Integration in IDP Process, (WSDP, SDF, IWRMP)	40%	Are the aquifers and groundwater management issues addressed in the IDP process and documents?	10%	40.0%	50%	5.0%	14.0%		0.0%	0.0%
				o WSDP	30%		100%	30.0%			0.0%	
				o SDF	30%			0.0%			0.0%	
				o IWRMP	30%			0.0%			0.0%	
		WC/WDM Strategy	10%	Does a WC/WDM Strategy exist that promotes groundwater use and management?	100%	10.0%	50%	50.0%	5.0%		0.0%	0.0%
		Bylaws	20%	Are groundwater related or aquifer specific bylaws in place?	100%	20.0%	100%	100.0%	20.0%		0.0%	0.0%
		Implementation of plans and bylaws	30%	Evidence of plans and bylaws being implemented	60%	30.0%	80%	48.0%	20.4%		0.0%	0.0%
				Budget assigned for implementation	40%		50%	20.0%			0.0%	
					20		**59.4%**	**11.88**		**0.0%**	**0.00**	

Silver Drop System for Groundwater Management at Municipal Level

							KKRWSS					
Criteria	**Weighting**	**Indicators**	**Weight**	**Requirements**	**Weight**	**Total**	**Score**	**Subtotal**	**Total**	**Score**	**Subtotal**	**Total**
Monitoring Protocol	20	Monitoring network	20%	Groundwater quality and quantity monitoring network defined and agreed upon	50%	20.0%	100%	50.0%	15.0%		0.0%	0.0%
				Monitoring network and technology considered sufficient	50%		50%	25.0%			0.0%	
		Regular sampling and measurements	20%	Continuous monitoring of water level at strategic sites	50%	20.0%	80%	40.0%	18.0%		0.0%	0.0%
				Sampling as per Monitoring Protocol	50%		100%	50.0%			0.0%	
		Credibility of sample analysis	10%	Chemical analysis carried out by accredited laboratory	100%	10.0%	100%	100.0%	10.0%		0.0%	0.0%
		Data management	10%	Data capture and data storage in suitable electronic format	50%	10.0%	100%	50.0%	10.0%		0.0%	0.0%
				Data exchange with regional and national databases possible	20%		100%	20.0%			0.0%	
				Results submitted to relevant authority as agreed upon	30%		100%	30.0%			0.0%	
		Adaptive management	20%	Do monitoring results influence the Aquifer Management Plan, the IDP and or the O&M Plan?	100%	20.0%	50%	50.0%	10.0%		0.0%	0.0%
		Budget for monitoring	20%	Budget assigned for monitoring as per monitoring protocol	100%	20.0%	100%	100.0%	20.0%		0.0%	0.0%
					20		**83.0%**	**16.60**		**0.0%**	**0.00**	
O&M Plan	20	Operational Rules	40%	Operational rules for wellfield management are clearly defined and aligned with licence conditions and aquifer management plan	40%	40.0%	100%	40.0%	16.0%		0.0%	0.0%
				Special operational rules for emergency situations; e.g. breakdown or drought, are defined	30%			0.0%			0.0%	
				Early warning system, telemetry etc. in place	30%			0.0%			0.0%	
		Maintenance Plan	40%	Asset Management system exists for all wellfield components, especially mechanical and electrical	50%	40.0%	50%	25.0%	20.0%		0.0%	0.0%
				Maintenance plan for all relevant equipment is in place and implemented, including, *inter alia* :	50%		50%	25.0%			0.0%	
				o Borehole yield testing and rehabilitation				0.0%			0.0%	
				o Inspection of pumps and repair/replacement				0.0%			0.0%	
				o Inspection of pipework and cleaning, if required				0.0%			0.0%	
				o Inspection of electrical supply and controls				0.0%			0.0%	
				o Calibration of monitoring equipment, and repair				0.0%			0.0%	
		Budget for O&M	20%	Budget assigned for wellfield operation & maintenance	100%	20.0%	100%	100.0%	20.0%		0.0%	0.0%
					20		**56.0%**	**11.20**		**0.0%**	**0.00**	

Silver Drop System for Groundwater Management at Municipal Level

							KKRWSS					
Criteria	**Weighting**	**Indicators**	**Weight**	**Requirements**	**Weight**	**Total**	**Score**	**Subtotal**	**Total**	**Score**	**Subtotal**	**Total**
Institutional arrangements for groundwater management	10	Split of responsibilities between WSA and WSP	10%	Split of responsibilities between WSA and WSP functions within the municipality, or WSP function outsourced?	100%	10.0%		0.0%	0.0%		0.0%	0.0%
		Groundwater knowledge / expertise at management level	20%	WSA manager, technical director or similar with qualification / knowledge / expertise in groundwater management	70%	20.0%	50%	35.0%	13.0%		0.0%	0.0%
				Use of external groundwater specialist / consultant	30%		100%	30.0%			0.0%	
		Trained and skilled operational staff	30%	Operational staff sufficiently skilled	50%	30.0%	80%	40.0%	19.5%		0.0%	0.0%
				Ongoing training provided for operational staff	50%		50%	25.0%			0.0%	
		Official stakeholder forum	30%	Municipality is part of a Water Users Association	50%	30.0%		0.0%	7.5%		0.0%	0.0%
				Monitoring Committee of I&AP and stakeholders established	50%		50%	25.0%			0.0%	
		Publication of groundwater management performance	10%	Monitoring results are published in papers or website	50%	10.0%	50%	25.0%	5.0%		0.0%	0.0%
				Groundwater management performance published	50%		50%	25.0%			0.0%	
					10		**45.0%**	**4.50**		**0.0%**	**0.00**	
Authorisation of water use	10	Groundwater abstraction	50%	Licence for groundwater use is applied for	50%	50.0%	100%	50.0%	50.0%		0.0%	0.0%
				Groundwater use is licensed	50%		100%	50.0%			0.0%	
		Landuse activities	20%	Environmental authorisation and permits for potentially harmful land use activities obtained	100%	20.0%	50%	50.0%	10.0%		0.0%	0.0%
		Compliance	30%	Licence and permit conditions are adhered to	50%	30.0%	50%	25.0%	7.5%		0.0%	0.0%
				Regular licence review	50%			0.0%			0.0%	
					10		**67.5%**	**6.75**		**0.0%**	**0.00**	
Total Score	**100**				**100**		**62.17**			**0.00**		