Introducing and Implementing an EMS in Khartoum State Water Corporation

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Abstract

Water-related diseases have been reported in many areas in Khartoum state in Sudan, others complain from the water turbidity while others complain that the supply goes off without previous notice and sometimes water flows in pipes at too high pressure and consumers accuse the Khartoum State Water Corporation (KSWC) of being the main cause of these water supply problems. Consequently, an assessment of the efficiency of the work of (KSWC) needs to be carried out to assess, and thereby help improve, KSWC services. One possible solution to help improve matters would be the introduction of an Environmental Management System (EMS).
Initially, an environmental review should be carried out as the first step, reviewing inputs, operations, outputs and future plans together with impacts related to KSWC activities and any other abnormal circumstances. This will help in the development of the environmental policy.
An EMS needs to be regularly reviewed to check the continuing suitability, adequacy and effectiveness of the EMS, and should be organised in a way that documents its findings and leads to appropriate changes in KSWC's environmental policy, objectives and/or targets in the light of changing circumstances and in the view of continual improvement.

Key words: Environmental Management System; Policy; Action Plan; Objectives; Targets.

1. INTRODUCTION

Although located in the arid zone of Africa, Sudan is considered to be rich in water resources. These are, in order of importance: The Nile River and its tributaries; Ground water; and Seasonal streams.

The country, with its 40 million population (according to the population census of 2008, before the separation of the south), utilizes 14.6 billion cubic meters of its share in the Nile water which stands currently at 20.5 md.c.m. at Sennar (18.5 md.c.m. at Aswan) according to the Nile Water Agreement, while the underground water reserves are estimated at around 9000 billion cubic meters, of which only 1.3 billion is actually utilized (Yildiz, 2008).

Khartoum State (consists of 3 towns Khartoum, Bahri and Omdurman) falls in a very strategic location in the centre of Sudan surrounded by the Blue Nileand White Nile till they meet at Al-Mugran. It is one of the most crowded areas in Sudan with disorganised distribution of its population, the people living in a very narrow line that begins from the banks of the Blue and White Niles and extends along the Nile Valley for 40 kilometres to the north. According to the population census of 2008, the Khartoum State population amounted to 7 million people (Al-Tayeb, 2012).

2. KHARTOUM STATE'S WATER SOURCES

Khartoum state's main sources for water supply are the River Nile and ground water. Groundwater is recharged by rainwater to a small extent, and by the Nile to a greater extent. Khartoum State Water Corporation is the body responsible of providing water services for the state population through treatment plants (the Nile stations) and pumping stations, Groundwater wells of varying depth and productivity, dams, canals, hand pumps and surface pulled carts or tankers. Tables 1 and 2 below present existing and under-construction treatment plants and wells.

Table 1: Treatment plants and pumping stations in Khartoum, 2010

Year	Main financier	Name	Production (in cubic metre per day)
1924	Britain	Burri	16.000; extension to 50.000 under construction.
1927	Britain	Betelmal	25.000 since 2003 (formerly 12.000)
1954	Britain	Old Bahri	12.000; merged with New Bahri in 1979
1964	Britain, France	Moghran	90.000 since 1990 (formerly 72.000)
1979	Czechoslovakia	New Bahri	180.000 since 1999 (formerly 90.000); extension to 300.000 under construction.
1992	Japan	El Gomayir Pumping Station	Storage of 50.000 since 2010 (formerly 36.000).
2002	Egypt	Sahafa Pumping Station	Storage of 80.000 since 2006 (formerly 63.000)
2009	Egypt	Soba	100.000; extension to 200.000 under construction.
2010	Iran	Gebel Aulia	68.000; production of 30.000 in 2010 due to lack of networks
2010	Spain	Noth Bahri	50.000; production of 20.000 in 2010 due to intake problems
2010	Britain, Netherlands	El Manara	200.000 capacity; production of 50.000 in 2010 due to lack of networks
Under construction	Spain	Aid Babikir	Pumping Station 50.000 projected
Under construction	Iran	Abu Said	200.000 projected

Table 2: Wells drilled in Khartoum State 1960 to 2010.

Decade	Khartoum	Bahri	Omdurman	Total
1961 to 1970	26	26	46	98
1971 to 1980	54	41	57	152
1981 to 1990	23	16	39	78
1991 to 2000	44	58	78	180
2000 to 2010	About 100 annually, a total of 900 wells			1080

Water supplied from wells is treated simply. KSWC pumps water from wells in basins then treats pumped water with fluoride to avoid dental decay and chlorine for disinfection then stores water in elevated tanks for distribution, since there are no suspended solids or turbidity in pumped water. While water supplied from the Nile is treated in the treatment plants as follows:

- Preliminary stage: Which includes screening, pre-sedimentation and the addition of chemicals to control the algae growth (sodium hydrochloride).
- Coagulation: In which small particles are clumped, chemicals like alum is added and mixed rabidly in a large basin to help bring particles together forming flocs.
- Flocculation: In this stage flocs start to settle dawn the settlement basin.
- Clarification: In which water is allowed to flow in a large basin to help the settlement of the remaining particles.
- Filtration: This stage helps removing suspended mutters including microorganisms, iron, silt and manganese.
- Fluoridation and Disinfection: In this stage fluoride doses are added to water to reduce teeth decay, and chlorine is added for disinfection.
- Storage Tanks: Water is then pumped to elevated storage tanks for distribution.

The amount of water produced by the water treatment plants at the end of 2010 can be estimated at more than 500.000 cubic metres per day, while all the wells in Khartoum were estimated to approximately more than 500.000 cubic metres of water per day. Consequently, Khartoum state is currently supplied about 52% by groundwater and 48% by water extracted from the Nile River. However, both treatment plants and wells are not always running at their full capacity due to siltation and maintenance.

3. WATER DISTRIBUTION

Originating either from Nile River treatment plants or groundwater wells, the governmentally produced water is transported to the households via a number of governmental water supply networks as follows:

1. The main treatment plant water network is located in central areas, such as in the centres of Khartoum, Bahri and Omdurman. These areas are exclusively supplied by treated water from the Nile River.
2. The hybrid network which is a mixture of water from treatment plants and from groundwater wells. In most cases, this hybrid water network covers the areas which surround the main central districts, such as El Thoura to the north of Omdurman, Umbadda to the south of Omdurman, or Sahafa to the south of Khartoum.
3. The local well network which is exclusively nourished by groundwater wells and is not connected to the central treatment plant or hybrid water network. Local well networks are usually located in the peripheral areas of Greater Khartoum, such as Dar Essalam in the west of Omdurman or Hag Youssef in the east of Bahri.

Usually, KSWC is fully responsible for operation, rehabilitation and maintenance of the treatment plant networks, the hybrid networks and the local well networks. In areas where no water networks exist, water is supplied from local wells by private donkey cart operators, who buy water from private well operators, who are in turn obliged to pay between 15 and 30 percent of their income to KSWC, in other cases, donkey carts buy water from local wells, which are directly managed by KSWC, local communities or NGOs.

4. STATEMENT OF THE PROBLEM

Water-related diseases have been reported in many areas in Khartoum State in Sudan and consumer's attention has been focused on Khartoum State Water Corporation (KSWC) as the likely main source of pollution. Additionally, some complain about the turbidity of supplied water while others complain that the supply goes off without previous notice and sometimes water flow in pipes with higher pressure. A current study on underground water contamination in Khartoum State stated that all areas complaining from turbidity are supplied from the River Nile. The study also stated that in some locations (particularly the southern part of Khartoum and East of the Nile) that the ground water has been influenced by waste water disposal and had some microbial contents (Yousef *et a1*, 2010). The underground water in Khartoum State is found at the formation of the Nubian underground reservoir and the formation of Al-Gezira, explaining that it is divided into two reservoirs, the upper one and the lower one, separated by a thick muddy layer with a thickness differs from a region to another, the contamination can move horizontally towards the course of the water flow and affects the other areas and can similarly move downwards to certain depths (Gandoul & Al-Dhaw, 2012).

These studies has concluded that the contamination of underground water in Khartoum State is because of the wastes of sanitation waters and the applied discharging methods including drainage wells (siphons), sanitation networks are not designed with scientific specification and the underground water wells is not designed in a suitable manner to block the upper layers, which are subject to contamination. Many of Khartoum State's water wells have been closed by contamination, namely at Al-Riyadh, Al-Manshiya, Al-Taif and a number of other areas in the state.

Another possible causes of contamination are the companies drilling siphons who use huge machinery that has contaminated the clean water wells, together with their patterns of administration. Therefore, in 2010, Khartoum State issued legislation preventing the use of modern drilling machines in drilling

sanitation wells to protect the underground water reserve after it turned out that there are some drilling companies drilling sanitation wells to depths more than 200 feet (while the clean groundwater level ranges between 100 and 200 feet) (Gandoul, A. & Al-Dhaw, I., 2012) .

This contamination problem has caused another major problem, which is a financial problem because citizen have started to consume more bottled water, this is also not completely free of faults and it is also high in price and so consumes a big share of their income. The bottled water industry has recently spread in the country and many local and foreign investors have been attracted. By 2010 there were investments of around 70 million US Dollars and the number of factories in the field skyrocketed to 26 factories including modern and traditional ones (Gandoul & Al-Dhaw, 2012). On the other hand there is no protection for the consumer where the price of a litre of bottled water is 2 SDG (the value of 1 SDG varies between 0.2 to 0.4 USD) while the price of a litre of petrol is 1.9 SDG. Although factories sell a litre of bottled water to a merchant for 0.1 SDG plus display, refrigerators and delivery, meaning much profit with very little effort, the monthly average house hold bill of water supply ranges between 50 to 100 SDG. In informal settlements, people buy 2 jerry cans (a jerry can holds 20 litres) of water for about 0.5 to 1.0 SDG and each household consumes about 130 to 175 litres per day paying around 9% of their monthly income to buy water (Siham, 2005).

5. CURRENT OFFICIAL EFFORT AND SUGGESTED SOLUTION

Despite important efforts in recent years, governmental water supply has not succeeded in catching up with the rising demand for water over the past decades. About half of the inhabitants of Khartoum State are not connected to governmentally provided drinking water, which results in a huge water supply gap (Beckedorf, 2012). The low income groups in squatter settlements, where there is no distribution network, are suffering the cost of paying for water, often bought from vendors who use water carts usually pulled by donkeys, the carts are made of low quality materials and they are poorly designed. The health section within the local council is supposed to monitor the hygiene situation of the water yards but they do not provide an effective service. Vendors in these locations complained about the high fees for obtaining licenses, health certificates and work permits. It seems that the local council may be interested in vendors as a source of revenue rather than important actors in water distribution to households, whilst on the other hand KSWC senior managers and officials complain that lack of financial investment is the main cause for most of the sector's problems.

Consequently, an assessment of the efficiency of the work of KSWC needs to be carried out to assess, and thereby help improve, KSWC services. One possible solution to help improve matters would be the introduction of an Environmental Management System (EMS).

5.1 Benefits of implementing EMS in KSWC

The implementation of an EMS in KSWC services would be carried out to help improve environmental and financial performance through:

1. Cost savings from wise resources consumption and better process efficiencies.
2. Plan inauguration of more water stations and implementation of a number of water projects in addition to extension of water networks to ensure complete covering of all parts of the state.
3. Chemical and energy management efficiencies.
4. Help to achieve regulatory benefits such as reduced fees and charges.
5. Better relations with banks and improved borrowing and insurance terms.
6. Competitive advantage and increased attraction to investors.
7. Improved community relations and other stakeholders.
8. Improved working conditions/environment, including vendors using carts for water distribution.

5.2 Expected outputs from introducing and implementing EMS in KSWC

1. Preparing a "water data bank" which includes inventory to document all water supply sources in Khartoum (surface & ground water) including the relative information for each source (location, design and supply capacity, quality of water, etc…).
2. Developing a digital map for all water supply sources and distribution networks in Khartoum to modify and update relevant data and alert/schedule for maintenance.
3. Assessment of the new technologies and practices of KSWC including aspects of water abstraction – treatment – distribution, chemicals and energy used in the industry, water quality monitoring, regular maintenance of the treatment plants and water supply network.
4. Investigating the quality of water sources (wells and for the River Nile at the intake point), and detect location of any possible source of pollution (e.g. liquid waste dump from municipals and industrial activities or seepage from septic tanks) and the hazard they might import to these water sources in terms of strength and extent of pollution, and collect information related to water users wrong practices in order to draw a water pollution indicators and water quality monitoring program.
5. Increasing the awareness of workers, technicians and consumers to promote and stimulate legislation enforcements.
6. Better management of allocated budgets to balance between budget verse quality of services.
7. Recommendations for different means to support KSWC (e.g. technical, financial and capacity building).

5.3 Introducing and implementing EMS in KSWC

An Environmental Management System EMS can be considered as a tool that manages a firm's activities that have or are likely to have an impact on the environment. Therefore, when KSWC chooses to implement a formal EMS, it will be trying to manage and minimise its environmental impacts, both commercially and for the sake of a better environment as a whole.

An EMS adopted by KSWC can be:

- Developed internally to meet its own needs and operated in its own way.
- Or it may be one that is subject to external audit, verification and benchmarked against recognised national or international standards.

Two international standards that are used worldwide are; ISO 14001 which are series of standards set by the "International Organization for Standardization", and the EMAS standards which are "the Eco-Management and Audit Scheme standards".

In 1998 Paul Arveson noted that "…business processes should be analyzed and measured to identify sources of variations that cause products to deviate from customer requirements". He recommended that business processes be placed in a continuous feedback loop so that managers can identify and change the parts of the process that need improvements, and offered a simplified diagram to illustrate this continuous process, commonly known as the Plan, Do, Check and Act [PDCA] cycle."

We can modify this PDCA cycle for specific applications to address all of the significant environmental/economic aspects and impacts associated with water service's activities and for a continual improvement in environmental and financial performance.

Such a modified PDCA cycle is shown below:

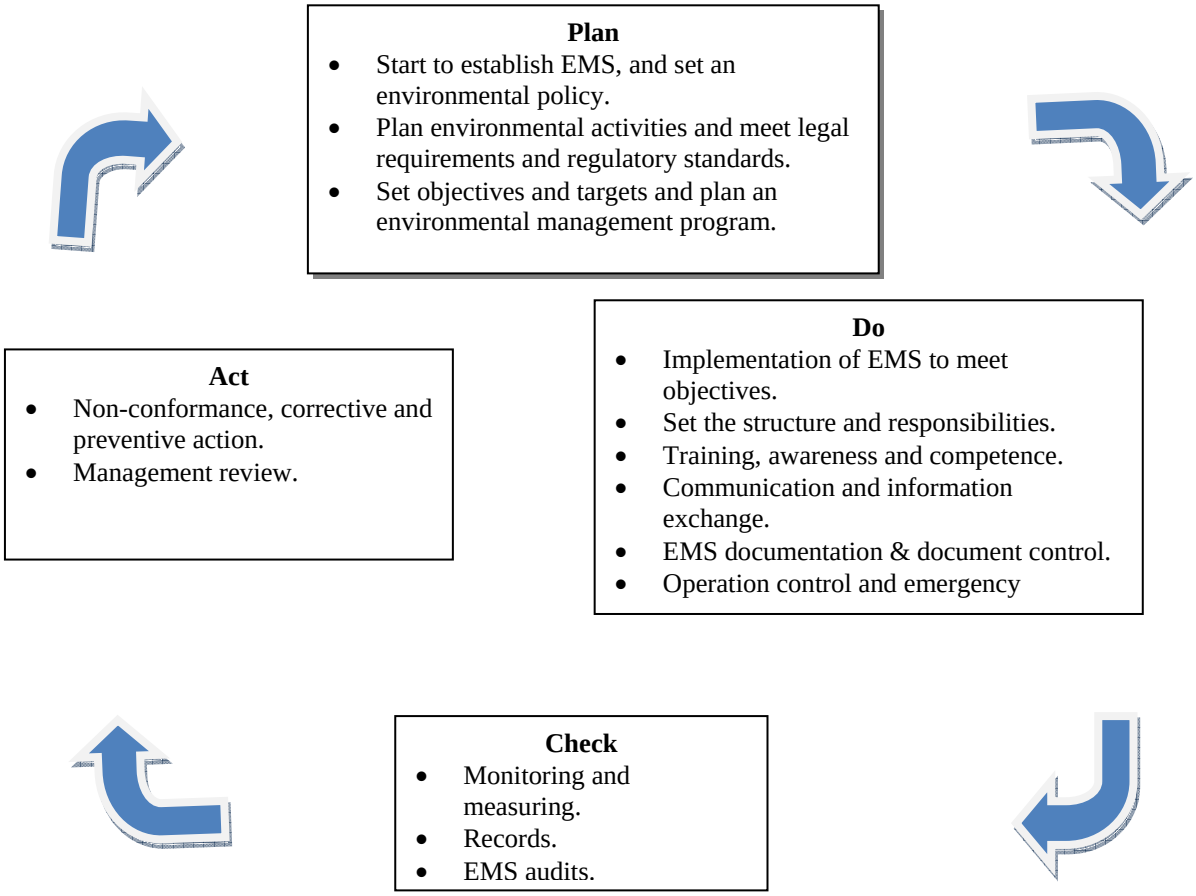


Figure 1: Modified Plan, Do, Check and Act (PDCA) cycle

5.4 Steps of introducing EMS In KSWC

The introduction of an EMS might be a step by step introduction, starting by setting internal standards for KSWC to be followed and modify standards gradually, or the introduction can be a certified/verified introduction following international standards like the ISO 14001 (Whitelaw, K., 2004). When introducing an EMS, the following steps should be addressed:

- Obtaining the support and commitment of senior management and involving different departments in each of the relevant steps and processes.
- Choosing a national/ international environmental standard to comply with, e.g. ISO 14001. If necessary an internal EMS may be developed to be adopted from this.
- Selecting a working group, assigning responsibilities for individuals and scheduling regular meetings for the group to encourage a good working relationship and to discuss relevant issues.

5.4.1 Environmental Policy

For KSWC to develop an environmental policy and for top managers to endorse it, the policy should be clearly set out and include the following:

- General principles relating to water and environmental strategy/planning.
- Information about the water products or services, size and scale of the water services and their proven impact on consumers and the environment.
- Information about and commitment to comply with adopted legislative compliance and regulations.

- A commitment to healthy and sustainable water production.
- Information about specific goals/targets and realistic objectives that can be verified (numerically if possible).
- Information about training, documentation, communication and worker protection.
- A commitment to continually improve its environmental performance through an on-going process of enhancement of the EMS.

It is important to both discuss and revise the policy whenever there is a need to cover any new objectives/targets, however final drafts of the policy should be easily available to public e.g. electronic format, KSWC leaflets, other hard-copy format etc.

5.4.2 Actions to achieve the policy's targets/objectives

For KSWC to achieve its policy targets and objectives, it will need to carry out an initial environmental review as the first step in order to:

- Review the KSWC management structure (e.g. organizational chart, jobs descriptions and responsibilities, and assigned environmental responsibilities) and the operational management system (e.g. documented or written procedures for different plans and activities, environmental records for permits, water treatment and transfers, monitoring & maintenance, complain records and training).
- Evaluate and quantify the current KSWC activities that have an impact on the environment, especially those that are subject to regulatory processes). Their impacts should then be listed in a register.
- Collect the necessary data and information about the key areas of KSWC environmental performance against which further improvements can be measured.
- Highlight key areas of environmental significance and problem areas based on the affected areas and groups and the severity of the impact, so that areas of priority can be identified to be resolved within the new EMS.
- Identify opportunities for improvements elsewhere that can help the organization's financial performance and marketing activity.

The initial environmental review for KSWC should clearly cover the following areas:

a. Input, operation, out-put and plans related issues.

- The detailed production processes and operational steps, including resources and materials (e.g. water sources, power, steam, chemicals/materials used etc.) and the main outputs from these (drinking water) together with byproducts such as sludge. Information about the water supply distribution network and budget allocated for environmental matters.
- All missing data should be identified and that which is available should be collected for documentation and collation or modification.
- Any hazardous substances that are used together with their concentration, whether in the influent waters or present in the materials/chemicals used during the production processes, together with information about whether these are discharged or released to the environment or in the potable water product.
- The working procedures including production/processes, cleaning, periods and/or any special procedures used for handling these input.
- Plans for reducing waste and/or pollution of water during its transportation to consumers.

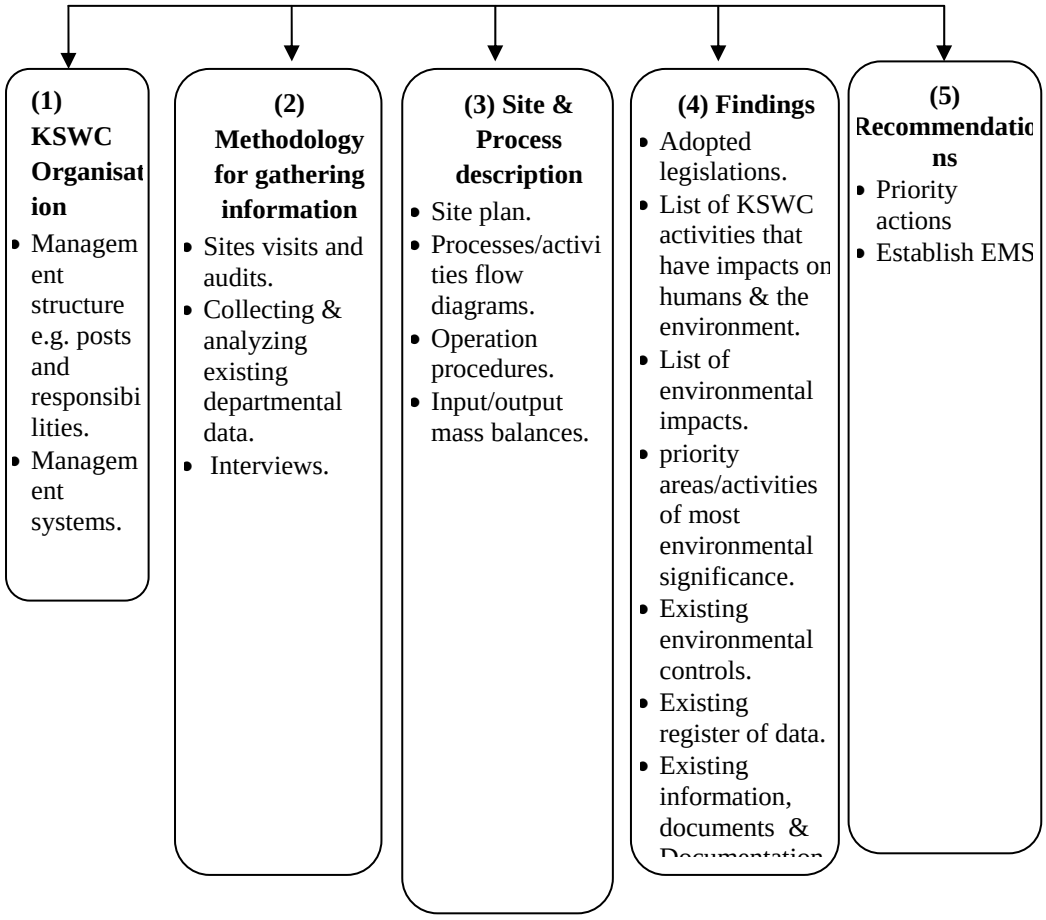
b. Impacts related to KSWC activities.

- Human health impacts, turbidity or odour, effects associated with any accidental spillage or release, cut of supply, scale, severity and duration of impacts, and risk of occurrence.
- Cost of changing and (if appropriate) availability of improved technologies/techniques.
- Consumers charges and tariffs.

C. Abnormal circumstances.

- What could happen under abnormal conditions or emergency situations? Such as the start-up or shutdown of a continuous process, might include floods, fires or failure to meet certain condition.

The outcome of the initial review should be a report that provides baseline data on KSWC current environmental performance. The environmental review can be organized and written to include the following chapters (Skerratt, 2012).



Source: Chapters of environmental review (CPDU – EMS), CIWEM - England, 2012.

5.4.3 Planning an EMS:

A plan has to be created in order to meet the policy commitment pollution prevention and continual improvement. This means that senior managers have to facilitate the selection of action groups with a group leader for setting the plan and implementing the various facets of the EMS.

Action planning springs from the initial environmental review findings and works as follows:

Prioritising effects/activities:

A. Environmental aspects/activities versus impacts:

The KNWC aspects/activities that have been identified are then prioritized according to the significance of their impacts on the environment, whether positive or negative. The ones with largest negative impacts are dealt with first. One method used for prioritizing activities involves grouping activities into those over which we have control and those over which we only have little influence.

In all the cases there are number of priority factors that should be considered. For example:

- Ecological effects.

- Human health impacts.
- Effects associated with accidental spillage/release and /or cut of supply.
- Scale, severity and duration of impacts, and its probability of occurrence.
- Cost of reversing negative impacts and availability of appropriate improved technologies/techniques.

These factors, in turn, will relate to utilization and contamination of water resources, human health and the environment in general together with an examination of costs versus benefit for each. A simple way of prioritizing KSWC activities is to use a tabular approach that will map the 'stage in the process' against that facet of human or environmental impact affected. An example of this is given in the table below (Skerratt, 2012):

Table 3: Stage in the KSWC activities against that facet of human or environmental impact affected

	Material Extraction	Raw Material Transport	Process or Service	Process Waste and Recycling	Packaging, Distribution and Transport	Use in-service	Disposal	Other
Energy	2	1	2		2	3		
Resources	2	2		1		3	3	
Air								
Water	2	1	4	1	4	4	2	
Soil		1						
Geology								
Landscape								
Noise								
Humans			3			3	3	
Cultural								
heritage	1	1			2			
Ecology and Nature	1	1						
Conservation	1	1					2	
Climate								

Source: Staffordshire University, England, 2012.

This table offers a generic starting point - only those columns/rows that are applicable to KSWC are completed, entries can be made on a scale of between, say, 1 to 5 (where 5 represents the worst imaginable impact and 1 little or no detectable impact). Vertical and horizontal totals can then be used as a starting point for prioritisation. It is shown that KSWC processes, distribution & transportation, use in service are the major areas in which major impacts are expected to occur, thus these are the areas for prioritization.

Various other weighting factors can be included for different row or column topics as appropriate.

B. Environmental impact assessment:

A more systematic way of dealing with both the identification and prioritisation of environmental aspects and impacts might be through a process of environmental risk assessment. Risk analysis is an approach and a set of tools for systematically comparing the social, economic, human health and other environmental costs and benefits of decision options. Risk analysis includes problem definition, hazard and exposure assessment, risk characterisation, risk communication and decisions affecting risk management.

C. Environmental targets and objectives:

The objectives and targets should focus on:

- The priority areas (those of most significance).
- Demonstrate commitment to continuous improvement.

- Quantifiable and incorporating delivery deadlines. These latter two points are very important because they help form the basis of the time-constrained action plan.

An indicator of the ability of an EMS to deliver continual improvement is setting objectives (maintaining or improving them) and meeting their targets, and this is a key requirement for certification.

An example of some environmental objectives to be targeted for KSWC

- **Water Supply Standards:**
  To identify all industry standards (including the current guidelines set by the Sudanese National Meteorological Corporation SNMC) or any other applicable standards like the World Health Organisation (WHO) standards e.g. the quality of the water from the source and quality of supplied water, method used for water purification the design of stages applied for treating the water, technologies and equipment used for operation and distribution network and methods by the end of a certain period and to ensure compliance with the applicable environmental SNMC guidelines within a certain period
- **Chemical consumption:**
  To assess current chemicals use against industry standards within a certain period and identify areas where chemical savings could be made.
- **Materials used:**
  To assess current materials (e.g. pipe lines materials, any devices used for measuring, metering or during the treatment and supply process, water appliance equipment and fittings) use against industry standards within a certain period and identify areas where pipe lines, devices and water equipment of better quality, efficiency and more durable could be replaced.
- **Energy Consumption (heating/cooling and lighting):**
  To assess current energy use against industry standards within a certain period and identify areas where energy savings could be made. To replace all lighting equipment and bulbs in offices and workshops with low energy, long life equipment and bulbs when they fail. This process will begin immediately and it is anticipated that all equipment will have been replaced over a certain period.
- **Operational equipment:**
  To fit electricity monitoring equipment to all major appliances within a certain period, With a view to identifying unusually high energy use equipment for replacement over a particular period
- **Legislative Compliance:** To comply with a relevant environmental legislation within a certain period.

5.4.4 Environmental Review:

A. Techniques for conducting environmental review & areas to be considered

Using techniques for conducting environmental reviews such as; interviews, direct inspection and measurement, review of existing records and review of previous audits. The review for KSWC can consider the following areas;

- The suitability of the KSWC environmental policy and whether it needs revision (developing concerns about the environment, increased knowledge of particular relevant environmental issues, new legislation, views of stakeholders, market factors and changes in KSWC processes).
- New developments in KSWC that may require amendment to the EMS.
- The suitability of the existing objectives (the demand/supply, number of beneficiaries, delivered water quality against type of use).
- Impacts of KSWC (withdrawal and use of water resources, energy consumption, supply contamination, drains/releases to/in water sources and surrounding environment, and management of materials used within the industry and managing produced waste).
- Impact on consumers and community including health and socio-economic impacts.

KSWC must establish and document a methodology for evaluating and assessing aspects of significance against a certain scale or using a certain risk assessment technique. The management review is an opportunity to consider the corporation's performance in meeting its environmental objectives and targets. If targets are not being met, then changes to the EMS may be needed.

If there has been a degree of success in reaching the targets and objectives then these should be revised and the setting of new objectives and targets should be discussed. If the rate of improvement has been more rapid than was expected, the organisation may wish to increase its rate of improvement for the future.

Once the corporate has identified its significant aspects and has examined its environmental management practices and procedures it can begin to identify areas for cost-effective improvement in environmental performance and set its objectives and targets.

B. Objectives and Targets

By analysing data collected from an environmental review the action implementation group will see areas that have shortages to meet legal compliance, therefore quantified objectives wherever possible and at a certain time of period could be set to comply with legislations, and to meet its policy commitment to continual improvement and prevention of pollution.

KSWC objectives would include a commitment to (for example)

- Reduce the depletion of water resources.
- Reduce or eliminate the release of pollutants into water sources and its surrounding environment.
- Design sanitation networks and the underground water wells with scientific specification and suitable manner to block the upper layers which is more likely to be contaminated.
- Design water supply system that minimizes environmental impact in production, use and disposal.
- Secure enough funds for expansion of existing and future treatment plants and supply network.
- Minimize any significant adverse environmental impacts on water sources and supply due to new developments and promote environmental awareness among employees and the community.

KSWC would measure its progress towards any given objective by using environmental indicators such as:

- Quantity of raw and treated waters and energy used.
- Quantity of emissions such as CO_2, specific pollutant quantities e.g. NO_x, SO_2, CO, hydrocarbons and Pb.
- Quantity of chemicals used in the industry e.g. alum, fluoride, chlorine and sodium hydrochloride.
- Waste produced per quantity of finished product, efficiency of water and energy use.
- Number of environmental incidents/accidents.
- % waste recycled, % recycled material used in the industry.
- Investment in environmental protection and number of prosecutions.

6. THE ACTION PLAN AND EMS IMPLEMENTATION

6.1 Environmental management programme

Having set objectives and targets, KSWC must now devise a programme or an action plan for achieving them. The action plan is a continuous procedure of analyzing and improving environmental stewardship through addressing environmental aspects using a number of action plans/projects, starting with the most important areas.

An effective action plan for any water supply company such as KSWC needs to include the following:

- An activities schedule, time-frame in which the objectives and targets are to be achieved.
- Identification of the people responsible for achieving them.
- Measuring performance indicator such that what gets measured gets managed.
- Monitoring of the anticipated benefits resulting from environmental improvements including those that cannot be directly measured.
- Formulation and quantification of investment costs and a budget for all the various phases of EMS implementation.
- Creation of dates for first and subsequent assessments, a regular review of progress to assist in identifying issues which may need to be addressed or to which special attention needs to be paid to ensure success.

- An emergency plan to deal with any abnormal situations that may arise.

The action plan needs to evaluate the environmental impacts throughout the organisation, beginning with the acquisition of raw water and continuing through all stages of processing, treatment, storage, transportation and final supply. After evaluation, the action plan needs to look for information and resources to design steps to eliminate or minimize negative environmental impacts.

6.2 EMS Implementation

It is important for KSWC to provide all the necessary human, technology and financial resources for the action plan to be implemented. Having done so, the key factors affecting the general operation and ongoing success of the EMS would be as follows:

- All personnel need to be aware of EMS benefits, objectives, procedures and targets, therefore staff training is very important, it is very significant and immediately improves staff competency and quality of service.
- Establishing a good communication system internally and externally and a receiving/responding system.
- Establishing a database to keep records of all relevant environmental materials, including review and revision or updates when necessary.
- Produce documented operating procedures for activities and processes to meet objectives and targets, as well as procedures relating to the significant goods, products and services used by KSWC.
- Preparing a budget for each project's development, costs will include staff and employee time, training, including any necessary consulting assistance, materials and equipment.

A regular assessment and review of the EMS should take place through the Management Review process and any necessary improvements incorporated back into the EMS to improve its operation.

A report based on the minutes of a review meeting can be used as documentary evidence that the review took place, and this can be used as evidence in any subsequent audit. The report should include a statement explaining why the review was conducted - whether it was a routine review or instigated by special circumstances. The report also needs to present the findings, conclusions and recommendations of the review and assign tasks to the personnel responsible for implementing the necessary corrective actions.

Management reviews are part of a continual (improvement) process. The extent to which improvements have been carried out will then be assessed in the next management review. Regular reviews of the EMS will highlight areas where the system itself can be improved, and they help to maintain the programme of continual improvement itself.

So, in summary, the Management Review needs to be :

- Objective in checking the continuing suitability, adequacy and effectiveness of the EMS.
- Organised in a way that documents its findings.
- Capable of changing the organisation's environmental policy, objectives and/or targets in the light of changing circumstances and in the view of continual improvement.

7. CONCLUSION AND RECOMMENDATIONS

- The proper implementation of EMS will help KSWC to early point out issues that may cause any deficits in its services, to continuously monitor the quality and the adequacy of the supply to satisfy consumers, to early plan for future goals and to seek financial funds for the implementation of these plans.

- Conducting continuous reviews for its services, KSWC will be able to early know problems and identify factors that cause these problems, such as the problems of groundwater and the supplied water pollution and factors that cause these pollutions (sanitation leakages, disposal from industrial, agricultural or other human activities, transporting the water through non-hygienic

tankers/carts). Also KSWC will be able to identify causes of occasional turbidity of the supplied water, un-scheduled and/or un-announced cut-off the water supply and the occasional high pressure water flow in pipes. Knowing the problems and identifying their causes KSWC can take specific steps (while implementing the EMS), these include the followings:

- KSWC has to work closely with municipalities and sanitation authorities in charge of wastewater collection, treatment and disposal, and to make joint projects/programs with them for changing the existing situation, preventing it from further deterioration and to develop the country's water sources.

- KSWC has to work with governmental authorities responsible for legislation and law enforcement to legislate laws for the development, enhancement and reservation of water sources, and to impose penalties on activities that break regulations/limits and cause the problems discussed in this paper (e.g. polluted liquid waste discharge, over loading consumers with extra charges for bottled water or water delivered by tankers or carts, poor operation and management of treatment plants, poor distribution and supply services, and poor quality of supplied water).

- In areas where there are problems of poor water supply KSWC has to raise the public awareness of the existence of such problems, and as a temporary solution KSWC has to raise the public awareness on how to deal with the problems, and to encourage and support them to take simple measures and use safe chemicals for disinfecting waters and for removing water turbidity at their localities and homes.

However, with a strong commitment from the right people and appropriate resourcing, the steps outlined in this paper are designed to deliver a functioning environmental management system that will serve the Khartoum State Water Corporation well for the future.

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