

Harties, Metsi A Me “My Water”

November 2007

Hartbeespoort Dam Integrated Biological Remediation Programme

The Department of Water Affairs and Forestry (DWAF) is implementing the Hartbeespoort Dam Remediation programme, referred to as *Harties, Metsi a me (My water)*. The aim of this programme is to address the imbalances and unhealthy biological conditions in the dam. The implementation will take place in two phases over a period of time. Phase one focuses on establishing biological processes and mechanical harvesting of biomass (algae and hyacinths). Phase two will focus on the treatment and the bulk removal of phosphate.

Hypertrophic State of the Dam

Hartbeespoort Dam is one of the most significant dams in the economic hub of North West Province and of the Crocodile West Marico Water Management Area (WMA). This dam is one of a number of hypertrophic dams in South Africa and has been in this state for some time. Hypertrophic means that there are excessive nutrients such as phosphates and nitrates trapped in the dam, as a result of a combination of factors:

- Daily discharges from Waste Water Treatment Plants in the catchment (600 million litres per day);

- Stormwater flows wash surface pollution such as sewer spillages, fertilizers, litter and animal waste into the dam;
- Washing powders;
- Poorly maintained sanitation systems that leak or overflow during rain storms;
- Stormwater increases into sewer networks that cause overflows into watercourses at manholes and pump stations: and
- Informal washing in the rivers.

The high level of nutrients in the dam results in uncontrolled algal growth, especially during summer months when solar radiation and the water temperature are high. This serves as an important element in promoting algal growth. However, while the presence of algal growth is usually less during the cold winter months, it was still present in the dam-basin over recent winter months.

Mr Petrus Venter, the DWAF's Deputy Regional Director: Water Resource Management: Crocodile (West) Marico is the Project Manager for this programme. He is assisted with the implementation of this programme by Rand Water.



DWAF's efforts over the years

DWAF, as custodian of South Africa's water resources, has over the last 30 years implemented various actions to address the eutrophic or nutrient enrichment in our water courses. These include management of the catchment area to reduce effluent discharge, and improvement of the effluent standards (special phosphate standard).

The economic growth in the catchment has overtaken the effects of these actions. DWAF has initiated the development of a biological method to deal with the imbalances that prevail in the Hartbeespoort Dam. Joint planning between DWAF and the North West Department of Agriculture, Conservation and Environment (NWDACE) led to the development of the Remediation Plan which was published in 2005 as the “North West Environmental Management Series 5”. This plan is now being implemented as the Hartbeespoort Dam Remediation Programme (HDRP). This programme uses integrated biological processes and programmes.

Harties, Metsi a me

The *Harties, Metsi a me* programme comprises a number of projects. DWAF is approaching the implementation of this programme according to Integrated Water and Environmental Management principles. Most of the projects in this programme will be fast tracked as a matter of urgency. It is however important that addressing one aspect of the dam does not negatively impact another which may move rather than solve the problem. In certain instances it will be necessary to complete projects in a set sequence.

For instance, to establish a healthy zooplankton community and to restrict nutrient availability for phytoplankton growth, it is necessary to immediately commence with the restructuring of the fish community. Furthermore, the success of reconstructing the fish community is dependent on the establishment of a suitable food chain that will be able to sustain them (food web manipulation).

“The improvement of water quality in the dam will enhance the development and economic growth in the area, which will certainly increase employment prospects, but the project itself will unlock further employment opportunities”.



The hypertrophic state of the Hartbeespoort Dam.

Integrated Water Resource Management (IWRM) aims to balance the use of water resources for livelihoods, and its conservation and protection for future generations. It furthermore promotes the principles in the National Water Act (No 36 of 1998), which includes the sustainable and equitable use of water resources for the optimum social and economic benefit for the country, as well as the need for transparency and participation in the management of our water resources.

The situation at Hartbeespoort Dam

The Crocodile River flows into Hartbeespoort Dam from Gauteng and brings with it waste from three Metropolitan areas, namely Jo’burg (Johannesburg), Ekurhuleni and Tshwane. It is therefore imperative to address the excess nutrients, sediments and the litter in the dam. The unhealthy state of the dam is evident from the excessive growth of the toxic *Microcystis* algae population. Further proof of the dam’s state is the distortion of the fish community, irregular shoreline vegetation and the entire aquatic ecosystem in the dam.

Although it is important that municipalities comply with the standard of effluent discharge quality, control sewage spills and better manage storm water impacts in the catchment, phosphate loads will have to be reduced dramatically for any change to take place. The removal of phosphates through the uptake in a food chain as well as establishing a biological balance is therefore the focus of *Harties, Metsi a me*.



“The dam is a symptom of our modern lifestyles and the way we consume our resources. This situation cannot be sustained and it is therefore imperative that we become aware of the limitations and impacts on our resources and start using them wisely and with more care. Every individual can make a difference by implementing waste minimisation and recycling in their own personal life” - Petrus Venter, DWAF.

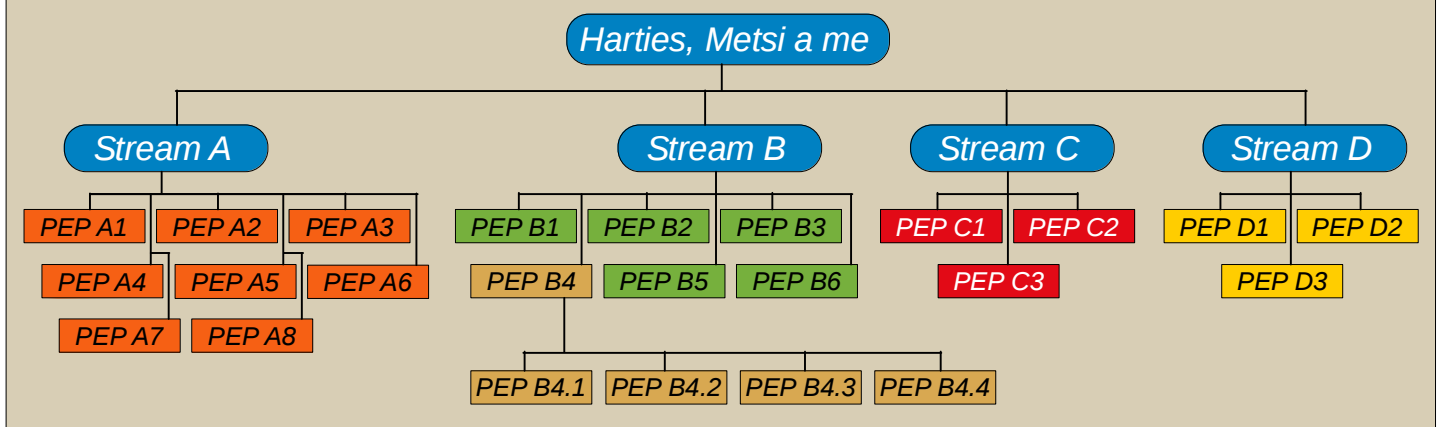
Visit the DWAF website to find out what you can do to make a difference: www.dwaf.gov.za/harties/

Harties, Metsi A Me - “My Water”



Focus of the Harties, Metsi a me programme (map supplied by Google Earth)

Schematic diagram of the components of the programme



Harties, Metsi a me aims to address the negative impacts on the dam while at the same time, creating job opportunities for local people. Phase one focuses on establishing biological processes and mechanical harvesting of biomass. Phase two will focus on the broader catchment impacts eg. stormwater, river ecosystems and possible instream treatment and the bulk removal of phosphate.

Components of the Remediation Programme

The remediation programme comprises four streams of projects:

- Stream A - Overarching Infrastructure Projects,
- Stream B - In the Dam Basin Projects,
- Stream C - Upstream Catchment Management Projects,
- Stream D - Downstream Catchment Management Projects.

A Project Execution Plan (PEP) has been developed for each project.

Stream A - Overarching Infrastructure Projects

PEP A1 Hartbeespoort Dam Steering Committee (HDSC)

The purpose of this intergovernmental committee is to coordinate and integrate legislation and policies with stakeholder interest in the programme at a strategic level. The North West Department of Agriculture, Conservation and Environment (NWDACE) was instrumental in forming

the HDSC as part of the Strategic Environmental Assessment (SEA) of the North West Province. NWDACE is responsible for the HDSC which meets quarterly. Rand Water as implementing agent provides administrative support, coordinates the activities and reports on the progress made with *Harties, Metsi a me*.

PEP A2 Hartbeespoort Dam Co-ordinating Committee (HDCC)

Rand Water as Implementing Agent is responsible for coordinating the implementation of the programme through the HDCC. Rand Water is further responsible, outside the scope of this programme, to sensitise local municipalities (water users) and large water consumers (e.g. industry) to the objectives of the programme and to obtain their support. This is done through other programmes and projects currently being undertaken in the catchment area, such as the Gauteng Water Cycle Management Project, which will have a direct impact on the execution and outcomes of *Harties, Metsi a me*.

PEP A3 Communication and awareness

Awareness has to be created about the aims and objectives of the *Harties, Metsi a me* programme and its different projects. It is important that stakeholders are made aware of the successes and challenges of the programme and the opportunities for involvement. Education and advocacy will be the basis to facilitate behaviour change with regards to the way people and institutions manage their water and deal with their waste. Extensive awareness activities will target the public, local authorities, industry, mining, agriculture and international interests.

PEP A4 Integrated monitoring system

The success of the *Harties, Metsi a me* is dependent on a well coordinated and integrated monitoring programme, which will accurately quantify the impacts from the catchment and the overall success of the programme to ensure that



the water quality is acceptable for the various water uses. Sustainability of the implementation of *Harties, Metsi a me* calls for the involvement of individuals and organised groups such as business, schools etc. in the monitoring programme.

PEP A5 Supporting research and development

Practical and essential research will be conducted when necessary as the implementation of the programme unfolds. This will be guided by the Water Research Commission (WRC) as a key partner in this programme. It is anticipated that through research many disciplines will be integrated through the programme. At present there are already six research projects relating to the Hartbeespoort Dam for assessment with the WRC.

PEP A6 Fund raising

Harties, Metsi a me is a DWAF funded programme but because of its magnitude further opportunities to acquire donor funding are being investigated by Rand Water, especially with regards to the projects within the broader programme. These involve research and development, monitoring of information and sampling. Private initiatives are also being considered such as business and land owners around the dam who wish to become involved and who are willing to contribute to the programme (facilities, human resources, etc). The Development Bank as a funding specialist will assist in leading this project.

Harties, Metsi a me aims to change the current distorted eco-system of Hartbeespoort Dam to a balanced one, simulating the most desired natural conditions possible. It focuses on managing the trophic state of the dam, restructuring the fish community and establishing a bio-diversity that can be sustained.

PEP A7 Policy, institutional and legislation support

The programme has to comply with policy and legislation. This support is provided to all aspects of the different projects within the programme.

PEP A8 Integrated Environmental Management

A dedicated environmental management plan will be developed and implemented. Monitoring data from the respective environmental projects will contribute towards environmental management information. Functional support is also to be provided to all environmental management related activities in order to ensure integrated environmental management.

During and after implementation of the programme, it will be necessary to guide the institution that will be responsible for the management of the dam (see B2). This institution will have to establish a practical environmental management system to enable the "owner" to control the activities in, on and around the dam. This is to ensure that the achievements of the remediation project are not adversely impacted on by on-going activities. A suitable monitoring process will be implemented to provide those responsible with timeous information to manage the dam.

An important aspect of the remediation programme is to create awareness and education amongst the public with regard to waste management e.g. elimination of nutrients contaminating water sources. The environmental management function is an important part of the communication team to create the necessary awareness amongst consumers and the public at large.

Stream B – Dam Basin Projects

PEP B1 Resource Management Plan (RMP)

A Resource Management Plan is being developed with input from local stakeholders on aspects such as integrated planning and sustainable development, recreation and safety around the dam.

PEP B2 Water Management Institute (WMI)

One of the main objectives of *Harties, Metsi a me* is to ensure the establishment of a Water Management Institute that will eventually be responsible for the management of the Hartbeespoort Dam and its immediate environs.

Establishment of a Water Management Institution will be done in parallel with the development of the Resource Management Plan (RMP). Rand Water, as implementing agent will implement aspects of the RMP until such time as the institution is established.

PEP B3 Recreational activities at the dam

There is a huge demand for the recreational use of the dam with an ever increasing demand. These demands have to be balanced with the demand for water to the domestic, mining and agriculture sectors. With the restructuring of the fish population, fly-fishing might also become part of the growing aquaculture hub in North West Province. It has the potential to be a major source of income and can contribute to tourism and job creation.

PEP B4 Biomass Management

PEP B4.1 Control and remove algae

Floating booms are used to assist with the surface movement concentration and physical removal of algae from the water. Four to five positions for boom placement have been identified, one of which has already been placed successfully at the dam wall as a prototype. Compost will be produced from the harvested algae and hyacinth. This will allow the breeding of earthworms - a high source of protein for fish and chicken. The composting combined with the removed sediment will produce a high quality soil conditioner.

PEP B4.2 Control and remove hyacinths

Similarly to algae, hyacinths will also be removed from the water by concentrating the movement of these water plants on the dam. Hyacinths may possibly be used as plant material in the floating wetlands (mesocosms) which has to be harvested on a regular basis.

PEP B4.3 Shoreline vegetation

Shoreline vegetation is important to improve the bio-diversity of the dam. This will contribute to the control of water



pollution; prevent benthic erosion, serve as a spawning substrate for fish and create micro habitats for fish and invertebrates.

The Hartbeespoort Dam and its littoral zone are artificial habitats and have little inherent conservation value. The dam is subject to rapid human induced fluctuations that are not caused by natural environmental conditions. Shoreline vegetation zones are evident in three zones depending on the dam level, the infra-littoral zone (mostly permanently flooded), the eu-littoral zone (the shoreline between the highest and lowest seasonal water level) and the supra-littoral zone (soil is seasonally saturated and have seasonally elevated soil water levels).

There are examples of impoundments that have higher phosphate levels than Hartbeespoort Dam which do not have excessive algae. This is because they have healthy zooplankton such as Daphnia as well as shoreline vegetation.

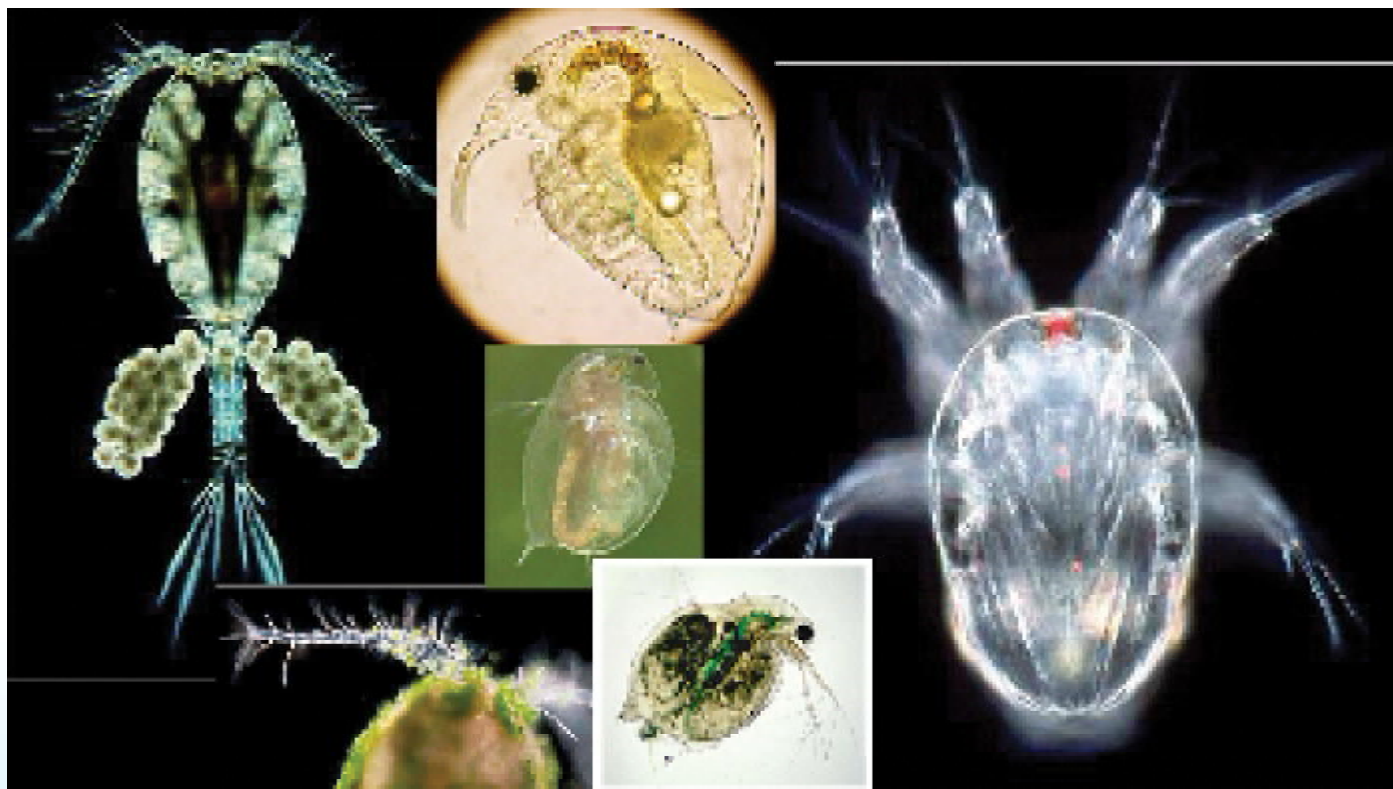


Prototype of boom at dam wall.

PEP B4.4 Floating wetlands

Floating islands of preferably indigenous water plants are considered an important extension of shoreline vegetation as they provide the capacity for nutrient removal from surface water. They also serve as a habitat for aquatic organisms and for fish to survive and grow. This artificial

safe habitat for zooplankton could contribute to increasing the size and diversity of its population since they feed on algae. The floating wetlands can therefore form an important part in the food-web structure. The floating island concept will be tailor made for the conditions in the Hartbeespoort Dam.



Zooplankton, the animal form of plankton, mainly includes protozoa, rotifers and small crustaceans.

PEP B5 Sediment removal

Significant volumes of nutrients are captured in the organic and inorganic layers of incoming sediment in the Hartbeespoort Dam basin. Treatment of water flowing into the dam will hardly change the appearance of the water unless sediment can be cleared of its high nutrient levels. The principle objective of this project is to ensure that:

- Contaminated sediments in the dam are removed;
- Dredging of incoming sediments is feasible,
- Removed sediments are re-used economically and in an environmentally safe manner, and
- Removed sediments are used with compost production or other applications such as rehabilitation of depleted soils, which might also include household, agriculture or mining.

PEP B6 Fisheries management and monitoring

The main focus of this project would be to manage, co-ordinate and monitor the commercial fisheries on Hartbeespoort Dam, and to monitor the impact the fisheries has on the fish community. The project will determine trends in the fish populations.

Restructuring of the fish community:

- Undesireable fish species will be removed by netting to achieve the desired trophic structure
- A commercial fisheries will be developed by harvesting the dam on a sustainable basis. The community will benefit from this additional protein source.

The fisheries will be managed on the following basis:

- On-site management of the commercial fisheries on the dam;
- Fisheries specialist input (monitoring, coordination and management);
- Bi-annual fish ecological surveys to determine trends or shifts in the fish community and evaluation of the trophic structure.

The fisheries task will create significant job opportunities, in particular for unemployed local residents. An organisation was appointed through a tender process for the removal of the coarse fish species, namely Catfish, Carp and Canary Kurper from the dam over an anticipated 3-year period. The project team will develop a scientific monitoring programme that will be implemented prior to catching and harvesting the fish.

Stream C – Upstream Catchment Projects

PEP C1 Pre-impoundment, litter trap, dredging and river water treatment

Harties, Metsi a me is developing biological and physical means to remove phosphorus from the dam and phosphates flowing into the dam. While most of the interventions are aimed at biological processes in the dam itself, the pre-impoundment will be based on engineering practices to manage and where possible, reduce the inflowing phosphate load into the dam.

The purpose of the pre-impoundment is to limit the build-up of phosphates in the dam which is fed from water in the Crocodile River. It will attenuate water in the river before flowing into the dam and allow sediments to settle in this small impoundment. It will also enable dredging of phosphate loaded sediments in the impoundment or allow the phosphates to be removed by means of chemical dosing.

Addressing the nutrient load in the sediment and the water mass entering the dam is a huge task. But this is necessary to prevent the algae growth. Obvious solutions to achieve this include:

- **Controlling and enforcing more stringent phosphate standards at wastewater treatment works in the catchment;**
- **Implementing stormwater management measures to prevent sediment loaded stormwater runoff;**
- **Developing a practical system to divert nutrient-rich water directly to the dam wall, to minimise negative effects.**

A prescribed annual minimum phosphate load for water entering the dam will be set. The focus will be on ortho-

There are a number of options to decrease the nutrient load entering the dam, but are costly and difficult to implement. Implementing the required phosphate standard in treated effluent from waste water treatment plants costs local authorities and metros millions of Rands per annum.

phosphates in suspension in the water and sediments. Phosphate loaded sediments are mainly associated with stormwater flowing in from the Crocodile River.

The pre-impoundment structure will also serve to collect water in the river, which can hydraulically be diverted to a suitable location in the dam. If the first rainy season nutrient rich stormwater can be diverted to a location at the dam wall it will also help with destratifying the top warm water with colder deeper water. The pre-impoundment structure could also assist in controlling excess hyacinth growth in the river system as well as their collection and removal.

A litter trap at the inlet of the Crocodile River is being planned as part of the programme to collect litter transported with stormwater from urban and informal settlements and roads. Stormwater inlets and outlets from urban areas into the rivers also need to be equipped with litter traps.

PEP C2 Wetlands

The wetlands project in the catchments of the Hartbeespoort Dam focuses on enhancing the functioning of the natural wetlands. It will also introduce artificial wetlands incorporating the identification, mapping, assessing, monitoring, remediation and management strategies utilising best practices. It includes developing regulations to protect wetlands while implementing the water resources classification system in the catchment to protect riparian vegetation and aquatic ecosystems along the rivers.

PEP C3 Phosphate removal

Eutrophic state is the nutrient enrichment state of water that results in an array of stimulation of increased growth of biomass (algae and exotic water plants), deterioration of water quality and various other adverse consequences. Nutrient enrichment may occur through the use of waterborne sanitation, washing powder, fertilizer etc. Significant reductions in surface water nutrient levels have been achieved in overseas countries by applying phosphate reduction initiatives. This project therefore aims to determine the feasibility of controlling nutrient sources i.e. phosphates and nitrates that exceed the threshold value and contribute towards increasing the level of eutrophication in the dam. The feasibility to actively promote the use of substitutions

or alternatives to phosphorous in detergents in the geographical area of the upper Crocodile River catchment area can also be considered as well as improving the processing at the waste water treatment plants.

Stream D – Downstream Catchment Projects

Although the dam was built for irrigation use, there is an increasing demand to provide water for all sectors including potable use, mining and industry. The water quality in the dam severely impacts on all of these users. Algal growth in canals result in obstructions, spilling and overflowing canals, with huge water losses deemed for agricultural use.

PEP D1 Downstream water use

DWAF is striving towards an integrated planning and management approach, referred to as Integrated Water Resources Management (IWRM). The goals of this IWRM process are:

- An allocation schedule that meets the requirements of the National Water Act (NWA) (Act 36 of 1998);
- Water resources yield and other models that are

representative of the flow regime of the river systems in the area;

- Management class scenarios for the river (i.e. reserve and resource quality objectives set); and
- An accepted catchment management strategy.

These deliverables are being developed and implemented by DWAF as part of IWRM. They will be taken further once the relevant Catchment Management Agency (CMA) assumes responsibility for managing the water resources of their respective Water Management Areas (WMAs).

In the interim, DWAF's Regional Offices will continue to manage the water resources in their area of jurisdiction until such time as they can hand over these management functions to fully operational CMAs. In accordance with the NWA, DWAF (the Minister) will remain ultimately responsible for the management of the country's water resources.

PEP D2 Water Efficiency Use (including Water Demand Management and Conservation)

The implementation of water demand management, which principally means to improve the efficient use of water in



Water flowing from the dam into canals

the Crocodile West Catchment area, will have a big impact on the quantity and quality of the return flows to Hartbeespoort Dam. This addresses an important aspect, waste minimization, which is part of the Remediation Programme and ultimately of the more ecologically sound management of the Dam. Compliance with the Water Services Act and National Water Act will be addressed by integrating the WMAs of upstream municipalities within the guiding principles of the remediation programme. Rand Water will be the team leader with several specialists taking part in this multi-disciplinary programme.

PEP D3 Aquaculture Hub

The quality and availability of water in the Crocodile West Marico Catchment Management Area together with the socio-economic climate requires optimum use of water resources. The establishment of an integrated aquaculture hub in the North West Province will have a substantial influence on these negative impacts.

Planning to develop a strategy to implement an integrated aquaculture hub has started. This will fit in with the fisheries management and monitoring project.

Stakeholders can assist to make Harties Metsi a me a success

It is a major challenge to address the negative impacts of pollution that originates from the upstream catchment. Extensive education and awareness programmes are needed to address waste minimisation, recycling, efficient water use, water demand management and water conservation in the catchment.

A further challenge is the practical implementation of co-operative governance. This programme needs to be harmonised with all other related activities in the area to ensure optimal economic growth and sustainability which can only be reached with effective stakeholder involvement.

The implementation of the Hartbeespoort Dam Remediation Programme is foreseen to be a long term programme. Stakeholders are invited to participate in this initiative, to make inputs and to assist with waste minimisation and recycling. Visit our website for more information.

For more information visit the Department of Water Affairs and Forestry's website at www.dwaf.gov.za/harties/. Alternatively register as a stakeholder in order to receive information as it becomes available. Contact Rachelle Seymore at Zitholele Consulting at telephone: (011) 254 4804, or e-mail RachelleS@zitholele.co.za.

