



Travel back in time to the last century: One hundred years ago, the Anglo-Boer War was drawing to its conclusion, and people's thoughts turned back to pastoral activities associated with day-to-day life. In the valleys around the town of Brits, planners and agronomists cast an eye toward the rich soils of the Crocodile River Valley and began to dream of the agricultural production that such soils could generate...if only there was water!

Jump forward in time to the 1920s: The Great War had drawn to its bloody conclusion, and people's thoughts again turned to more peaceful pursuits. This time, the plans made and left dormant while the peoples of the world engaged in mortal combat are dusted off and

construction of the great concrete wall at the Antelope Gorge upstream of the fertile Brits Valley on the Crocodile River was begun, culminating in the completion of the Hartbeespoort Dam in 1925.

Some twenty five years later another global conflagration had ended. In South Africa urban growth centered on the Golden City of Johannesburg. The influx of people into the valleys of what is now Gauteng Province inevitably spilled over into the Crocodile River watershed.

With these people came roadways, homesteads, and waste. Because of the value of water, recognized even in those optimistic days, provision was made for the construction of a wastewater treatment plant on the

northern side of Johannesburg which would discharge into the Crocodile River basin. These effluents entered Hartbeespoort Dam and stimulated the growth of aquatic plants to the extent that the first reports of impaired water quality entered the scientific literature. Humans had indeed effected a change to the landscape, and, in terms of Hartbeespoort Dam, initiated a process of enrichment and water quality decline that culminated some 25 years ago with the conduct of extensive scientific investigations into the causes and consequences of water quality degradation in Hartbeespoort Dam.

Forward again to the present, in fact March 2004 to be precise: A barge slowly makes its way around the perimeter of Hartbeespoort Dam.

A variety of voices are heard...South African accents mingle with those of Finns and Yanks. The New South Africa has engendered a new era of global cooperation, with the focus, again, on Hartbeespoort Dam. The new age of prosperity is bringing new investment to the area, and, with it, new demands for action to rehabilitate the waters of the impoundment, now home to a thriving community of residents and holiday-makers alike.

On the barge are a team of international specialists assembled by DH Environmental Consulting, prime contractors tasked with the preparation of an action plan to restore balance to the Hartbeespoort Dam ecosystem. Also present are specialists and technical advisors from

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the North West Province Administration, the national Department of Water Affairs and Forestry, the Government of Finland, International Environmental Management Services Ltd. – DH Environmental Consulting’s partner in the development of an action plan for Hartbeespoort Dam, and the citizen members of the Hartbeespoort Water Action Group (HWAG). Discussion was animated as these citizens and specialists shared thoughts and ideas for the rehabilitation of the impoundment.

Subsequent to this site visit, and based on the results of proposals submitted during 2001, and work that commenced during August 2003, the consulting team settled down to the business of drafting a



A lot of what enters Hartbeespoort Dam passes through this giant pipe first!



Sections of the Crocodile River could be used for the chemical removal of phosphorus.

lake management and business plan for Hartbeespoort Dam. Dr Bill Harding, project leader, noted that “understanding the public wishes, and integrating their vision for Hartbeespoort Dam with the science and public policy of both provincial and national agencies, was the cornerstone of our efforts.” Consequently, the project team met with representatives of the various agencies for detailed discussions of alternatives.

The first phase of the Hartbeespoort Dam Remediation Project, now completed, concentrated on the identification of workable and implementable solutions to eutrophication. Integral to this approach were lessons learnt from the pioneering work of DH Environmental Consulting in advocating and implementing foodweb management approaches (“top-down” management applications as opposed to “bottom-up”) and the use of enclo-



Mesocosms have provided valuable information at Hartbeespoort Dam.



A mesocosm array located in a shoreline embayment.

sure trials to provide *in situ* evaluations of the efficacy of proposed treatments. The results of the latter work are now being extended to much larger scale pilot testing.

After ten days of intensive work, the team joined with the Hartbeespoort Water Action Group to present their recommendations to the public. "This was the first opportunity that we had to share the technical recommendations with the community at large," said Garry McKay, Chairperson of the Hartbeespoort Action Group. "It is gratifying to see such a good turnout for this session." Present were about 80 people representing a cross-section of the population living on and around Hartbeespoort Dam.

Bill Harding introduced the meeting by reviewing the history of the Hartbeespoort Water Action Group and the involvement of DH Environmental Consulting. "In seeking practical solutions to the concern expressed by the Hartbeespoort Dam community as a whole," he said, "DH Environmental Consulting and its international team have looked both within South Africa as well as outside to compile a realistic, doable and cost effective management programme for this

water body." "A locally implemented and sustainable management plan is our goal," said Dr Harding.

Dr Pirjo Kuuppo of Finland, project oversight specialist, then shared a case study from Finland that re-enforced the fact that, with sound knowledge and good will, communities can change a degraded lake into an attractive and productive waterbody. To do so successfully, however, she noted that "the community has to be willing to make the necessary investments and even voluntarily make lifestyle changes to turn a lake back from the brink, and restore it to being a desirable feature in the community." Enhanced wastewater treatment, stormwater management, and fisheries management measures were all used to restore the ecological balance of the lake and return the lake to pride of place in the local community and its landscape.

The project team then turned to the case of Hartbeespoort Dam: Five issues were identified as critical to managing the condition of Hartbeespoort Dam; namely:

- ◆ water quality – including both point and nonpoint source pollution;
- ◆ management of lands and ecologically valuable areas tributary to Hartbeespoort Dam;
- ◆ fisheries;
- ◆ recreational boating and recreational access; and
- ◆ institutional development.

WATER QUALITY MANAGEMENT

Point sources of water pollution are clearly identifiable discharge points, characterised as "end-of-pipe" discharges. Nine wastewater treatment plants discharge to the Crocodile River and its tributaries upstream or adjacent to Hartbeespoort Dam. Of these, the Johannesburg Northern Works is the largest and most effective, contributing about one-third to one-half of the total phosphorus load to the impoundment. Phosphorus is a fertilizer element that is present in least supply, thereby controlling the growth of algae and aquatic plants in the impoundment. The other eight plants are much smaller, contributing only one-quarter of the water load to the Dam, but making up two-thirds of the phosphorus load. While one of these small plants has been identified for abandonment, the others will continue to operate into the future. Clearly, reducing the nutrient content of their discharge will benefit Hartbeespoort Dam. Consequently the plan recommends reducing phosphorus effluent concentrations from over 5 milligrams per litre (mg/l) to less than 1 mg/l, which standard is being consistently met by the Johannesburg Northern Works. This would contribute to a 30% reduction in external phos-

phorus load to Hartbeespoort Dam.

In addition to these larger treatment plants, a number of smaller or package wastewater treatment systems exist in the areas immediately surrounding Hartbeespoort Dam. It is recommended that these plants be extended and upgraded to include a nutrient removal stage. These plants, too, should be operated and maintained to meet or indeed perform better than the 1 mg/ℓ phosphorus effluent standard. Individual households using septic tanks and "French drains" should be encouraged through an informational programme to ensure that these individual sewage treatment systems also operate efficiently and effectively.

CATCHMENT AND IN-LAKE MANAGEMENT

The catchment area of Hartbeespoort Dam is not heavily developed at present. This lack of urban intrusion into the drainage area provides an opportunity for implementing sound land use management practices in the catchment to minimise water quality impacts on the impoundment. "All human actions on the landscape generate contaminants which can be mobilised and washed off the land into our waterways," said Dr Jeff Thornton of International Environmental Management Services. "These are controllable activities which can be mitigated or moderated with sound planning and use of available management measures," he said, adding that "catchment planning begins in the riparian zone immediately adjacent to the impoundment." Actions recommended in the plan to address these issues are:

- completion of integrated and comprehensive land use and lake

- edge/riparian buffer plans; implementation of (minimum) 10 m setbacks from the water's edge and restoration of shoreland vegetation as a buffer between human activities on the land and the waters of the Dam; limitation of removal of riparian vegetation both on the landward side of the full supply level/high water level of the Dam and on the lakeward side, the latter protecting the lakeshore from erosion due to wind waves and boat wakes;
- restoration of in-lake habitat to promote both aquatic diversity

"the community has to be willing to make the necessary investments and even voluntarily make lifestyle changes to turn a lake back from the brink, and restore it to being a desirable feature in the community"

- and a balanced fishery;
- consideration of the use of planned unit developments or conservation subdivisions on the lands adjacent to the waterbody to maximise open space, preservation of shoreland buffers, and enhance provision of basic sanitation services;
- extension of integrated agricultural nutrient and pest management practices, including conservation tillage, to farms in the catchment with specific attention to land form, water courses, and soil characteristics for each farm; and,
- promotion of good urban housekeeping practices such as litter reduction, recycling, home-stead maintenance, and garden care, as well as stormwater management within larger neighborhoods.

Water quality modelling conducted as part of the consultants' investigation suggested that, even with full implementation of the point, non-

point, and catchment management practices, the mass of nutrient reaching the impoundment may continue to exceed tolerable conditions. The modeling process has supported the identification and compartmentalization of the target phosphorus reduction requirement deemed necessary to bring the dam back into balance. Achieving the identified goals within each of these compartments requires a different approach – for example in the final stage the project team has proposed the use of an in-stream or off-channel drip system using ferric sulphate be considered to ensure control of phosphorus reaching to waterbody. Iron or ferric sulphate can be locally manufactured using facilities that can be made available at NECSA, upstream of Hartbeespoort Dam, and dosed into the Crocodile River at the gauging station adjacent to the property.

FISHERIES MANAGEMENT

Professor Gert Steyn of Ecodynamics and a member of the consulting team is overseeing the fisheries management programme. Prof Steyn is proposing a commercial fishery on Hartbeespoort Dam as a means of restoring a sustainably balanced fish community in the impoundment. "Canary kurper are abundant and aggressive in the Dam," notes Prof Steyn. He notes that these fish "are hammering other species such as blue kurper and bass," and that "control of the canary kurper, carp and catfish in the Dam through an appropriate harvesting program can not only contribute to the local economy, but also fill the demands for fish protein elsewhere in Africa, as well as helping to rebalance the ecosystem of Hartbeespoort Dam." Dr Steyn's fisheries studies are ongoing.



Chetia flaviventris: A major problem for the Hartbeespoort Dam ecosystem.



This could be a popular fishing spot if....

RECREATIONAL USE MANAGEMENT

The project team noted the continuing demand for lands around Hartbeespoort Dam. In the past, these demands have been met, in part, by the sale of public lands, which diminish the opportunities for the public to visit and enjoy the waterbody. The plan recommends that consideration be given to main-

taining public access in the form of local and provincial parks that can be used and enjoyed by all. In addition, enforcement of boating laws and limitations on boating traffic in environmental sensitive areas of the impoundment was proposed. These latter actions should be viewed in conjunction with the proposed shoreland management actions, and as a means of helping to balance the in-lake ecosystem by protecting and

preserving fish habitat and breeding areas.

INSTITUTIONAL ISSUES

"In order to make this ambitious management programme work," said Bill Harding, "the key ingredient is an appropriate and adequately equipped and financed management organization." Such an organization is provided for under the South African Water Act in the form of a Water Users Association (WUA). These agencies have the capacity to raise public funds as well as to provide a stable institutional and financial base from which to undertake an ambitious programme of reservoir management. "The Hartbeespoort Water Action Group stands ready to accept the challenge of becoming South Africa's first Water Users Association," says Garry McKay, HWAG Chairperson. "Our organization, currently incorporated as a 'grass-roots' Section 21 not-for-profit company, is in place, concerned, and actively seeking to partner with government to protect and rehabilitate Hartbeespoort Dam."

Fast forward now to the year 2020: Hartbeespoort Dam is continuing to serve the needs of the humans settled in the Crocodile River Valley, thanks to the foresight and concerted actions of a multinational, multi-ethnic group of individuals who gathered on the Dam during 2004! The outcomes of the Hartbeespoort Dam Remediation Project are being applied at a number of other SA impoundments, and the bogeyman of "little can be done about eutrophication" has been well and truly dispelled!

For further information contact Dr Bill Harding at DH Environmental Consulting (tel 021 855-2528) or visit their website at www.dhec.co.za/hbpd.

