Project Sheet

Orange River Water Supply System – Various Projects

LOCATION: Orange River Basin, largest river basin in South Africa

CLIENTS: South African Department of Water Affairs, South African Water Research Commission (WRC), The Permanent Water Commission (between RSA and Namibia) and ORASECOM funded by GTZ.

STATUS: Initial involvement by WRP personnel in Orange River Projects started in 1988 and is still ongoing (2009)

OBJECTIVES: Over time these studies addressed various objectives from the evaluation of the available water resources, yield analysis for various possible future schemes and transfers, determining the influence of upstream developments on downstream users, setting up of unsteady hydrodynamic models and determining the river evaporation and riparian vegetation requirements. Other objectives were to investigate management and development options in the Lower Orange to promote strategic objectives for RSA and Namibia, to determining the status quo in the Orange River in terms of available information and gaps addressing all four basin states, to the real time management of the Orange River Project to ensure the most beneficial utilization of the resources for hydro-power generation and primary water users.

CHALLENGE: The Orange River basin includes the Vaal River and is by far the most important river basin in the RSA and Lesotho, of high importance to Namibia and affects Botswana. One of the largest and most ambitious water projects in Africa are situated in the Orange River basin. Industrial areas supported by the Vaal River produce more than 50% of South Africa's wealth and more than 80% of RSA electrical requirements or more than 50% of Africa's electricity. Irrigation in excess of 300 000 ha is supported from the Orange River basin and provides a large part of the agricultural production in the RSA and Namibia. The proper planning, management and operation of this system is of utmost importance.

DESCRIPTION

Full hydrological analysis and system modelling for the 1 million km^2 Orange River basin were undertaken by RS Mckenzie (late 1980's) while still at BKS (Pty)Ltd. This study, Orange River System Analysis (ORSA) was followed by a research study (River Losses Study) supported by the WRC (RSA) to determine the high volume of river evaporation and evapo-transpiration losses along the 1300km river stretch from Vanderkloof Dam to the river mouth. A hydrodynamic model was used to evaluate the evaporation losses between points. For this purpose an evaporation loss module and a facility to incorporate real-time data into the hydrodynamic model were developed.

The Orange River Development Project Replanning Study (ORRS) was commissioned in the mid 1990's to determine a strategy for the most beneficial utilization and optimal development of the water resources in the Orange River. Existing and potential RSA developments within the Orange River basin were considered and the possible transfer of water to other basins. All the above mentioned studies involved key input from WRP personnel while still at BKS.

The Lower Orange River Management Study (LORMS) investigated and reported on the availability of water with the focus on the Lower Orange (2002 to 2004). Options for improved management through the efficiency of water use and utilizing of management measures were investigated and analyzed. Both countries were involved (Namibia & RSA).

The Orange River Integrated Water Resources Management Plan (ORIWRMP) Phase 1 was commissioned in 2004 by ORASECOM and was funded by GTZ. The study determined the status quo in the Orange River basin in terms of available information and areas where gaps in information need to be addressed. The study involved all four basin states namely Botswana, Lesotho, Namibia and South Africa. The gaps in information identified were used to develop task descriptions for Phase 2 of the study.

The Orange River Annual Operating Analysis was awarded to WRP in 2008. This project involves the real-time management of the Orange River Project to ensure the most beneficial utilization of the resource for hydro-power generation and primary water users, while maintaining the selected reliability of supply to users. WRP personnel were also responsible for these annual operating analysis from 1995 to 2002 while still at BKS(Pty)Ltd.

KEY RESULTS

- The ORSA study found that Orange River resources were significantly less than previously estimated with the result that the full Lesotho Highlands Water Project (LHWP) cannot be undertaken. This lead to a complete re-evaluation of all further phases of the LHWP.
- The Orange River Losses study produced a hydraulic model for the Orange River (ISIS) which was modified to simulate spatially and temporally varying evaporation losses and to include a variable time step facility. Evaporation losses along the 1300km river stretch were determined to range from 575 million m^3/a at 50m^3/s flow rate to 989 million m^3/a at an annual release of 400m^3/s.
- At the time of the ORRS a surplus of 274 million m^3 was available from the ORS. No single development option can fully harness the resource, various combinations of development options were identified for realising the remaining potential of about 1 735 million m^3/a from the Orange River
- The LORMS showed the current system to be in balance by 2005. A re-regulating dam at Vioolsdrift and the use of a real-time hydraulic model were proposed to reduce the high operating requirements. To increase system yield for Lower Orange the raising of Vioolsdrift Dam and utilisation of the lower level storage in Vanderkloof Dam were recommended. The importance of improving the protection of the ecology was strongly emphasized.
- Key deliverables for the annual operating analysis includes the release schedules from Gariep and Vanderkloof dams, optimize hydropower generation, imposing water restrictions, extending the system to include other important water supply systems and development of operating rules.