China – UK, WRDMAP
Integrated Water Resources Management Document Series

Thematic Paper 8.4: Inter-agency Collaboration for Improved Water Quality Management

May 2010

8. Inform-ation Exchange

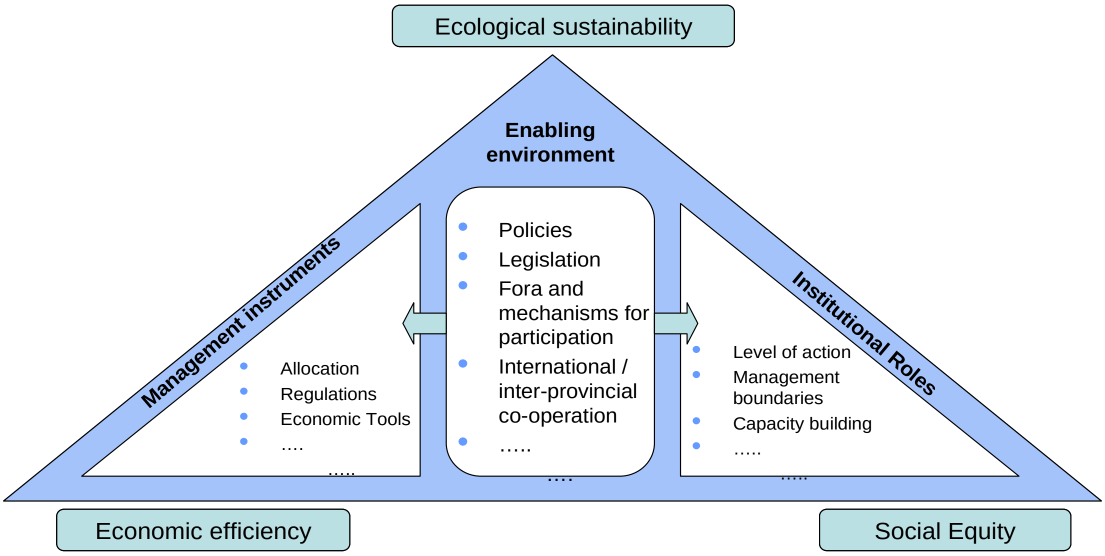
中国水利 CHINA WATER

DFID Department For International Development

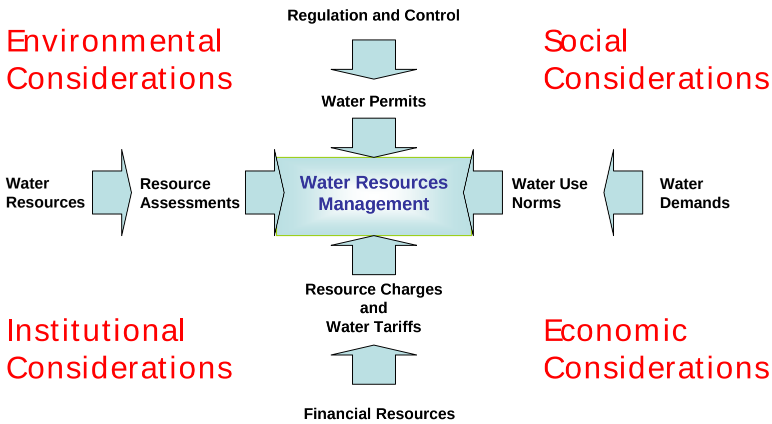
Mott MacDonald

Integrated Water Resources Management (IWRM)

(Basics after Global Water Partnership)



Driving Elements of Integrated Water Resources Management



(Second figure after WRDMAP)

Summary: This Thematic paper explores the current status of different aspects of **water quality management** (WQM) in China. It suggests ways in which the these aspects could be improved by coordinating the efforts of the government agencies involved, namely the agencies of the Ministry of Water Resources and the Ministry of Environmental Protection. Examples and recommendations are drawn from experiences working with the Water Affairs Bureau (WAB) and the Environmental Protection Bureau (EPB) in Chaoyang Municipality, Liaoning Province on a case study under the WRDMAP project.

The document covers the following topics:

- Generic concepts of WQM
- Legal framework
- Case study – WRDMAP Chaoyang
- Current practices in WQM focusing on collaboration issues
    - Assessing water quality conditions
    - Water quality planning issues
    - Water quality control strategies and levers
    - Reporting on water quality conditions
- Mechanisms for improved collaboration
- Considerations

This document is part of a series addressing aspects of integrated water resources management (IWRM) under which water quality is increasingly viewed as a critical component.

The Ministry of Water Resources have supported the Water Resources Demand Management Assistance Project (WRDMAP) to develop this series to support WRD/WAB at provincial, municipal and county levels in their efforts to achieve sustainable water use.

1 Introduction

Water quality management (WQM) in the natural drainage systems of the country has increasingly become the focus of attention in the media and is recognised even internationally as a major concern.

Numerous documents report on the generally poor condition of some of the main river systems in the country, with rivers in the north of the country (the Yellow, the Liao, the Songliao, the Huai and Hai) having particularly poor water quality status. However, the problems are not confined to these major rivers as many of their tributaries, and other rivers in northern China, also have significant reaches categorised as having poor water quality (Classes IV, V and if worse than V 'inferior', according to the State standards).

There are many reasons for the deteriorated condition of the river systems ranging from uncontrolled or limited control of effluent discharge from industry and urban centres, to reduced natural flows that affect the assimilative capacity of the natural system. However, another aggravating factor is the spread of water quality management roles and responsibilities between the departments under the Ministry of Water Resources (MWR) and the Ministry of Environmental Protection (MEP).

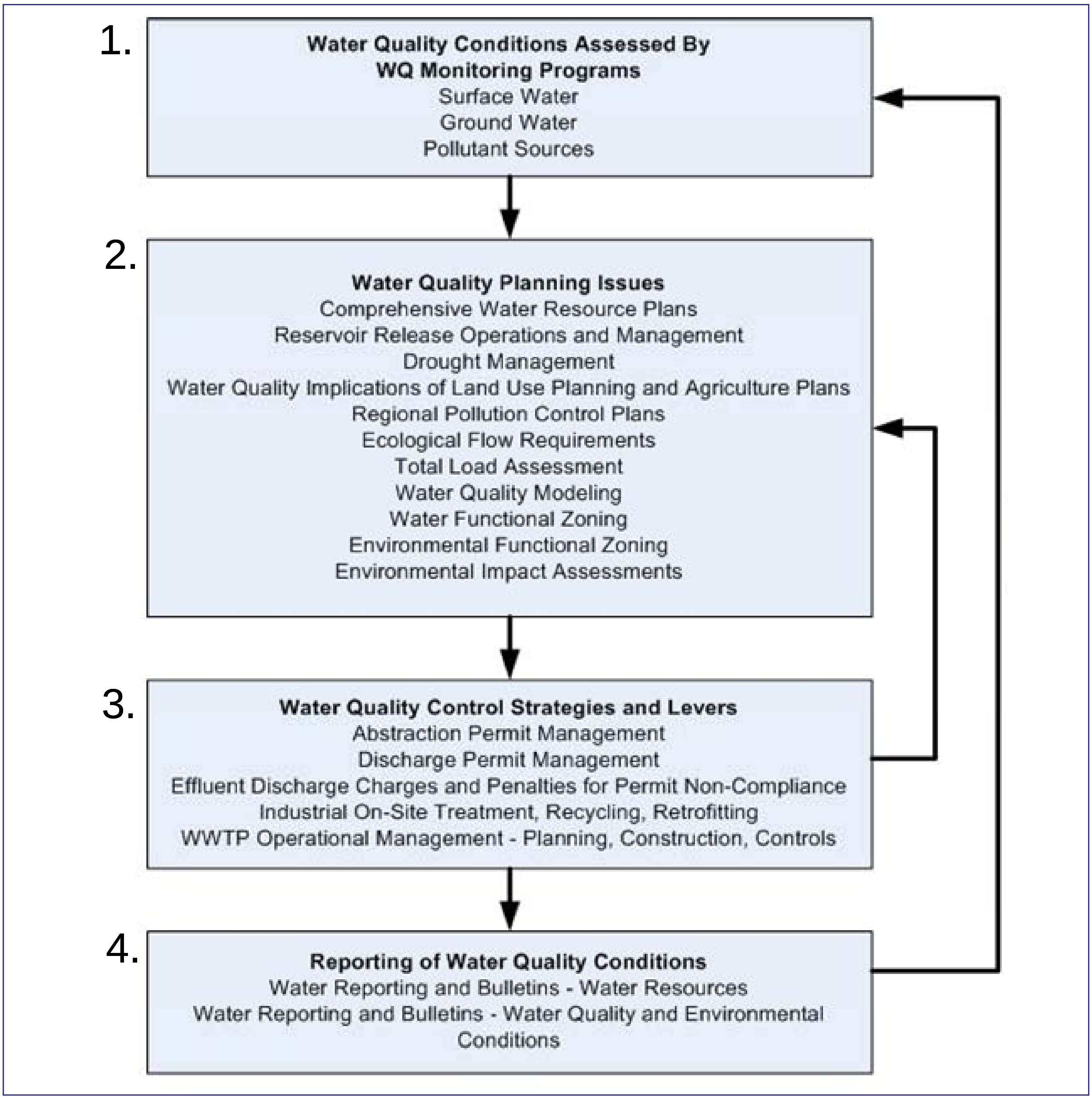
Given this context this Paper aims to provide some recommendations as to how inter-agency (here between line agencies of MWR and MEP) **communication, cooperation and collaboration** (in this paper referred to as **the three 'C's**) can be improved to increase the effectiveness of water quality management in the country (*without any view to institutional change*).

The need for effective communication, cooperation and collaboration between agencies in this respect is a fundamental element of integrated water resources management (IWRM).

2 Generic Concepts of Water Quality Management

The management of water quality in natural drainage systems involves a strategic investment in understanding, monitoring and controlling all aspects of the water systems in question (see Figure 1).

Figure 1: Generic water quality management (WQM) measures in China



There are many and varied institutional frameworks and governmental organisations involved in water quality management issues throughout the world. In many developed countries, a detailed "water quality management" (WQM) framework has evolved over time that generally involves the following steps:

1. Provide a **strategic goal or objective for the programme**. For instance, the US Clean Water Act central objective is "*to restore and maintain the chemical, physical and biological integrity of the nation's waters.*"

2. These goals and objectives are then translated into **management indicators** such as "*by year 20xx, xxxx additional km of water will attain water quality standards and specific interim milestones will be achieved in xxxx impaired km.*"

3. Provide **phasing options** such as achievement of technology standards prior to achievement of water quality based standards, and set priorities for key watersheds.

4. Provide **monitoring programmes** to facilitate decision-making.

5. Develop **management tools, technical assistance and guidance** for environmental managers.

6. Incorporate **scientifically defensible systems in water quality studies** including water quality models for various aspects of the programme.

7. Use **scientific assessments of ecological conditions** to assist in water quality decision making on issues such as minimum and environmental flow needs.

8. Set **appropriate water quality criteria, standards and water use classifications**.

9. Develop and enforce a **comprehensive effluent discharge permit programme** for point sources and other control programmes for non-point sources.

10. **Monitor compliance** with ambient and discharge standards and take action against non-compliant dischargers.

11. **Report results** to the public and incorporate citizens in decision-making.

Each country has their own institutional mechanisms for implementing such a WQM framework, but the general principles and tenets remain the same. The attainment of success in a WQM programme involves the integration of chemical data, biological data, toxicity data, bacteriological data and environmental habitat data. It involves the selection of metrics or indicators to show success in water quality standards attainment.

Water quality management is a strategic management and decision-making system, not merely the collection and storage of water quality data and information.

In Section 5 the four generic elements of WQM illustrated in Figure 1 are described in more detail in relation to current practices drawing on case study experience in Liaoning Province.

3 Legal Framework for Water Quality Management

In China most of the responsibilities relating to water quality management are split between two Ministries: The **Ministry of Water Resources** (MWR) and the **Ministry of Environmental Protection** (MEP) and their respective Water Resources and Environmental Protection agencies at all levels. The mandated roles and responsibilities of Water Resources and Environment Protection Agencies are specified in the **Water Law of 2002** and the **Water Pollution Control Law of 2008** which state that:

- The Ministry of Water Resources is the state department primarily responsible for water resources planning, allocation, and water quantity and quality protection. The latter includes water at its source and ambient conditions for surface and ground waters with allocations for water use.
- The Ministry of Environmental Protection (formerly the SEPA) is the state department primarily responsible for setting standards and implementation of the pollution contol system and discharge permit system for wastewater/effluent discharges from point sources such as municipalities and factories and also from non-point return flows.

Although the principles of integrated water resources management and water quality management treat water as a single resource, at present the agencies of the MWR and the MEP undertake separate yet related functions concerning the use of water and the management and protection of water quality.

Consequently a number of overlaps and gaps have emerged in water quality management activities in China. These work against the goals and objectives of water quality management and also the overall effectiveness of the management activities themselves.

Both the Water Law (2002) and the Water Pollution Control Law (2008) contain references to the need for cooperation between the Water Resources agencies and the Environmental Protection agencies (as well as other government departments).

In July 2008 the **State Council** issued **Official Document No. 11** (SCOD11) which set out the "***3 establishments***" (**responsibilities, organizational structure, and staffing**) for a number of ministries, but in particular, those of MWR and MEP. This stressed the need for the two ministries and their provincial level departments and bureaus to *"further strengthen coordination and cooperation, set up an inter-ministry consultation mechanism, circulate information concerning water resource protection and water pollution prevention and control on a regular basis and solve relevant major issues through consultation"*.

However, when it comes to ways to achieve such coordination and cooperation both the Laws and SCOD11 could be considered to be rather ambiguous or unclear. Thus SCOD11 calls for the organisations to 'establish working arrangements', leaving the two organisational systems to work out the means of working together on water quality management for themselves.

The key challenge, therefore, is to develop **effective and practical ways**

to facilitate the cooperation and coordination between the two agencies. Some suggestions and recommendations are presented in Section 6.

4 Case Study - WRDMAP

4.1 Introduction

A case study was undertaken in Chaoyang Municipality, Liaoning Province, as part of the Water Resources Demand Management Assistance Project (WRDMAP) funded by DFID (2005-2010). The case study used various tools to improve collaborative efforts in water quality management between the local Water Affairs Bureau (WAB) and the Environmental Protection Bureau (EPB), agencies of MWR and MEP respectively.

The experiences of this case study are used in Sections 5 and 6 to make suggestions for improved inter-agency collaboration in different aspects of water quality management.

4.2 Chaoyang Municipality and water resources overview

The Chaoyang Municipality of Liaoning Province is located on the boundary of Inner Mongolia, Hebei and Liaoning provinces, with a population of 3.4 million in 2005. The urban population of Chaoyang is 330,000, within an urban area of about 30 km^2.

The city of Chaoyang is located on the Daling River. The extent of the Daling River Basin is shown in Figure 2. The case study was initially focused on the river reach between the Yanwangbizi and Baishi Reservoirs, which includes the city of Chaoyang. Figure 3 shows the initial case study limits. During the course of the project the issues surrounding water quality were extended to the whole river basin. However, the focus of the Paper relates to the municipality area within the basin.

The Daling River is a major potable water supply source for the case study area. However, significant surface water and groundwater abstractions coupled with wastewater discharges have caused the water quality in the Daling River to become significantly deteriorated, particularly adjacent to and downstream of the urban area. As such, Chaoyang is facing the dual problems of (1) insufficient water resource availability for existing and proposed populations and (2) economic development with decreasing surface water.

4.3 Objectives of case study

The goal of the case study, *“integrated water abstraction and waste water discharge permitting in Chaoyang Municipality”,* was to improve the water environment and people’s livelihoods in Chaoyang through equitable water resources management.

The emphasis of the case study was on coordination between the WAB and EPB to implement “integrated” water abstraction and discharge permit management systems to achieve social, economic, and environmental objectives in relation to water use. At the start of the case study the following activities were proposed:

Figure 2: Daling River Basin in Liaoning Province

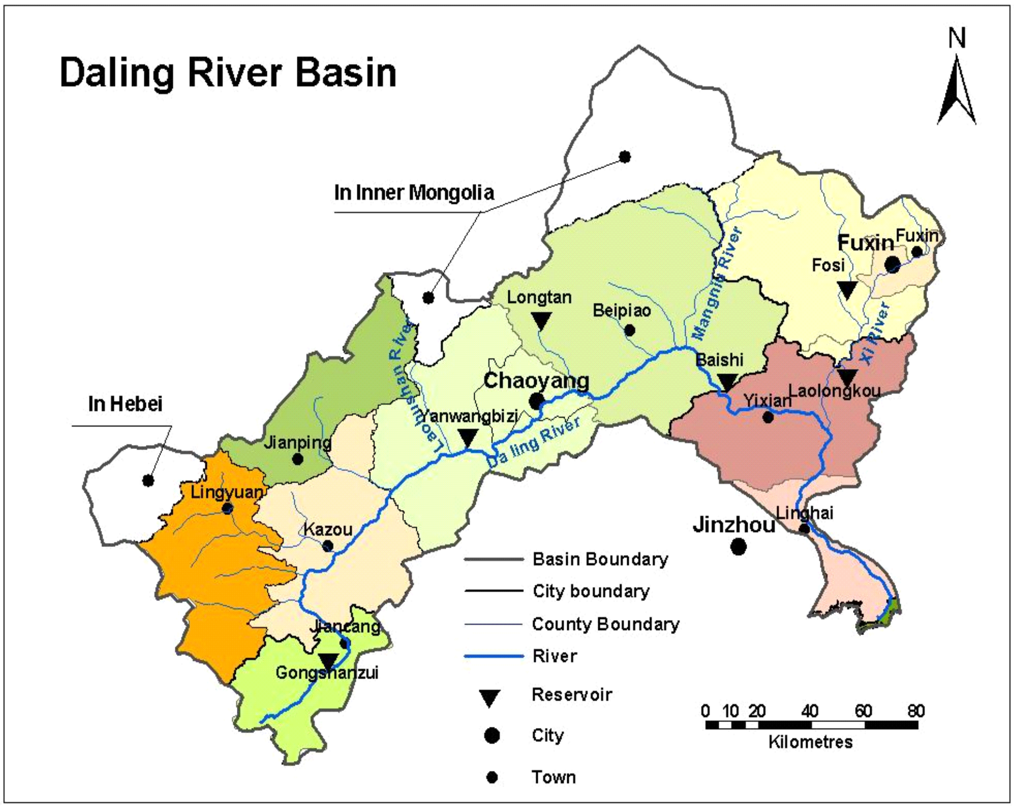
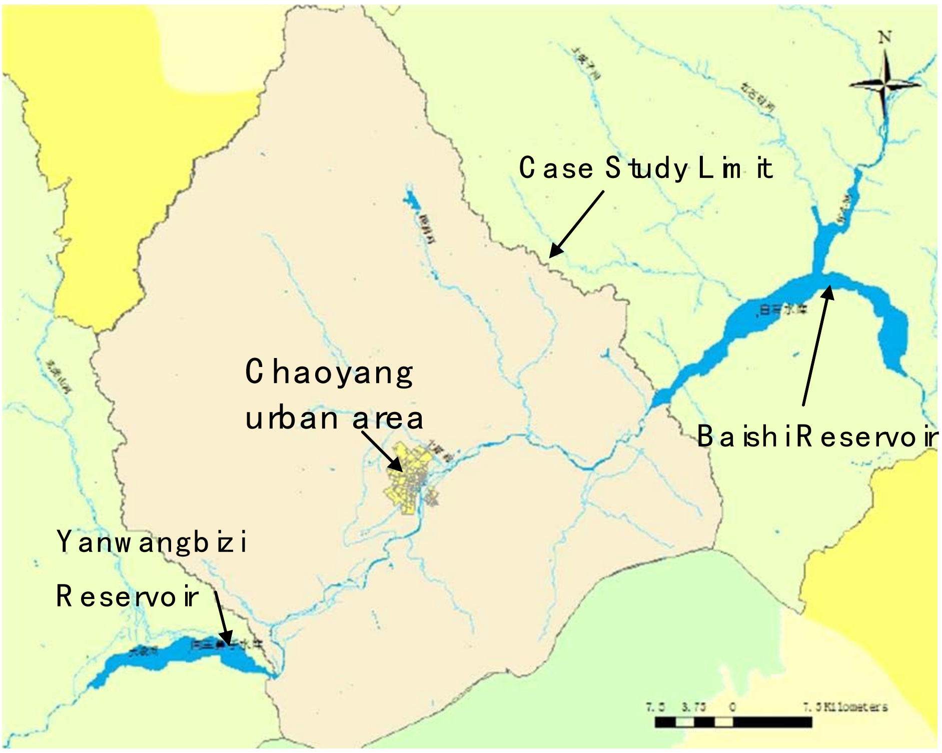


Figure 3: Chaoyang initial case study limits



- Investigate ways to enhance the water abstraction permit system of Chaoyang WAB and the waste water discharge permitting system being established in Chaoyang EPB through the use of a joint GIS water resources database
- Establish a shared inventory system for existing abstraction and discharge permits between the WAB and EPB
- Establish pilot cooperation between WAB and EPB on the basis of the integrated permitting approach for selected water users
- Develop proposals for improving permit administration and enforcement, including revised water norms, service and water resources fees
- Set-up a drought action plan for transparent temporary resource re-allocation during water shortages, with enforcement mechanisms for abstraction and discharge permits
- Propose a framework for the integrated assessment, management and enforcement of abstraction and discharge permits

An impediment to the achievement of all these tasks was the fact that there were in fact no effluent discharge permits in place at the start of the case study as had been believed but only an inventory of effluent discharges by various organisations. Another commonly experienced problem, symptomatic of the issue being addressed, was the fact that as the project was being implemented through MWR it was more difficult to gain the full cooperation of the various local EPB offices.

Figure 4 (based on Figure 1) shows where the WRDMAP case study focused its efforts in improving the overall framework for water quality management. It should be noted that the case study did not cover all components of WQM, nor were the components covered all treated to an equal level.

Table 1 displays the key aspects of water quality management and where it is perceived that WABs and EPBs in Chaoyang have responsibilities.

Section 5 considers the status of each of these water quality management aspects in turn. Methods for improving collaboration between municipality Water Resource agencies (WABs in Chaoyang) and Environmental Protection agencies (EPBs in Chaoyang) are suggested for each aspect, drawing on experiences from the Chaoyang case study.

In order to encourage cooperation between the agencies whilst also creating a tool to facilitate water quality management a water quality model was constructed, initially for the river and channel reaches in the urban area, but subsequently for the whole river basin. This is often a good way to obtain data from different agencies whilst also providing a check and basis for discussion on the quality of data and the integrity and shortcomings of the monitoring network.

Figure 4: WQM framework in China and objectives of Chaoyang Case Study, Liaoning Province, WRDMAP

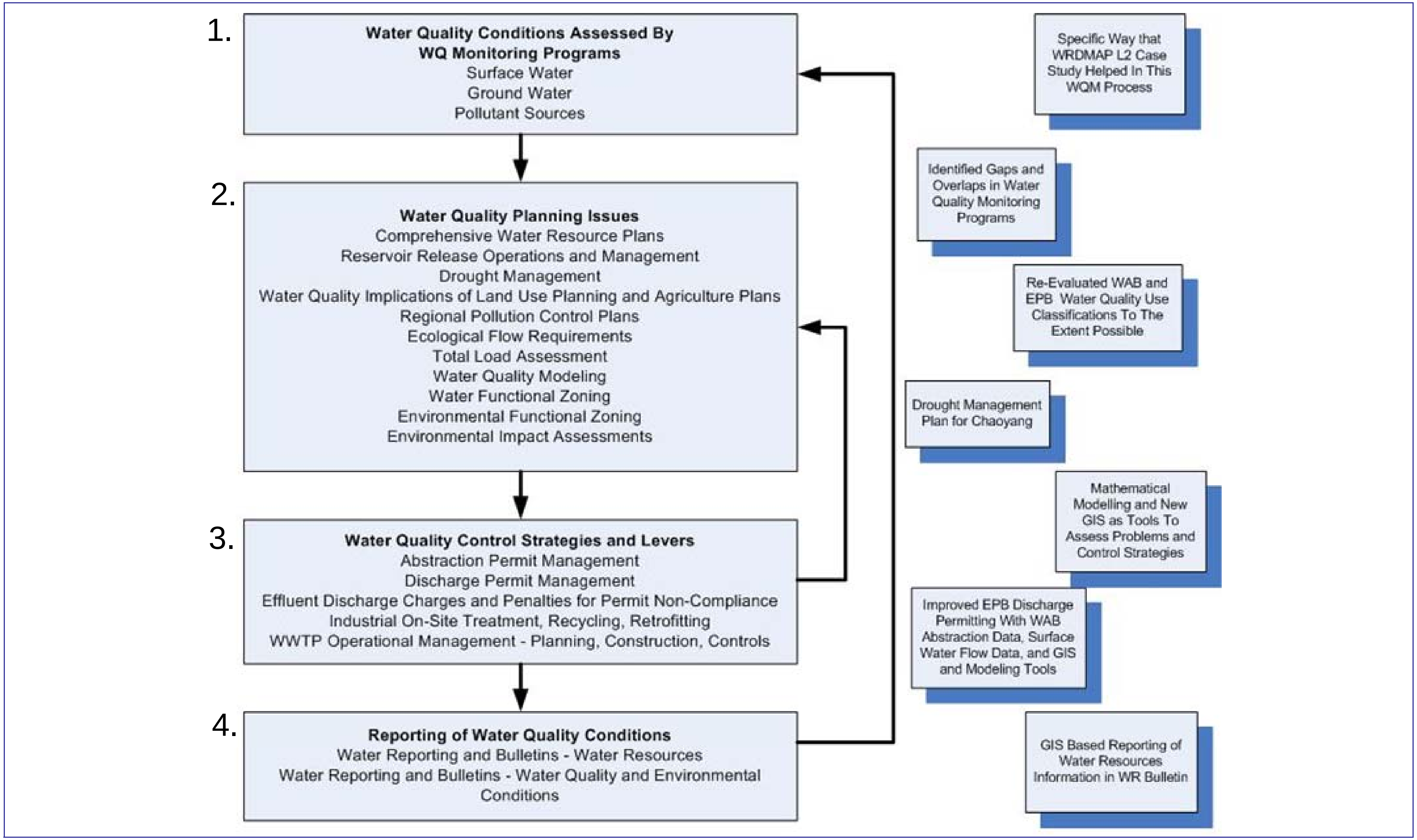


Table 1: Matrix of WQM aspects and perceived responsibilities of Chaoyang WAB and EPB

No.	**WQM Aspect**	**Primary agency**			**Collaboration based on input from aspect No.**	**Use of GIS**
		WAB	**EPB**	**Other**		
Water quality conditions						
1	WQ monitoring - surface water	✓	✓	✓		Priority
2	WQ monitoring - groundwater	✓	✓	✓		Priority
3	WQ monitoring - pollution sources, premises		✓		18	Potential
4	WQ testing laboratories	✓	✓	✓		Priority
5	Sewerage system and WWTP monitoring	✓	✓	✓	10-15, 17	Priority
Water quality planning issues						
6	Comprehensive water resource plans	✓			7, 8, 11, 13, 16	Potential
7	Reservoir release operations and management	✓			6, 11-13, 16	
8	Drought management	Mayor+✓			1-5	Potential
9	WQ implications of urban development, forestry and agriculture plans	✓	✓	✓	1- 5, 10	Potential
10	Regional water pollution protection and control plans		✓		1-5, 11-17	Potential
11	Ecological flow requirements	✓?	?		1-7	Potential
12	Total Load assessment	✓	?		1, 3, 6, 7, 13	
13	WQ modelling	✓			1, 3, 6, 7	Potential
14	WQ functional zoning	✓			1-5, 12, 13	Priority
15	Environmental functional zoning		✓		1, 3, 12, 13	Priority
16	Environmental impact assessment		✓	✓	1-5	
Water quality control strategies and levers						
17	Abstraction permit management	✓			1, 2, 6-8, 11	Priority
18	Discharge permit management		✓		1,2,5,6,10-17	Priority
19	Effluent discharge charges and penalties for permit non-compliance		✓		18	
20	Industrial on-site treatment, recycling, retrofitting		✓	✓	1,2,5,6,10-17	
21	WWTP operational management – planning, construction and controls	Mayor+✓	?	✓	1,2,5,6,10-17	
Reporting of water quality conditions						
22	Water reporting and bulletins – water resources	✓			All	Priority
23	Water reporting and bulletins – WQ and environmental conditions		✓		All	Priority

Note: Situation as perceived in Chaoyang Municipality during the WRDMAP Case Study (2005-2009). Both the Water Pollution Control Law and State Council Official Document No. 11 were issued in 2008 indicating that the legal and institutional framework was in a state of flux over the case study period.

5 Aspects of WQM – Current Status and Recommendations

This section follows the framework set out in Figure 1 to review the current status of the many aspects of WQM as evidenced in Chaoyang Municipality during the case study. While the situation in Chaoyang is not universal it is felt that it displays many common features that can provide lessons for others.

5.1 Water quality conditions

Water quality monitoring

With regards to monitoring, the mandated role and responsibility of Water Resources agencies is to monitor the quantity and quality of both surface water and groundwater. The mandated role and responsibility of the Environment Protection agencies is to administer the environmental monitoring of water resources and discharges.

For MWR, surface water quality in rivers and reservoirs is generally monitored by Hydrology Bureaus, in addition to their responsibilities for monitoring water quantity. Groundwater quality monitoring stations are maintained by the Water Affairs Bureaus (WABs), with special emphasis on key groundwater sources used for potable water supplies. All water quality monitoring follows the MWR's 'Technical Specification for Monitoring Water Quality' (SL219-98) in terms of selection of locations, parameters to be measured, frequency of sampling and measurement procedures.

For MEP, surface water quality monitoring stations are maintained by national, provincial and municipal levels. This monitoring follows the MEP's 'Technical Specification Requirements for Monitoring of Surface Water and Waste Water' (HJ/T91-2002) in terms of selection of locations, parameters, frequency, and sampling procedures. Groundwater is monitored for areas where significant potable water supplies are used following the requirements of MEP's 'Technical specification for environmental monitoring of groundwater' (HJ/T164-2004).

The technical specifications on monitoring of the two ministries are not harmonised and thus it is difficult to coordinate water quality monitoring activities between these two parties.

Other agencies also have water quality monitoring responsibilities such as the Disease Prevention Control Centres, Geological Environment Monitoring Stations, Reservoir Management Bureaus, and Municipal Administration Departments (organisations of other ministries: Ministry of Health, Ministry of Land Resources and Ministry of Housing and Urban-Rural Construction). This multiplicity of actors further complicates the picture and makes effective WQM harder to achieve.

A factor in the design of current monitoring programmes is the definition of function zones for water bodies. Function zones are discussed in Section 5.2.

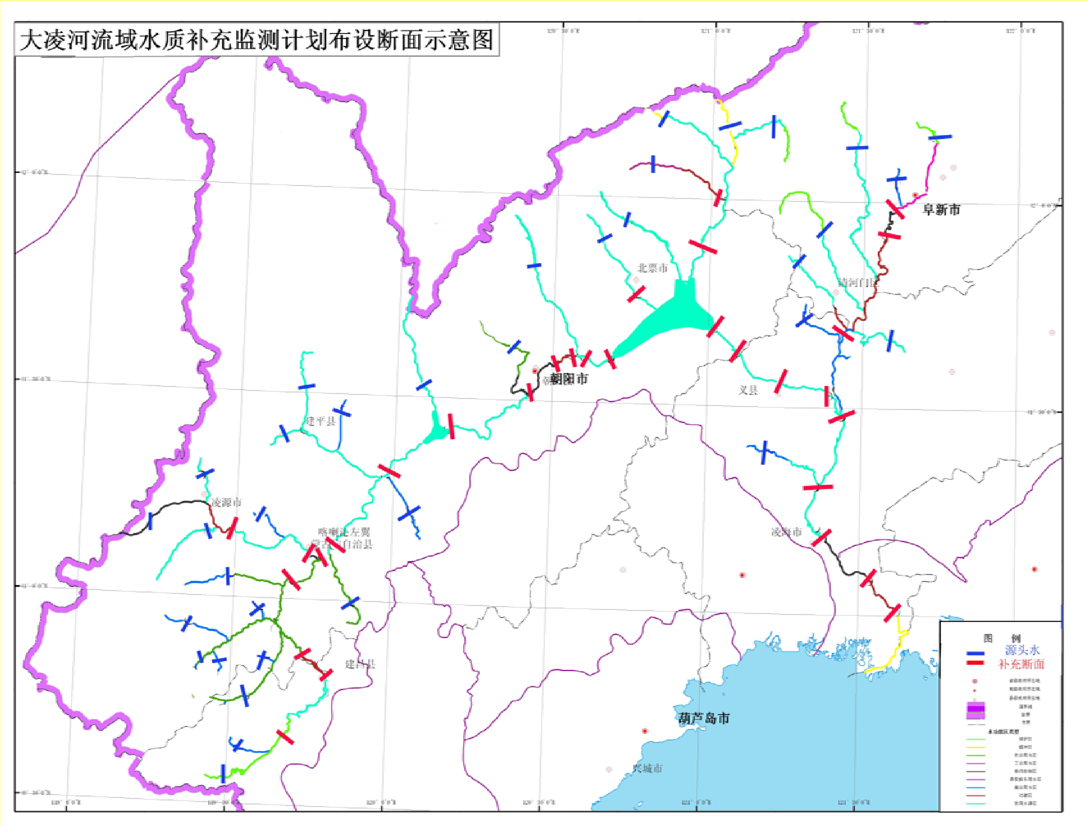
The current water cycle monitoring programmes of the agencies of MWR and MEP are not generally coordinated with one another and so large overlaps exist between them.

Basic findings from the work in Chaoyang Municipality related to water quality monitoring are described in Box 1.

Box 1: Is current monitoring practice sufficient for effective WQM?

The case study assessed existing water quality monitoring systems in place in Chaoyang Municipality with a focus on the issues in the main urban area. The monitoring programmes appeared to meet minimum standards, but without regard for water quality management objectives and without a strategic management framework for day to day workloads; data was merely gathered and reported as required by provincial and national mandates.

As part of the case study a water quality model was developed, which is described in more detail in Section 5.2. The development of the model indicated that the current water quality monitoring regime for both surface waters and pollution sources was inadequate for rigorous water quality modelling work. As such, significant additional data had to be collected in order to complete a water quality model for even a small pilot reach of the Daling River. (This was collected as part of the case study activities.)



Objectives for the future should focus on the adjustment of monitoring programmes of Water Resources and Environmental Protection agencies to increase the coordination between them. Overlaps and gaps between the monitoring programmes of the two agencies should be identified and the programmes rationalised, eliminating redundant monitoring stations and overlapping work loads. This will ultimately allow budgets allocated to these monitoring activities to be used more effectively. As demonstrated by the Chaoyang case study, a GIS is useful in analysing the distribution of water quality and quantity monitoring data of the two agencies and thus identifying overlaps and gaps.

Another important future objective should be to ensure that all components of the monitoring programmes (including monitoring station density, items measured, monitoring frequency) **target the overall goals and objectives of the local water quality management strategy** while meeting the national and provincial minimum technical standards.

There is also a need to strengthen the capacity for effective water quality monitoring in the relevant agencies.

However, a vital factor is to both ensure the consistency of data between the two agencies systems at every administrative level whilst also **openly sharing data and analyses**.

Pollution source monitoring

Agencies of both MWR and MEP monitor discharge outlet points to surface water bodies, however, EPB are primarily interested in end of pipe water quality monitoring from industries and municipal waste water treatment plants (WWTPs). Experience from Chaoyang suggests that in some cases there is no set effluent discharge monitoring programme; MEP agencies monitor discharging enterprises irregularly, based on needs. (However, this may not necessarily be extrapolated as an assumption for all areas or regions).

Box 2 Are pollution sources monitored?

In Chaoyang, pollution source monitoring is the responsibility of the EPB but in most cases the only data found to be available is “permit registration” data rather than actual monitored data. Such actual data is critical to the development of a true pollutant load management programme, as well as the assessment of environmental flows, assimilative capacities and water quality based permit conditions. (Data might have existed, but no evidence was seen of the type of data expected to be available).

There is a need to coordinate and optimise the surface water discharge monitoring system of the agencies under MEP and MWR as well as increase the monitoring of both enterprises and WWTPs.

In some countries, the discharging entities (industries, WWTPs, etc) are required to monitor their own discharges regularly and provide this data to the environment agency, who then does random checks of the validity of this reported data. In China, there is a need to understand the overall monitoring needs and determine if such as system of discharger “self monitoring” with compliance checks is appropriate and cost effective for implementation. Such a system involves the certification of various testing laboratories for their ability to provide tests performed under a rigorous set of data collection and laboratory protocols that ‘dischargers’ must use at their own cost.

It will be impossible to develop a true pollution load management system using water quality models until an improved programme of pollutant source monitoring is implemented. Continuous monitoring of major pollutant sources is the only way to accurately determine pollutant loads entering surface water for good quality total load calculations.

Ultimately, the pollutant source monitoring programme and regime should be connected to the new discharge permit programme (being planned under the Water Pollution Control Law 2008) with the type, frequency, tests and other aspects all outlined in the approved discharge permits for enterprises and WWTPs. Such monitoring regimes will undoubtedly require more resources than is practical for the local EPBs to maintain alone, and some monitoring by the enterprises themselves will eventually emerge, with periodic auditing of results by the EPBs. (Note, for water abstraction permits, it is a legal requirement under State Council Decree 460 (SCD460) for the 'abstractor' to pay for a meter to record abstractions).

5.2 Water quality planning issues

Comprehensive Water Resource Plans and Water Pollution Protection and Control Plans

At or above county level, water resource agencies are responsible for producing **Comprehensive Water Resource Plans** for river basins and lakes. Meanwhile, environmental protection agencies are responsible for producing **Water Pollution Protection and Control Plans**.

Regarding the Comprehensive Plans, these should be produced jointly with the relevant local people's government. The plans are then submitted to and approved by the people's governments at the corresponding level or other departments authorized by them. They are then submitted to the next higher level of the Water Resource agencies for recording purposes.

Regarding the Water Pollution Protection and Control Plans, these should be formulated jointly by Environment Protection agencies, planning departments, Water Resource agencies and the relevant local people's government. They should be submitted to the corresponding people's government for approval.

There is a need to integrate, or at least better coordinate, the water quality and water pollution control planning of the Environmental Protection agencies with the Comprehensive Plans of the Water Resource agencies. This will involve linking their contents, bridging any gaps between them, and clearly defining roles for their actual implementation. These are basic elements of integrated water resources management.

Any effort to integrate water resource management plans and water quality management plans involves significant collaboration and data sharing between the Water Resource agencies and the Environmental Protection agencies across many of the aspects of water quality management listed in the matrix shown in Table 1.

It is also important that efforts are made to meet the water quality objectives set out in the plans; there is generally **a need to move towards management of water quality by results (i.e. improvements in water quality)**, rather than management by mandated duties.

Box 3 How collaboration could aid preparation of pollution control plans

Part of the Chaoyang case study involved establishing a shared database-GIS system and a water quality model. In the future, these tools could allow the impact of different development scenarios on assimilative pollutant loads to be tested. This would enable Regional Pollution Control plans to outline detailed plans for how water quality objectives could realistically be met.

Reservoir release operations and management

The timing and quantity of reservoir releases dictates the assimilative capacity of the downstream river and therefore are critical to water quality. Reservoir releases are also important for maintaining minimum stream flows for ecological as well as any tourism or recreational needs.

A key objective for the country in the future would be to ensure that the operations and management of reservoirs includes some consideration of water quality protection and control. These should be incorporated as clear objectives and allowances in water allocation plans.

Drought management

Drought management has generally been the responsibility of the mayor's office, with significant assistance from departments under MWR. The Environmental Protection agencies have had little input into drought management activities in the past.

Drought management is not always considered part of water quality management programmes, but in fact the control of water quality and waste water discharges becomes more critical during periods of low surface water availability and flow. The integration of water quality management and drought management will become increasingly important as industrialisation continues and the demand on water resources increases. It is therefore important that Environmental Protection agencies work with Water Resource agencies in planning for drought.

An important part of the WRDMAP case study was drafting a Drought Management Plan (DMP) for Chaoyang Municipality. This is detailed in Box 4. Guidance for establishing a drought management plan is given in Advisory Note 2.5 (see bibliography).

Box 4 Drought Management Plan for Chaoyang Municipality

Drought management was an element of the case study activities. A Chaoyang Drought Management Plan was produced and subsequently approved and implemented by the municipality administration.

The preparation of the DMP aimed to set up a structured and flexible framework of drought management actions to deal with droughts of different types and severities, to reduce their potential effects on local communities, the economy and the environment.

The DMP contains the specific roles and responsibilities of Chaoyang WAB and EPB in drought planning, in normal conditions as well as during various levels of drought.

This DMP sets out the levels of information and technological instruments necessary for the Chaoyang Municipality portion of the Daling River basin. These processes will be modified and applied to the rest of the Daling River basin.

A key process in developing an effective DMP involves setting out drought management actions and detailed guidance for implementing these actions. The actions respond to different levels of drought severity, and so certain actions will be triggered according to pre-determined drought conditions. This allows the DMP to be flexible and respond to different types of drought.

These drought management actions will impact the implementation of existing abstraction permitting and discharge permitting systems. For example, when there is inadequate water supply for socio-economic water uses in severe/extreme drought conditions, it will be necessary to adopt emergency limits to water abstraction permits ("drought permits") in order to reduce water demand. Environmental Protection agencies are also likely to have to reduce wastewater discharge volumes during extreme drought conditions.

The DMP should detail team structures, responsibilities for different aspects of drought management, and relevant administrative procedures. These are necessary to allow the different government departments at all levels to deal with droughts in an effective, timely and coordinated manner.

The review and update of the DMP is important and should happen as more experience is gained in responding to drought situations.

Water quality implications of Urban Development, Forestry and Agriculture Plans

It is very important for both the MWR and MEP to review the water quality implications of all urban development, forestry and agricultural development plans. Such plans have major impacts on both water availability and water quality.

Ecological flow requirements

Ecological flow requirements refer to the water quantity and quality needs required to sustain particular aquatic species.

The assessment of flow for ecological requirements is in its infancy in the country. The work is fundamentally a responsibility of MWR as a surface water management issue, but there is little evidence of significant work in this area.

In many parts of the country, hydrological conditions are widely controlled by impoundments. Thus reservoir release operations and controls are important tools in managing downstream water quantity and quality, and ensuring ecological flow needs are met. Reservoir operation plans and water allocation plans should therefore feature strongly in plans for environmental and ecological protection.

Ecological flow requirements demand very close collaboration between Water Resource agencies and Environmental Protection agencies amongst other stakeholders: the former is responsible for surface water quantity and quality in the natural drainage network, both of which will directly impact the habitats being protected and studied by scientists within the latter.

Functional zoning

Surface water bodies (rivers, lakes, reservoirs) are categorised into function zones based on beneficial use (drinking water, fishery, agriculture, industry etc) and need for protection.

Each zone then has water quality standards that must be met if the intended use of the water is not to be compromised. Establishing function zones along the length of a river system is a key component of WQM and linked to planning processes.

Water function zones have water quality standards/pollution load targets that provide a basis for:

- The formulation of water resources protection plans
- The verification of assimilative capacity of water bodies
- The implementation of total pollution load controls
- The determination of the actual location of water abstraction or discharge during the abstraction/discharge application approval process

In 2002 a five category water classification was prepared by MEP (as SEPA) and issued as 'State Standard for Surface Water Environmental Quality' (GB3838-2002). In 2003 MWR issued 'Regulation for the Management of Water Function Zones' which created a two level classification: Level I for river basin level planning and Level II for provincial level planning, see Table 2. The 'grades' in the MWR scheme relate to the categories in GB3838.

Table 2: Water function zoning by MWR

Class	**Water environmental function zone**	**Grade (I = highest quality)**
Level I River Basin Level		
I.1	Protection Zone	
I.2	Reserve Zone	
I.3	Buffer Zone	
I.4	Development and Utilisation Zone	
Level II Development Zone at Provincial Level (ie category I.4 further sub-divided)		
II.1	Drinking Water Source Zone	Grades I-III
II.2	Industrial Water Zone	Grade IV
II.3	Agricultural Water Zone	Grade V
II.4	Fisheries Water Zone	Grade III
II.5	Landscape and Recreation Water Zone	Grade III-V
II.6	Transition Zone	Depends on downstream needs
II.7	Wastewater Discharge Control Zone	Depends on downstream needs

Source: 'Regulation for the Management of Water Function Zones', MWR, 2003.

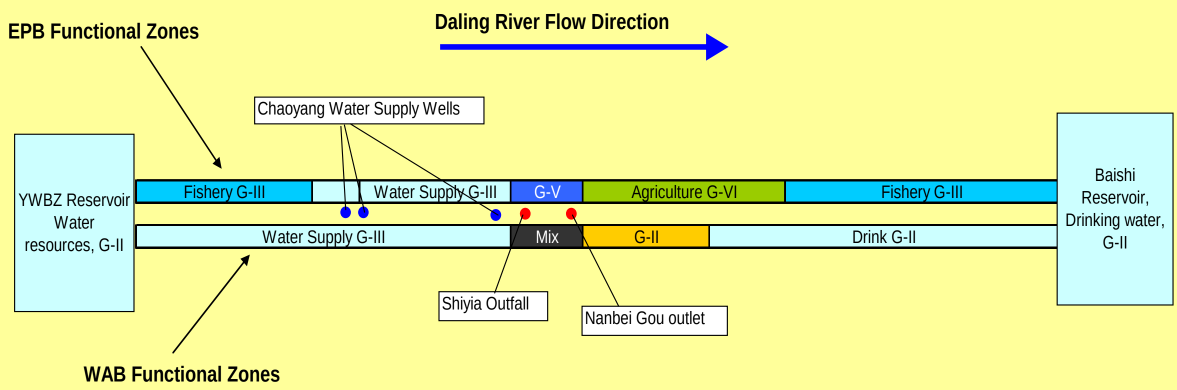
Since regulations issued by MWR are not followed by the Environmental Protection agencies there has been scope for divergent practices to develop, particularly at the lower administrative levels. Box 5 illustrates how in Chaoyang Municipality an approximately 60 km length of the Daling River has been differently divided into function zones, and associated water quality grades, by the municipality WAB and EPB.

Box 5 Function zones compared on Daling River in Chaoyang Municipality

The main reach of the Daling River running through Chaoyang Municipality has been split into:

1. Water function zones - by Chaoyang Municipal WAB, approved in 2005
2. Environmental (water) function zones - by Chaoyang Municipal EPB

The Chaoyang Municipal WAB/EPB boundaries and water quality objectives are different.



Grade-III water quality standard applies in both schemes upstream of the Shiyia Outfall. However, downstream of the Nanbei Gou outlet the WAB zoning sets higher water quality standards (at Grade-II).

Article 32 of the Water Law 2002, states that *"… department of water administration [MWR]… jointly with the environmental protection administrative department [MEP] and other concerned departments … shall work out water functional division plans"*. This clearly indicates the intention that the Water Resources agencies should collaborate with Environmental Protection and other agencies in developing their water function zones so that they have the best available information to guide their decision making. The focus for all should be the achievement of improved water quality, collaborating closely where necessary to succeed in meeting this objective.

Total load assessment

Total pollutant load controls are set in the 'Five Year Plans for Environment Protection', as part of the overall five year planning process. Each river basin is given targets for pollutant load reduction, usually based on organic pollutant loads. The basin loads are then disaggregated to the various municipalities of the basin. However, there are no clear directives on how this is accomplished in practice and it appears that pollutant load reductions are not allocated on the basis of assimilative capacities of particular river reaches. (Assimilative capacity is calculated for each pollutant by computing the maximum pollutant load that the river can assimilate without deteriorating the river water quality beyond the permissible threshold as specified for its designated uses). There is thus a need to ensure load reduction allocations are derived from a scientific assessment of loads and capacities. (This requires good cooperation between Water Resources and Environmental Protection agencies).

Much of the pollution load reduction specified in previous Five Year Plans has been addressed through the construction of many new WWTPs. There does not yet appear to be a significant emphasis on load reductions from existing pollutant loads that would not be eliminated by new WWTPs. The Five Year Plans reportedly include knowledge of all potential new industries or other sources of pollutant load that could be initiated during the five year plan, and these new loads are taken into account. However, there do not appear to be any maximum “caps” or ceilings for the pollutant loads based on assimilative capacity assessments which would probably encourage stricter discharge standards.

Both Water Resource agencies and Environment Protection agencies are involved in the process of controlling total pollution loads. Water Resource agencies verify the assimilative capacities of water bodies required to meet the water quality targets dictated by the water function zones. They liaise with Environment Protection agencies to determine how the pollution loads discharged can be limited in order to meet the water quality targets.

Meanwhile, Environment Protection agencies are responsible for controlling the total pollution load discharged into water bodies in which water quality fails to meet national water quality requirements. They should also determine the pollutant loads for individual enterprises which are required to reduce their loads.

To ensure the effective control of water quality in water bodies, the key challenge is to strengthen the coordination between the two agencies under the current framework of mandated roles and responsibilities. **Because the achievement of water quality objectives depends on the control of the total loads discharged AND the assimilative capacity of water bodies (which is, in turn, dependent on volumes abstracted and volumes released from reservoirs, etc), sharing data between the agencies on discharged loads and water quantity is crucial**. It is also important that load targets are agreed jointly by the two agencies to ensure a coordinated approach to total load control.

One aspect which requires particular attention is how the achievement of load reductions can be linked to water flow regimes, as the more critical times for water quality are during low flow conditions. In the long-term, outputs from hydrological basin models could be used together with outputs from water quality models to develop a more rigorous programme of basin-based load reduction targets. There will inevitably be ‘debate’ between the agencies as to how the total load and assimilative capacities can be brought into a sustainable and ecologically acceptable balance – should flows be increased (by reducing abstraction) or pollution curbed (by tighter/tougher controls on industry and urban waste or agricultural diffuse pollution). This ‘debate’ should be ‘informed’ and ‘open’.

Box 6 How modelling contributes to total load and assimilative capacity estimation

Both WABs and EPBs in Chaoyang are involved in controlling total pollution loads.

The case study made good progress towards achieving the joint determination of total loads and assimilative capacities by the two agencies. This was achieved through a shared GIS database and Qual2K water quality model.

Water quality modelling

Mathematical water quality modelling can be used to assist in the setting of abstraction and discharge permit conditions. A model can be used to test "what if?" scenarios which can demonstrate the effect on the water quality in the river due to changes in abstractions and discharges. The model can also be used to investigate the discharge and abstraction limits required to achieve specific river water quality targets.

There are many and various water quality modelling options used in other countries. In the Chaoyang case study, a US Environmental Protection Agency (EPA) water quality model was used - Qual2K. The Qual2K model is free to download, is continually updated and maintained by the US EPA and includes a detailed user guide, making this model particularly appropriate for use in the case study and possibly throughout the country. There are other potential models available, and ultimately MEP and MWR will need to determine an appropriate water quality model to be applied to ensure a consistent approach and comparable model results.

Some details of the water quality modelling carried out in Chaoyang are provided in the following box, but a full description of the modelling process is given in Example 1.5, 'Water Quality Modelling in Chaoyang' (see bibliography).

Box 7 Water quality modelling

The water quality modelling work using Qual2K carried out for the case study initially covered a reach from the Yanwangbizi Reservoir outlet to the Baishi Reservoir inlet on the Daling River. This reach includes the urban area of Chaoyang (see Figure 2).

Various Qual2K model scenarios were made to assess the ability of the Daling River to meet water use function zone targets. One scenario included the construction of the new Chaoyang WWTP, which was completed in 2008. Results indicated that further reductions in waste water treatment may be required and/or the reuse of WWTP effluent in order to meet the function zone targets.

The GIS database established during the case study provided support to the water quality modelling work. It provided relevant data for the model, such as discharge data, abstraction data, information on the rubber dams in the Chaoyang urban reach of the River Daling, river water quality monitoring data and information on river modelling nodes. Its spatial measurement function helped to determine the distance from discharge outlets to the river. Simulation results were displayed on GIS maps of the river reaches.

Chaoyang EPB was working on the 2011-2015 Five Year Plan for Environmental Protection. The scenarios and model runs of Qual2k provide important information about changes in total loads, assimilative capacities and how water quality targets might be met. This work also provides an important beginning to the development of future water quality based discharge permit requirements for point sources in the Chaoyang urban area.

General guidance describing approaches to water quality modelling at the provincial level is given in Advisory Note 1.5: 'Water Quality Modelling' (see bibliography). The guidance provided in AN1.5 covers choosing a model, data requirements, appropriate uses of models, and how they can be used by provincial or municipality level government.

Environmental Impact Assessments

The Environmental Protection agencies manage the Environmental Impact Assessment (EIA) process. EIAs are carried out for all infrastructure or other developments that might result in new or increased sources of water pollution, or other environmental impacts. Guidance or requirements on pollution control or minimisation might be given. This leads to (or should do) the issuance of an effluent discharge permit. The discharge standards form the basis for discharge permits and in many areas, the discharge permits currently in place primarily correspond to new pollution sources.

Box 8 How to capture data for existing enterprises that are pollution sources

The Chaoyang EPB uses the EIA process to develop proposed wastewater effluent limitations and standards for **new** sources of pollution. Some EPB staff have proposed using EIAs to assist them in developing discharge permit conditions for **existing** enterprises. This is likely to be a somewhat time consuming and costly process - therefore it has been suggested that simpler methods be implemented.

(In fact the process of application for and issuance of effluent discharge permits should be followed for all organisations discharging effluent to the environment).

Water Resources agencies are consulted about water supply and abstraction needs for new facilities in the process of abstraction permit issuance.

5.3 Water quality control strategies and levers

Referring to Figure 1, this section addresses ways of achieving effective WQM. A holistic approach is essential to achieving the goal of effective WQM; integrating activities such as permitting is strongly emphasised.

Abstraction permit management

Water use and effluent/waste discharge are controlled by the government primarily through water abstraction and discharge permitting.

Based on the current legal framework, Water Resource agencies take responsibility for the management and supervision of water abstraction through a water abstraction permitting system which is currently well advanced.

Abstraction management requires the consideration of both water quantity AND water quality; one has to consider the quality of the water being abstracted, as well as the impact of the abstraction on the assimilative capacity of the source water body. The latter is important in achieving water quality objectives and meeting the ecological needs of the water body. Thus it makes sense to adopt IWRM principles and develop an approach to permitting which manages abstraction and pollution discharges conjunctively (an integrated approach).

Integrating permitting processes

Integrating abstraction and discharge permit processes calls for Environmental Protection agencies and Water Resource agencies to engage in collaborative working towards shared WQM objectives. As demonstrated in Chaoyang, a good starting point for the ultimate achievement of an integration of these permitting systems is the establishment of a GIS for sharing data between the two agencies.

However, it should be noted that the 'integrated permitting' system which is currently under discussion within MEP, covers not only waste discharge to the water environment, but also solid waste and air pollution. This form of 'environmental permit' is called an '**integrated pollution prevention and control**' **(IPPC)** permit in UK and Europe, or similar elsewhere (see Box 9).

Hence, from the perspective of MEP, integrating the permitting of water abstraction and waste discharge to water bodies was, at the time of the case study development, not a key focus. It was therefore decided during the course of WRDMAP activities to address the issue of three 'C's (communication, cooperation and collaboration) in terms of water abstraction permits and other water quality management activities (or requirements).

GIS and permit management

A GIS based permit system can provide assistance to many aspects of water abstraction and discharge permitting. These aspects include routine activities, management of units or individuals who abstract or discharge water, and permit application management.

Box 9 Integrated Pollution Prevention and Control in Europe

IPPC is a regulatory system that employs an integrated approach to control the environmental impact to air, land and water of emissions arising from industrial activities. It involves determining the appropriate controls for industry to protect the environment through a single permitting process.

IPPC was introduced in 1996 by the European Community Directive 96/61/EC, with national implementation required to be fully compliant for new and existing installations by October 2007.

When determining an application the regulator is required to ensure that the applicant is using, or proposing to use, 'best available technology (not entailing excessive cost)' (BAT[NEEC]). Where several emissions to the environment are involved the regulator has a duty to ensure that the 'best practicable environmental option' (BPEO) is achieved so as to have the least effect on the environment as a whole.

Once the regulator has issued a permit, the operator of an IPPC installation will have to carry out monitoring to demonstrate compliance with the permit conditions. Regulators will also carry out their own monitoring and inspections, and have a range of enforcement powers.

www.envirowise.gov.uk

A GIS-database system for permit management can provide the following functions:

- Creating an inventory of water abstraction and discharge permits for data querying;
- Comparing actual water abstraction and discharges with permitted water abstraction and discharges, during checking the

enforcement of water abstraction and discharge permits;

- Providing water quantity and quality data for analysis and for use in approval of water abstraction and discharge applications for projects in construction / rehabilitation / expansion;

A GIS essentially allows Water Resource agencies to access a more complete data set of surface water quality as well as volumes and loads of pollutant sources. Meanwhile, the Environmental Protection agencies can gain access to abstraction information. (This would benefit from a common user/organisation referencing system).

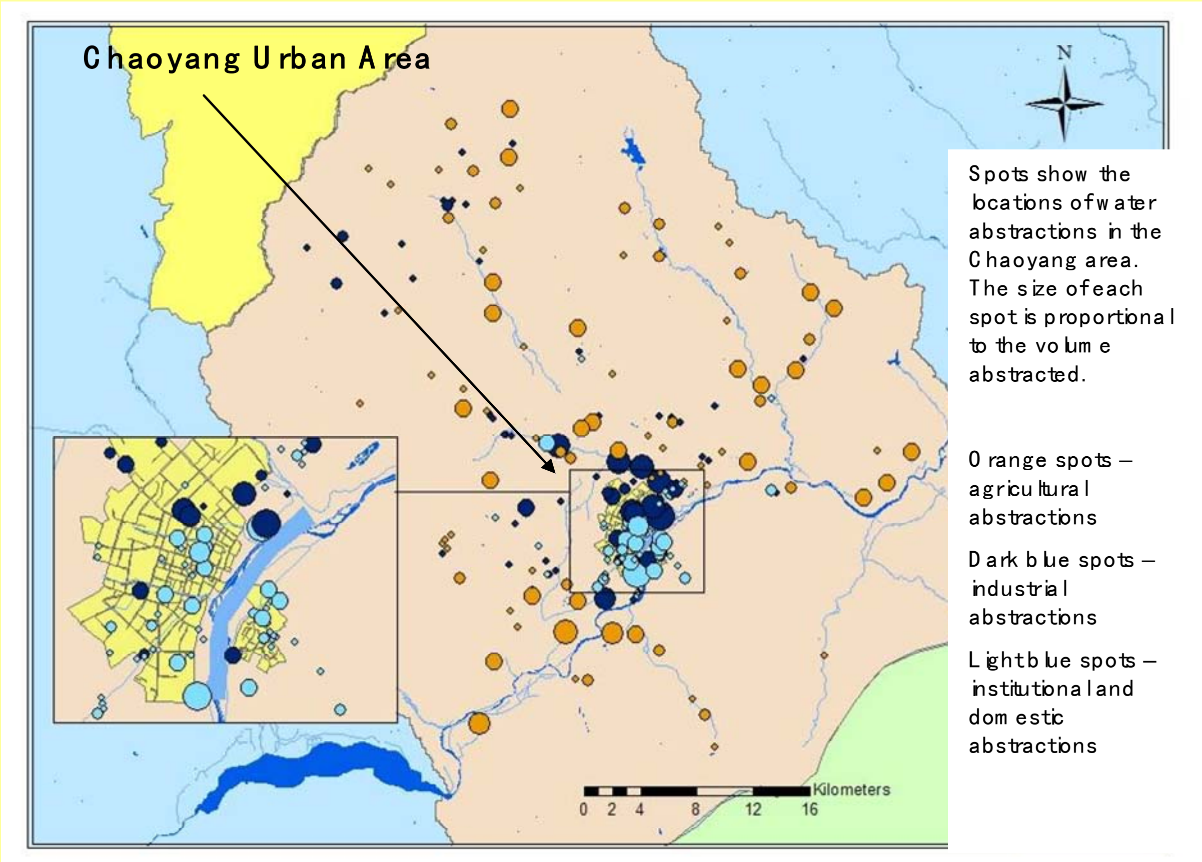
The access to discharge data allows Water Resource agencies to calculate the *water consumption* of abstractors, enabling abstraction volumes to be rationalised. It also enables them to work collaboratively with Environmental Protection agencies on controlling total pollutant loads, and thus determining rational standards or limits for discharge permits.

Ultimately, a GIS system should enable Water Resource agencies and Environmental Protection agencies to control the total amount of water abstracted and discharged more scientifically and rationally, helping to achieve sustainable utilisation of water resources, improvement of the water environment, and recovery and protection of water function zones.

Such a GIS brings benefits beyond assistance with abstraction and discharge permitting. For further information on the value of GIS in IWRM refer to Advisory Note 8.2 (see bibliography).

Box 10 Use of GIS to map abstractions

In Chaoyang, the abstraction permit programme has been well advanced for several years. However, the essence of the Case Study was to investigate options and ideas for improving and/or integrating the requirements of Chaoyang's existing abstraction and discharge systems. As part of this effort, a GIS system for information and data sharing between WAB and EPB was established. This has provided a good basis of cooperation between these two agencies.



With the data-sharing system in place, WAB is able to review water use and discharge volume information contained in the EPB effluent discharge inventory or discharge permit applications to verify consistency of information. WAB is also able to review any surface or groundwater quality data held by the EPB that could affect the viability of any proposed water abstraction locations and volumes. Likewise, the EPB is able review water abstraction data held by the WAB to verify consistency of information with their discharge permit applications. The EPB and WAB can also verify the relative locations of existing and proposed wastewater discharge points and surface water or groundwater abstraction points that could be affected by these discharges.

The long term vision in Chaoyang WAB and EPB is that the new GIS will form the basis of a decision-support system that will allow for integrated planning and management of water resources – this will include an integrated water abstraction and wastewater discharge permitting system. However, at present, the GIS and water quality model are not yet developed to the stage of a full decision-support system.

Discharge permit management

The agencies of Environmental Protection can achieve the objective of water discharge control and the achievement of total pollutant control targets through the implementation of a water discharge permitting regime.

The implementation of a discharge permit management programme has largely been carried out on an experimental and limited basis to date. Discharge permits are generally ill-defined and lack legal standards. This has lead to management or operational loopholes. There is also a need for coordination between local and high-level discharge permit procedures. The government has recognised the issues and addressed them through the Water Pollution Control Law (2008) which anticipates a more complete and robust discharge permit programme with legal effects at national level. Detailed control regulations are currently being developed by MEP but have yet to be implemented.

There is also a need to clarify the objective of discharge permits and how they are to be used. **Permits should act as a pollution control mechanism which helps achieve many of the objectives of water quality management programmes**. However, many organisations perceive permitting to be an extension of the discharge quantity registration process.

As discussed in the previous section, the inter-dependent relationship of water quantity and water quality calls for an 'integrated' approach to abstraction and discharge permitting and thus cooperation and coordination between Water Resource agencies and Environmental Protection agencies. A summary of the situation in Chaoyang Municipality is presented in Box 11.

Effluent discharge charges and penalties for permit non-compliance

Charges and penalties are used in many countries as the principal methods for ensuring compliance to permits.

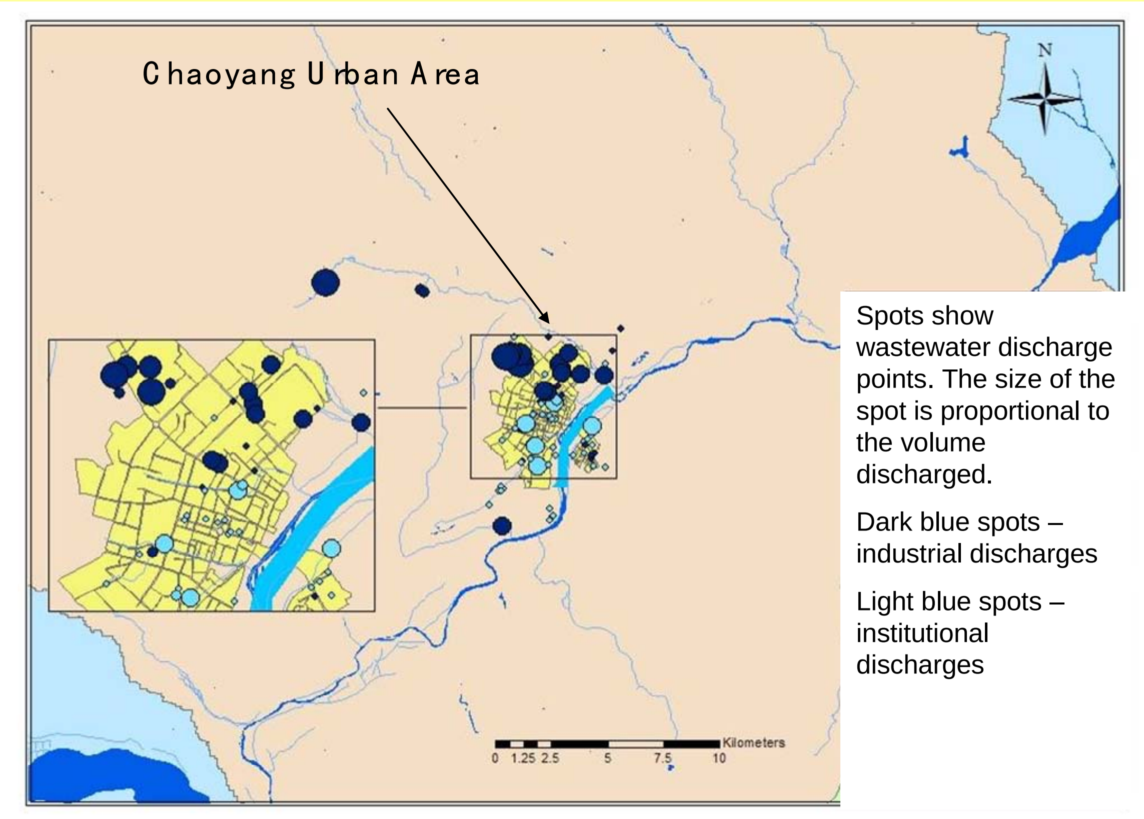
Effluent discharge permit issuance and enforcement is generally not widespread in the country. In some areas, local Environment Protection agencies register pollutant discharges and collect a pollution fee based on the reported load from the facility. However, there is reportedly often little connection between compliance with discharge standards and the fees collected.

The new focus on a complete and comprehensive discharge permit programme under the Water Pollution Control Law will undoubtedly require a complete change in existing management practices with more emphasis on enforcement of discharge permit conditions. The law increases potential fees for non-compliance but these increases are limited and may not be high enough to discourage non-compliance by major polluters.

Box 11 Use of GIS to map pollution sources

In urban Chaoyang, the total waste water volume is over 130,000 m^3/day, with untreated effluent discharging until recently into the Daling River through three discharges: Nangou, Beigou and Shijia River. However, a new 100,000 m^3/day WWTP went into operation in 2008 and takes water from the Beigou and Shijia discharges.

The figure below shows discharge locations in Chaoyang municipality.



In Chaoyang, there have been few discharge permits issued by EPB to date, and these have been mainly for new industries and based on Environmental Impact Assessments. It is assumed that the Water Pollution Control Law of 2008 will move the Chaoyang discharge permit programme ahead substantially.

Industrial on-site treatment, recycling, retrofitting

The problems of water scarcity and poor water quality and the need for demand management and WQM are usually articulated in national policy and drive the behaviours of industrial water users.

A key component of this top-down process is the role of regulations, standards and permit restrictions that set out to force change in a positive direction. This is often accompanied by government-led initiatives for research into industrial processes and water conservation techniques, and initiatives to promote the wide application of on-site treatment and water conservation technology, restrict and eliminate outdated and high water-consuming technologies, techniques and equipment, etc.

If Water Resources agencies and Environmental Protection agencies work in a coordinated manner, the regulatory control on industrial units can be more effective, both in terms of pollution control and water usage.

WWTP operational management – planning, construction, controls

For municipal WWTPs and sewage networks, there is another government agency involved: the Municipal Administration Department - affiliated with the Public Affairs Bureau.

The municipal sewer networks are generally managed and maintained by the Municipal Administration Department, which is also responsible for collecting the treatment fee of waste water from private wells. However, the Municipal Administration Department is not normally responsible for monitoring water quality and water quantity of the municipal sewer system. Experience is Chaoyang City suggests that it some areas no government agency is responsible for this.

The planning for the construction of municipal WWTPs is directly related to the Five Year Plans for Environmental Protection, which specify certain WWTPs to be built within the time period.

The WWTP is required to meet certain discharge standards based on the Environmental Impact Assessment submitted to the Environmental Protection agency. However, often there are no discharge permits issued to WWTPs, and on-going compliance monitoring to ensure they meet the discharge standards is not happening yet.

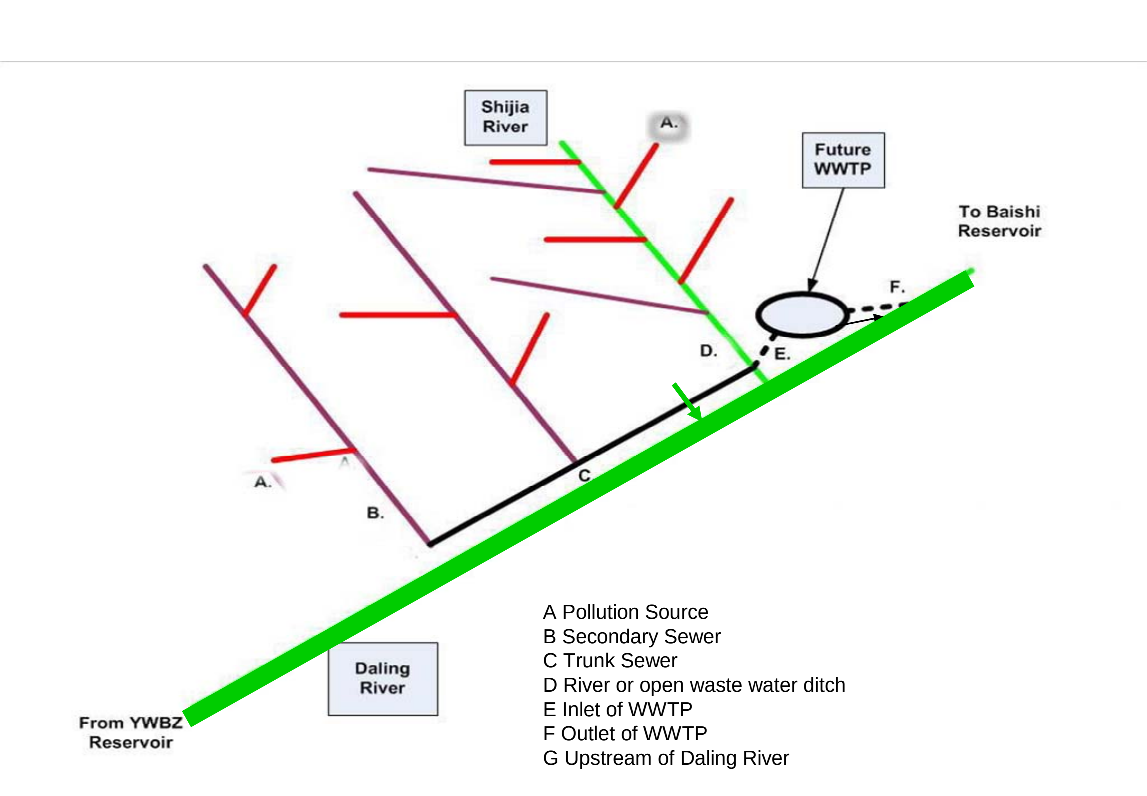
The management arrangements for urban waste water infrastructure can currently vary considerably between cities reflecting the local situation and the relatively recent introduction of centralised WWTP in many municipalities. In Liaoning Province the various municipalities can select different patterns for the management of WWTPs – alternatives include: Public Affairs Bureau, WAB, Construction Bureau/Commission, EPB. In Chaoyang City the newly commissioned (2009) WWTP is managed by the WAB.

However, regardless of the management alternative adopted for the WWTP in most cases two different organisations undertake the management of the WWTP and the sewer collection system.

A summary of the situation in Chaoyang City is given in Box 13.

Box 12 Overlapping responsibilities for waste water disposal in Chaoyang City

There are overlapping responsibilities with regard to permitting and monitoring of sewerage systems and the WWTP in Chaoyang City. These are illustrated in the figure and table below.



Location	Standard control	Monitoring	Permitting
A pollution source	EPB + MAD	EPB	EPB + MAD
B secondary sewer	MAD	No dept. responsible	No dept. responsible
C trunk sewer	WAB	No dept. responsible	No dept. responsible
D open ditch for waste water disposal	WAB + EPB	WAB + EPB	Not applicable
E inlet of WWTP	EPB	WWTP	No dept. responsible
F outlet of WWTP	EPB	WWTP+WAB+EPB	EPB
G Daling River	EPB	WAB + EPB	EPB

Note: Open ditch waste water disposal is unusual in large urban centres, normally covered sewers are provided.

There is a clear need to rationalise the responsibilities for sewer and WWTP management between the three (or more) government agencies, ensuring that there are no overlaps and that the duties of each agency are clearly defined. This will need to be done in anticipation of the new permitting system which is likely to call for a more rigorous approach to permit issuance and enforcement for sewer systems. All organisations need to work seamlessly together and where there is joint involvement (shown as WAB, or

WRD, and EPB) roles, responsibilities and the three ‘Cs’ (communication, cooperation and collaboration) need to be agreed and clear.

5.4 Reporting of water quality conditions

Water reporting and bulletins - water resources

The MWR prepares regular reports and bulletins according to national, provincial and municipal requirements.

Many Water Resources agencies produce annual Water Resources Bulletins. These bulletins help to disseminate water resources information on the river basins to the government and relevant departments; facilitate the establishment of a water-saving society; and promote the rational development, utilisation, allocation, and protection of water resources.

GIS are very useful in displaying data in maps and figures for the bulletins, helping to improve the reader’s understanding of the water resources situation.

Box 13 Modernising dissemination material

The shared GIS system instigated by the case study was used for the preparation of the Water Resources Bulletin produced by Chaoyang WAB. The Bulletin is issued once per year and contains information on water resources volumes, the status of water resources development and utilisation, water quality conditions, and water demand and supply forecasts for the entire Chaoyang Municipality.

Recent bulletins have made full use of statistical spatial analysis functions and graphics provided by the GIS system.

The local EPB produce similar reports - incorporating a common data base would avoid potential conflicting information that no doubt could confuse readers.

Water reporting and bulletins - water quality and environmental conditions

The Environmental Protection agencies disseminate information on the state of the environment as well as environment protection plans, many of which are now published on the internet.

In the short term, there is a need to cross-reference the status of each of the agencies’ work, but in the long-term it may be beneficial to consolidate such reporting.

6 Mechanisms for Improved Collaboration

Section 5 has given brief suggestions for how increased inter-agency cooperation might improve the different aspects of water quality management. This Section focuses on two **practical tools or mechanisms that can be implemented to facilitate cooperation and coordination between government agencies**. These are the use of inter-agency agreements (namely MoAs and MoUs) and the establishment of a GIS data-sharing system, both of which were utilised during the WRDMAP Chaoyang case study.

6.1 MoUs and MoAs

Mechanisms for inter-agency cooperation, namely the **memorandum of agreement (MoA)** and the **memorandum of understanding (MoU)**, can be applied to facilitate collaboration between provincial level departments.

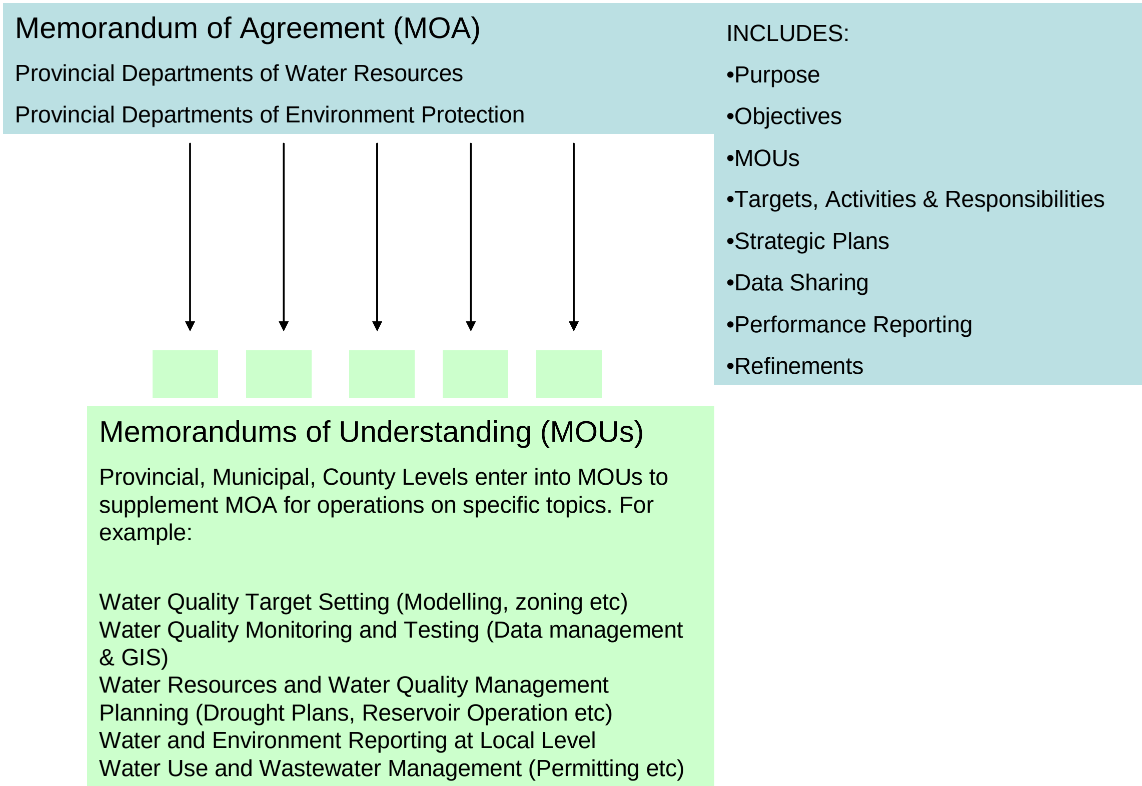
MoAs and MoUs can be employed to improve water quality management conditions and to a number of other areas where two or more agencies have overlapping jurisdiction, administrative and operational issues and improved collaboration is required.

MoUs have been defined as *"a document describing a bilateral or multilateral agreement between parties. It expresses a convergence of will between the parties, indicating an intended common line of action."* The MoU establishes a clear understanding of each party's roles and compensation (cost sharing). A MoA is a higher level mutual agreement between parties, supported by MoUs for specific areas. Figure 5 illustrates the relationship between a MoA and MoUs, and shows typical topics in water quality management that MoUs could be applied to.

An advisory note on the application of MoUs and MoAs has been produced as part of this series (**AN 8.4, 'Use of Memorandums of Understanding (MoUs) in Collaborative Water Quality Management'**). This includes steps for producing MoAs and MoUs and an example MoU outline.

An MoU was established for water quality management and applied through the Chaoyang Case Study. The details are given in the Box 15.

Figure 5: MoAs and MoUs



Box 14 Use of MoU to aid collaboration

Beginning in mid-2005, the WAB and EPB of Chaoyang Municipality, under the WRDMAP project, entered into a written agreement to pursue various means of cooperation and coordination of their activities to improve WQM. In December 2005 the first Memorandum of Understanding (MoU) was entered into to share data in an effort to develop coordinated water abstraction and discharge permit systems. A second MoU was agreed in October 2006 to strengthen and expand the cooperation in sharing data, including details of data to be shared. The roles and responsibilities for the establishment of the data sharing system and for its management and maintenance were clarified and finally agreed as follows:

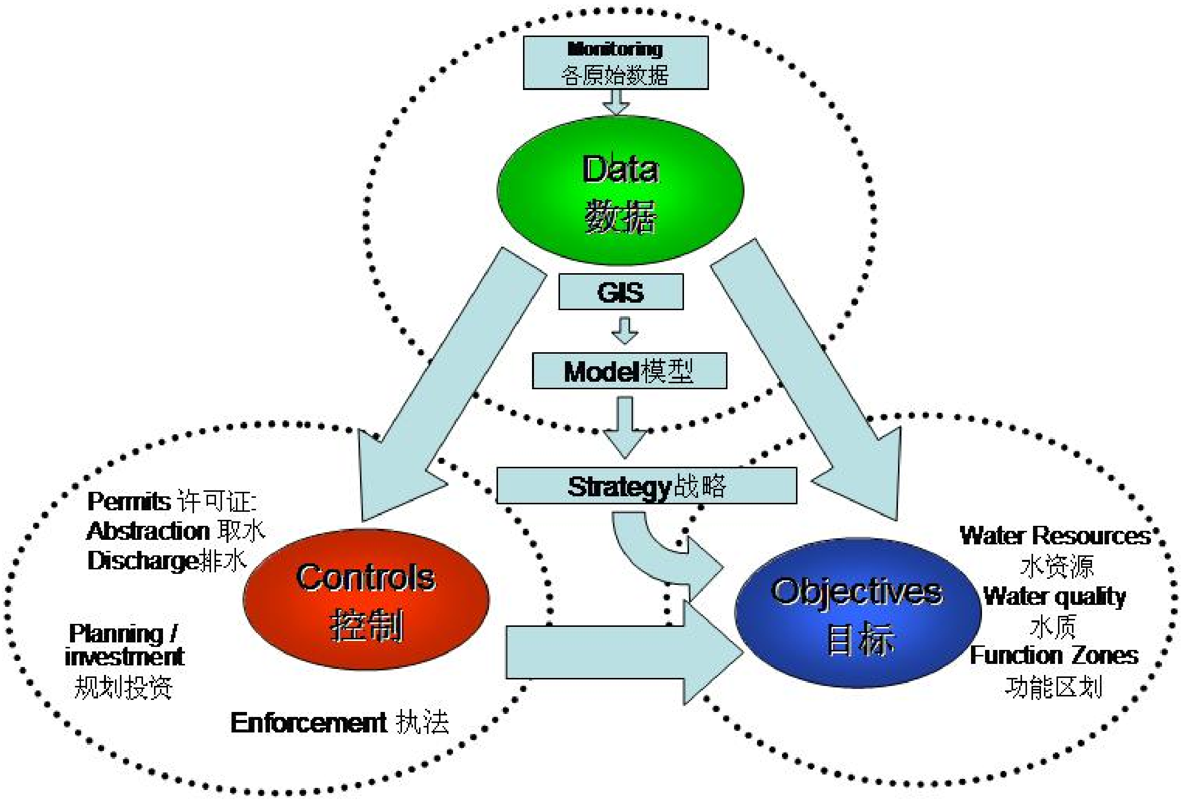
- the server for the GIS to be managed and maintained by WAB in Chaoyang;
- the cost for system operation to be paid for by WAB;
- WAB and EPB will maintain their respective user terminals separately;
- Data and information to be added to the GIS in accordance with the agreement of ‘The Range and Requirement of Data sharing between WAB and EPB in Chaoyang’;
- Updating of the data sharing system and other matters to be discussed regularly.

The existing MoUs have provided a valuable start to the sharing of water-related data and information between WAB and EPB. As the WAB and EPB move toward more coordinated planning under an IWRM focus, there will be a need to expand the scope of the data sharing between the organisations. This will require **new or amended MoUs**.

6.2 Data sharing and GIS

The establishment of a shared data and information system between Water Resource agencies and Environment Protection agencies opens up information flow paths, supplementing the basic information of each agency and thus better informing the water quality objectives and the water quality control procedures of both agencies. Figure 6 shows the links between data and information and water resources controls and objectives.

Figure 6: Schematic of data and information flow paths between components of water resources management systems



Data access between offices can be affected through the internet.

A shared information system, such as a linked database-GIS system thus provides a very good basis for coordinated future water quality management between water resources agencies and environmental protection agencies.

Fundamentally, a shared database system means that Water Resource agencies have access to more discharge information (volumes and pollutant loads) while Environmental Protection agencies have access to abstraction information. This allows the two agencies to take an 'integrated' approach to water quality management in the following ways:

- **Total pollution load control and functional zone management.** Both agencies are able to provide reliable data for the calculation of total discharge loads into each water function zone and the assimilative capacity of each function zone. This allows both agencies to work collaboratively to prepare water pollution control plans and thus set up meaningful objectives for water functional zone management. The shared data allows for tighter control over water abstractions and effluent discharges.

- **Water abstraction and discharge management**. A GIS system enables Water Resource agencies and Environmental Protection agencies to control the total amount of water abstracted and discharged in a scientific and rational manner, helping to achieve sustainable utilisation of water resources and recovery of river water quality conditions.
- **Water resource monitoring**. Overlaps in the water quantity and quality data collected by the Water Resource agencies and the Environmental Protection agencies can be identified. The monitoring stations and monitoring programmes of the two agencies can then be rationalised, eliminating redundancies and overlaps. This will ultimately allow budgets allocated to these monitoring activities to be used more effectively.

The GIS component of the system allows users to view data spatially and analyse data statistically. This enables Water Resource agencies and Environmental Protection agencies to improve water resources management in the following ways:

- **Improvement of the approval process of abstraction permits**. In accordance with the regulations of 'Water Resources Justification for Construction Projects' (MWR and Development and Reform Commission Decree 15), for all new or adjusted abstraction permits, a water resources analysis must be carried out in order to ensure rational allocation, efficient use and protection of water resources. The GIS can clearly illustrate the water abstraction status of a river basin, showing the abstraction volumes and distribution of abstraction points. It therefore is a useful tool in determining rational abstraction volumes and appropriate sites for water abstraction infrastructure. This can standardise the approval process of water abstraction permits.
- **Assessment of surface water quality**. GIS can display and analyse spatial water quality data and information for a particular river reaches on a map. It can also be used to display results of water quality models, generating pictorial representations of river water quality changes. It also allows statistical analysis of water quality changes.
- **Strengthening water resources and water allocation planning**. Water resources are closely linked to population, economy and environment. GIS can store and link socio-economic information (e.g. property, population, economic activities) and water resources information through maps and tables. The analytical module of GIS can then be used to carry out water supply and demand analysis and planning, leading to the establishment of a GIS-based decision-making system which can optimize the allocation of water resources.

Box 15: Management support is vital to progress inter-agency collaboration initiatives

A key element of the Chaoyang case study was the establishment of a **shared data and information system** for Chaoyang WAB and EPB. The objective was to open up information paths between the two bureaus and better inform their water quality objectives and controls (Figure 6). The establishment of a database linked to GIS provided the physical means for data sharing between the two organisations.

The initial focus was on data related to water abstraction and discharge permit management. The sharing system was designed to include:

- approval data on water abstraction and discharge permits;
- water quality and quantity data of water abstraction and discharges;
- water quality data for surface water and groundwater bodies in the basin and surface water flow and groundwater level records;
- data on water function zones;
- data on total load control in the basin
- indicators to control water resources management and plan (including water quality management and water pollutant control plan).

Based on the data requirements above, an ARCGIS system was developed. This included a shared database, an analysis system, and internet access for the transfer of data between WAB and EPB.

There are three types of users of the shared GIS system: 1. WAB; 2. EPB; 3. Other interested parties eg DRC. WAB users can view/change WAB data but only view EPB data; while EPB users can view/change EPB data but only view WAB data; other users can only view WAB and EPB data. The system users are mainly composed of directors of Chaoyang WAB and EPB and staff who manage water abstractions and effluent discharges.

The GIS system produces a number of special maps for abstraction and discharge management (Boxes 10 and 11). These maps illustrate the spatial distribution and size of water abstractions and effluent discharges and provide a basis for IWRM planning, water environmental protection planning and decision-making for abstraction and discharge permit management. In addition, a dynamic display has been established which uses colour to depict water quality and compliance in different water function zones.

The GIS system provided support to the development of the Chaoyang Drought Management Plan (Box 4), allowed WAB and EPB to improve their combined water monitoring programs (Box 1), and has supported the Qual2K water quality modelling (Box 6).

Box 15 (*continued*)

Issues Preventing Full Cooperation

Despite the demonstrable improvements brought about by the shared data system, and an acknowledgement by both WAB and EPB of the importance of data sharing, it was still difficult to achieve full data sharing.

Possible reasons for the difficulties are as follows:

- There may be a reluctance to provide data that is incomplete or inaccurate
- There may be no incentive for the staff of agencies to cooperate or the staff believe it is not their responsibility. The latter may be because there is no order or instruction to this effect from higher levels in the government.
- The current administrative management means that there are no practicable measures in place to encourage or ease data sharing.
- Agencies may be focused on their own daily duties which have been mandated to them from higher up in the government; there is no time to put energy into coordinating with other agencies.
- Agencies believe they have been undertaking their tasks adequately to date and hence see no need to change. (Generally many individuals within organisations fear change).
- The MoU did not explicitly cover **which data** should be shared.
- There is no extensive understanding, nor official approval, of how to implement the coordination between agencies.

Solutions to these issues must be found if the shared GIS is to advance and contribute to its full potential in supporting efforts to achieve effective water quality management in Chaoyang Municipality. Active management support is vital to finding solutions and keeping the overall collaboration moving forward.

7 Considerations

It should be noted that the collaborative working described in this Paper was achieved under '**project conditions**' where all software, hardware and training was funded by the project. Hence the recommendations emanating from the project activities might not be easily reproducible. On the other hand, in terms of data sharing this might be easier to achieve when international involvement is absent.

Some of the potential issues that need to be addressed in improving or obtaining **communication, cooperation and collaboration** (the three 'C's) in water quality management between EPBs and WABs (WRBs) are:

- Appreciation and belief by the two organisations that communication, cooperation and collaboration is required to effect improved water quality management
- Support of their higher level offices for communication, cooperation and collaboration in WQM
- Funding of hardware and software for a shared GIS platform
- MoUs that facilitate and promote both lateral and vertical communication, cooperation and collaboration
- Willingness to share data and not be concerned about 'power loss' nor 'suspect data quality (loss of face)'
- Concern about agency budgets and power bases and influence

Document Reference Sheet

Glossary:

BAT(NEEC)	Best available technology (not entailing excessive cost)
BPEO	Best practicable environmental option
DFID	Department for International Development, UK aid
DMP	Drought management plan
EIA	Environmental Impact Assessment
EPD/EPB	Environmental Protection Department/Bureau
IPPC	Integrated pollution prevention and control
IWRM	Integrated water resources management
MAD	Municipality Administration Department
MEP	Ministry of Environmental Protection (formally SEPA)
MoA	Memorandum of Agreement - a document setting out the terms on which the parties agree to work on a particular project or meet an agreed objective. It can be used between agencies, the public and the federal or state governments, communities, and individuals.
MoU	Memorandum of Understanding – a document setting out, in more detail than included in a MoA, practical operations on specific topics. MoUs are generally considered an expression of voluntary compliance in the area of cooperation.
MWR	Ministry of Water Resources
SCD460	State Council Decree No. 460
SCOD11	State Council Official Document No. 11
WAB/WRD	Water Affairs Bureau/Water Resources Department
WQ	Water quality
WQM	Water quality management
WRDMAP	Water Resources Demand Management Assistance Project
WWTP	Waste water treatment plant

Document Reference Sheet

Bibliography:

Chapra, S.C., Pelletier, G.J. and Tao, H. (2006). *QUAL2K Documentation and Users Manual*. Civil and Environmental Engineering Dept., Tufts University, Medford, MA. Free download: http://www.epa.gov/athens/wwqtsc/html/qual2k.html

IPPC - information on the European Community Directive 96/61/EC on Integrated Pollution Prevention and Control and its application in the UK www.envirowise.gov.uk

US Environmental Protection Agency (EPA) Introduction to the Clean Water Act http://www.epa.gov/watertrain/cwa/

GB 3838-2002, 'State Standard for Surface Water Environmental Quality', 2002

SL219-98, 'Technical Specification on Monitoring Water Quality', Ministry of Water Resources, 1998

HJ/T91-2002, 'Technical Specification Requirements for Monitoring of Surface Water and Waste Water', Ministry of Environmental Protection, 2002

HJ/T164-2004, 'Technical specification for environmental monitoring of groundwater', Ministry of Environmental Protection, 2004

'Regulation for the Management of Water Function Zones', Ministry of Water Resources, 2003

Related materials from the MWR IWRM Document Series:

Overview Document OV1	Integrated Water Resources Management (IWRM)
Overview Document OV2	Water Demand Management (WDM)
Thematic Paper 1.5	Use of Water Quality Modelling for Water Protection
Example 1.5	Water Quality Modelling in Chaoyang, Liaoning Province
Advisory Note 1.7	Designing a Monitoring Programme for Water Quality Modelling
Advisory Note 2.5	Developing a Drought Management Plan – Guidance for Water Resources Managers
Advisory Note 8.2	Application of GIS in IWRM (in Chinese only)
Advisory Note 8.4	Inter-agency Agreements for Collaborative Water Quality Management

Where to find more information on IWRM – recommended websites:

Ministry of Water Resources: www.mwr.gov.cn

Global Water Partnership: www.gwpforum.org

WRDMAP Project Website: www.wrdmap.com

China – UK, WRDMAP

Integrated Water Resource Management Documents
Produced under the Central Case Study Documentation Programme of the GoC, DFID funded, Water Resources Demand Management Assistance Project, 2005-2010.

Documents will comprise of:

Thematic Papers

Advisory Notes

Manuals

Examples

Training Materials

IWRM Document Series materials, English and Chinese versions, are available on the following project website

WRDMAP Project Website: www.wrdmap.com

Advisory Services by : Mott MacDonald (UK) leading a consultancy team comprising DHI (Water and Environment), HTSPE (UK), IWHR, IECCO (Comprehensive Bureau), CIAD (China Agricultural University), Tsinghua University, CAAS-IEDA, CAS-CWRR, Gansu WRHB and Liaoning WRHB.

8. Inform-ation Exchange

中国水利 CHINA WATER

DFID Department For International Development

Mott MacDonald