AltWater Guidance Document 1

Guidelines for baseline assessment of water supply and demand, and for the collection of institutional data

Janez Sušnik, Assela Pathirana, Saroj Sharma, Andres Cabrera, Klaas Schwartz, Françoise Bichai (UNESCO-IHE)

1. Introduction

This document serves as an initial guidance for the assessment of baseline (present day conditions) water supply and water demand. The document will guide stakeholders through the assessment of supply and demand sources/users, as well as the assessment of the volumes of water supplied to cities and demanded by the cities. This document also serves as a background and overview for the training sessions that will be organised in Maputo and Surabaya in early 2017 as part of the AltWater project. In addition, we introduce the data to start collecting to facilitate an institutional analysis of the water system. It is not intended as a comprehensive methods protocol, but as an introductory text that lays out what data are required in order to begin the assessment process. The concepts outlined here will be elaborated in more detail during these workshops and can be tailored to partner requirements. Where possible, spatial data in GIS map format should be obtained in order to facilitate more detailed spatial assessment of water supply and demand. The next guidance document will focus on estimation of future water supply and demand.

2. Assessment of water supply

Water supply for current (baseline) conditions should be assessed according to two metrics:

a) water sources;

b) water volume.

While water quality is important, it is not a key focus of AltWater. However, certain information would be useful in order to better assess alternative water supply sources. This is because the cost of supply is strongly related to the type of treatment required.

Therefore, as a minimum, it would be good to know:

i) what treatment is carried out and what treatment stages are applied for water supply (this will depend on end use and water source quality/condition);

ii) whether these stages differ for different water sources (if applicable), and;

iii) whether or not water meets minimum national water supply standards for quality, and what your quality assessment procedures are.

a) Water sources

Funded by

Ministry of Foreign Affairs of the Netherlands

Regarding water sources, all sources that contribute to current city water supply should be accounted for. These sources may include: surface water (from rivers, reservoirs or lakes), groundwater (from nearby or distant aquifers), (interbasin) water transfers, and existing alternative water sources. These alternative water sources can include, but are not limited to: desalinated water, rainwater harvesting (usually collected from a roof during rainfall events), stormwater harvesting (e.g. collection of overflow runoff from storms), and wastewater treatment and re-use. Informal water supply should also be considered. AltWater focusses on the assessment of alternative water sources, so it is important to know if any alternative sources already exist in order to be able to assess the impact and effect of potential future developments, and assess gaps in current practice. It also provides a good measure of knowing which alternative sources will be more readily accepted.

A list of essential information to collect includes:

i) the location and type (river, groundwater, etc.) of the source;

ii) the distance from the supply area in the case of surface water supply, and any elevation changes, or for groundwater, the distance from the supply area and the depth of the aquifer (if there are considerable elevation changes, is this gravity fed, or pumped);

iii) flow rates of the river(s) and/or safe yield of the aquifer(s);

iv) the number of wells or intakes (including an estimate of illegal wells if possible and where relevant);

v) if multiple sources are used, information on the seasonal/yearly variation for each source.

Information on water sources should be known to local city water utilities, councils and local academic experts. Please use your networks in order to gather this information for your cities.

When considering spatial data, the sources and which regions they supply could be included, as well as information on elevation differences, distances to the supply centre, use of the source, and so on.

b) Water supply volumes

For each water source, an estimate of the water volume contributing to urban water supply is required. By summing each source, we get a good idea of the total urban water supply. For traditional supply sources such as rivers, lakes and groundwater, local water utilities and companies will have a good idea of total supply volumes from each source. Again, please use your networks to collect this information. Likewise, the supply volumes from desalination plants (where applicable) are also well known the plant operators and utilities. In the case of alternative sources already being implemented, consulting with the operators and users of these systems will provide an initial estimate.

Again, a list of essential information to collect includes:

i) average volume of water supplied from each source (in m3/day, m3/month, m3/year);

ii) monthly and/or seasonal variations in supply (if any);

iii) total population serviced/covered by the water supply system, and what fraction of the population is served by which source;

iv) service level information, including number of hours of supply per day, types of service (household, public standpipe, kiosk, etc.), level of coverage in the population;

v) information on peak factors would also be useful. For example, a utility's average capacity may be ample, but they may have trouble supplying everyone at peak times.

If you are aware of some alternative sources already being used (so not for the future, but already implemented), here we provide two simple examples to estimate their contribution, unless you already have a good estimate of this supply. If it is not being used at the moment, you can ignore this section. As an example for other alternative water supply systems, some calculations to estimate potential supply may be needed. For example, potential surface stormwater runoff can be estimated using surface area, soil types and the 'curve number' to feed into the Soil Conservation Service methodology. However, this can be data intensive. GIS software is required to process data including: rainfall, surface area, land use and soil type/texture. The Curve Number is estimated, then the stormwater runoff can be estimated. The general process is as follows:

i) delineate the area of study and estimate the area (for example using ArcGIS or other GIS software);

ii) obtain a soil map (from local survey departments) and overlay with the study area boundary. If there is more than one type, calculate the area of each soil type and the percent as a total of the area. The hydrological soil group (HSG) should be identified for each type;

iii) obtain a land use map (from local survey departments) and overlay with the study area boundary. If there is more than one type, calculate the area of each land use type and its percentage;

iv) obtain a digital elevation model (DEM; freely available at 30 x 30 m from USGS) and overlay with study area. Process the DEM to extract only the study area and to obtain a slope map.

v) the curve number can now be obtained for each HSG from the manual TR 55 (1986).

vi) if there is more than one soil type in the area, then a weighted curve number can be calculated using the following formula:

$$CN = \frac{\sum(CNi \times Ai)}{A}$$

Where, CN= weighted curve number.

CNi= curve number from 1 to any no. N.

Ai= area with curve number CNi

A= the total area of the catchment

vii) the potential stormwater runoff can be estimated. The above information is computed using the Soil Conservation Service model method for estimating runoff of the catchment (Gajbhiye, 2015).

UNESCO-IHE Institute for Water Education
Global Partnership for Water and Development
Funded by
Ministry of Foreign Affairs of the Netherlands

$Q = (P-0.3S)^2/(P+0.7S)$

Where:

$S = (25400/CN) - 254$

and, Q= Runoff depth (mm)

S= Maximum recharge capacity.

CN= Curve Number

P= Rainfall depth (mm)

Calculations are then used to estimate the potential runoff or storm water contribution.

Rainfall data, to obtain the rainfall depth, if not available locally, can be obtained from the following link:

http://sdwebx.worldbank.org/climateportal/index.cfm?page=global_map

You just need to select your country to obtain the data.

These calculations give an estimate of the maximum potential runoff generated for a given rainfall depth. The reality may be lower.

For rainwater harvesting estimates (again for those situations where this is already being used. If it is not being used at the moment, you can ignore this), annual rainfall totals (and if possible monthly rainfall data) are required, as is information on a) the rooftop area in the city (this can be extracted from the open-source OpenStreetMap service); b) the proportion of rainfall that can realistically be captured and; c) the proportion of people implementing such practices.

It is important that these numbers for the base are as accurate and reliable as possible, although some uncertainty is expected, so please be explicit and include any assumptions, estimates, or other methods used to arrive at these numbers.

Other methods are available, but the two described above are relatively simple and require little data.

3. Assessment of water demand

In addition to the water supply to the city, an estimate of water demand is also required. As with supply, this can be split into two categories:

a) water users;

b) water volume.

a) Water users

It is important to know who the main water users are within a given area such as a city. Water users can include: domestic users, industrial/power generation, municipal/commercial (including hotels), agricultural users, environmental users and so on. It is likely that the main water supply utility companies and/or agricultural and environment ministries will have good data regarding water users within a city, so use your networks and expertise to gather this information.

b) Water demand volume

As with supply, two things are required – 1) the water demand for each category of user and 2) the total water demand. Additionally, information on the existing level of water losses in the distribution system (non-revenue water (NRW) or at least leakage) is required as it affects the total water demand. For water demand, fewer calculations are required as for supply. Water utilities will have a good idea of supplied water, which will give a useful first order approximation. However it must be realised that supply does not equal demand. Sometimes utilities may not be able to meet actual demand, or the demand cannot be met due to leakage in the system. In addition, some utilities may not cover an entire urban area. This demand may also be available per user type depending on metering and connection information. Please consult your local networks in order to obtain information on baseline water demand volumes.

If data are not available from local sources, simple estimates can be arrived at. By knowing the population, and the number of industries, shops, hotels, etc., a rough estimate of demand can be obtained. By knowing the average (daily/annual) water demand per person, or per industrial unit, or per hotel etc., (or by using utility-standard figures for such demand based on connection type) then by multiplying the total population, number of industrial units, hotels, etc., with the average demand per type, then an approximate value for daily/annual water demand can be obtained. This will not be as accurate as data from the utilities, but will provide a reasonable first estimate.

4. Institutional analysis data

For the institutional analysis of your water system, we hope to collect and analyse information regarding the legislation, policy and plans, organizations, responsibilities and coordination arenas.

- **Legislation**: The specific legal framework (laws, regulations, etc.) that governs the water sector is a key aspect for the baseline.
- **Policies and Plans**: this set of data refers to the governmental and organizational documents (policies and plans) which describe the desired goals and objectives for the water sector within a mid- to long-term timespan. These policies can include countries' overall development plan, specific water laws, and environmental considerations which are of relevance for the water sector.
- **Organizations:** Which organizations are involved in different stages of the water cycle?
- **Responsibilities**: Once the different organizations have been identified please indicate what the responsibilities of these organizations entail. These responsibilities may concern legal and policy making/planning responsibilities or may be more operational in nature.
- **Coordination arenas**: as decision-making, consultation, and discussions on how water services are (and should be) provided can occur in various different arenas with varying

stakeholder groups – for example: ministerial meetings, academic conferences, and community projects – please indicate and describe the arenas in which organizations meet to discuss and decide about water management issues.

- **Institutional Challenges/Issues/Opportunities** – Under this final heading please describe the main institutional challenges, issues or opportunities that characterize the water sector? These may concern a wide variety of topics such as organizational and human resources capacity, financial resources, coordination between organizations, political priorities of government entities, etc.

Table 1: Institutional baseline

	Legislation (laws, regulations, etc.)	Policies/Plans	Organizations involved	Responsibilities	Coordination Arenas	Challenges/Issues/Opportunities
Water Resources (quality)			1. 2. 3.	1. 2. 3.		1. 2. 3.
Water Resources (quantity)			1. 2. 3.	1. 2. 3.		1. 2. 3.
Water Treatment and Distribution			1. 2. 3.	1. 2. 3.		1. 2. 3.
Wastewater collection and treatment			1. 2. 3.	1. 2. 3.		1. 2. 3.
Wastewater discharge (to receiving waterbodies)			1. 2. 3.	1. 2. 3.		1. 2. 3.

UNESCO-IHE Institute for Water Education
Global Partnership for Water and Development
Funded by
Ministry of Foreign Affairs of the Netherlands