Practice Note #8

GROUND WATER

Water Smart design is the effective planning, design and building of homes, subdivisions, suburbs, towns and cities that are sensitive to the ecological needs of the waterways that are impacted by them.

Water Smart developments aim to mimic natural processes which reconnect neighbourhoods with local waterways and improve visual amenity and quality of life, make better use of all water within our urban areas, seek to protect the ecological health of urban waterways from the potential negative impacts of urban development, and to add value to our water and waterway management activities.

Each Practice Note in this series is designed to give greater detail and specific advice on different aspects of Water Smart developments and devices. The Practice Notes provide reviews of the main design features, advice on installation and maintenance issues, include diagrams and pictures to assist with implementation, and reference useful websites to assist with further research into Water Smart developments.

Some understanding of groundwater is required when implementing Water Smart designs due to the close link that exists between surface water and groundwater and the interaction that drainage measures have with this.

This Practice Note provides a general introduction to groundwater, how urban development impacts on it, and what measures we can take to promote more sustainable management of this important resource.

WHAT IS GROUNDWATER?

Groundwater is water located beneath the earth's surface and is stored in, and moves slowly through, layers of soil, sand and rocks called aquifers. Aquifers typically consist of gravel, sand, sandstone, or fractured rock. These substrates are permeable because they have large connected spaces that allow water to flow through. The speed at which groundwater flows depends on the size of the spaces in the soil or rock and how well the spaces are connected. Water in aquifers is brought to the surface naturally through a spring or can be discharged into lakes and streams. Groundwater can also be extracted through a well drilled into the aquifer.

In the Hunter and Central Coast region there are a number of large, well known aquifers including: Woy Woy Peninsula, Kulnura, Mangrove, Somersby, Tomago Sand Beds, Tomaree and Stockton.

Aquifers exhibit different flow rates which is determined by the aquifer substrate, hydraulic pressure, and water availability. This flow rate significantly influences the extraction methods needed to gain access to groundwater.

UNDERSTANDING GROUNDWATER

In a water cycle context, groundwater provides significant contributions to rivers, lakes, estuaries and wetlands and there are many ecosystems that are dependant on this.

Groundwater is a resource widely used for domestic and commercial purposes and it provides an important source of water supply, particularly in times of drought. Groundwater is used extensively throughout Australia for farming and irrigation and is it used as a drinking water supply in some parts of NSW.

The management of both surface water and groundwater should be integrated to minimise any impacts on the environment and natural water cycle.

USES OF GROUNDWATER

A number of coastal councils include the harvesting of groundwater to supplement town water supplies, which is especially useful in drought periods. The 1995 NSW State of the Environment Report suggests some 200,000 people from over 130 communities, rely on groundwater for their drinking supply. In addition to drinking water, many councils in the Hunter and Central Coast Region utilise groundwater for irrigation of public parks, playing fields, gardens and golf courses. This is illustrated in **Figure 1**.

Domestic or household use of groundwater is practical within coastal sand aquifers where smaller bores (spear points) can be used to penetrate the shallow water table. Generally in areas of porous or fractured rock the groundwater yield is reduced and the water quality is not as good, limiting groundwater use in these areas.

Figure 1: Irrigation of sporting ovals with groundwater is common in NSW, even premier locations like the Blue Tongue Stadium at Gosford benefit from groundwater re-use.

Figure 2: Tomago bore & pumping station owned by Hunter Water (source: Hunter Water)

The Department of Natural Resources advises that ground water taken from individual bores and spear points in urban areas should not be used for drinking water supply, due to the risk of groundwater contamination in an urban environment).

WATER QUALITY & GROUNDWATER CONTAMINATION

Water quality within aquifers varies depending on:

- If the water is from a sand or rock aquifer; and
- The level of impact from neighbouring land uses, such as agriculture, industry, housing estates etc.

Fine sand aquifers generally have poorer water quality, where as sandy coastal aquifers generally have good water quality. Sandy coastal aquifers also have the greatest risk of contaminant due to a increased population in coastal zones where concentrated development and modified land use practices occur. Many aquifers, regardless of the sand / rock matrix they reside in, are unsuitable for use due to concentrations of salt, dissolved metals, calcium, magnesium, sulphates and pH level. Groundwater in Western Sydney has salinity levels in excess of 5,000mg/L making it unsuitable for almost all purposes (SCCG, 2007).

Many land use practices have the potential to impact on groundwater quality and the risk of contamination is high in urban and industrial areas due to issues such as leaky sewers, leaks from on-site sewage disposal systems (septic tanks), infiltration of untreated stormwater runoff, leaking underground storage tanks (petrol stations), chemical spills and motor vehicle use.

As a general rule, the more easily a groundwater supply can be accessed, the greater the potential for contamination of the groundwater supply.

Through the implementation of Water Smart measures, as documented in these Practice Notes, the likelihood of contamination of ground water can be minimised.

GROUNDWATER DEPENDANT ECOSYSTEMS

If the water quality within an aquifer deteriorates, this will impact on the surrounding natural environment which uses this groundwater as a moisture and nutrient source. Groundwater carries a range of dissolved nutrients and organic matter that is often essential to the animals and plants within certain ecosystems.

The importance of groundwater in sustaining certain ecosystems has been identified in four key areas:

- terrestrial vegetation and fauna
- flow in streams
- estuarine systems and
- natural wetlands

Figure 3: Example of a groundwater dependent ecosystem

Changes to groundwater through urbanisation (increased sediment and contaminant loads) or over-extraction of ground water (reducing water availability) can significantly damage natural systems, especially in dry or drought periods.

Urbanisation not only increases contamination of groundwater, but can reduce the amount of rainfall that infiltrates soils due to increased catchment imperviousness – this natural infiltration process is needed to recharge ground water systems. Water Smart designs aim to re-establish the natural surface/ground water connection by reducing impervious areas and treating the surface water.

GROUNDWATER MAPPING

Information on groundwater resources in NSW is provided in the NSW Resource Atlas, which is an online database containing information and mapping on;

- bore distribution
- groundwater availability
- and groundwater vulnerability

The NSW Resource Atlas provides a good preliminary assessment for use when designing medium to large size developments or to identify where specific site constraints are present.

PLANNING, POLICY & LICENSING

The NSW State Government controls the use of surface water and groundwater resources. Extraction of water from creeks, rivers or aquifers (through installation of groundwater bores) requires a licence approval and registration of the bore.

Licensing for the extraction of water enables the government to control the amount of cumulative water removed from the surface and groundwater systems ensuring the sustainable use of water, maintenance of natural flows and reduced risk of contamination. The management of groundwater is administered through the Water Management Act 2000 and the Water Act 1912.

CONSTRUCTING BORES

Generally, there are two different bore construction techniques. The determination on which to use relies on the ground conditions i.e. rock or sand and the desired extraction rate.

Spear Points

A spear point is typically used in coastal sand aquifers, or areas where there is soft ground and a high water table. Spear points are smaller sized wells which deliver reduced volumes of water by utilising a suction pump at the surface which raises the groundwater.

Bores

Bores are typically used in hard, rocky ground conditions. Bores allow for higher flow rates than those provided by spear points and generally will have a larger diameter pipe than used in spear points. Installation of bores typically is more costly than a spear point due to the installation works (through hard rock) and larger equipment and parts required. See **Figure 4** below for an example of a typical bore.

Bores can only be installed by a licensed water bore drilling contractor, and only when a bore license has been issued by NSW Office of Water for its construction. Refer to Useful websites at the end of this Practice Note for further information and frequently asked questions on bores and licensing.

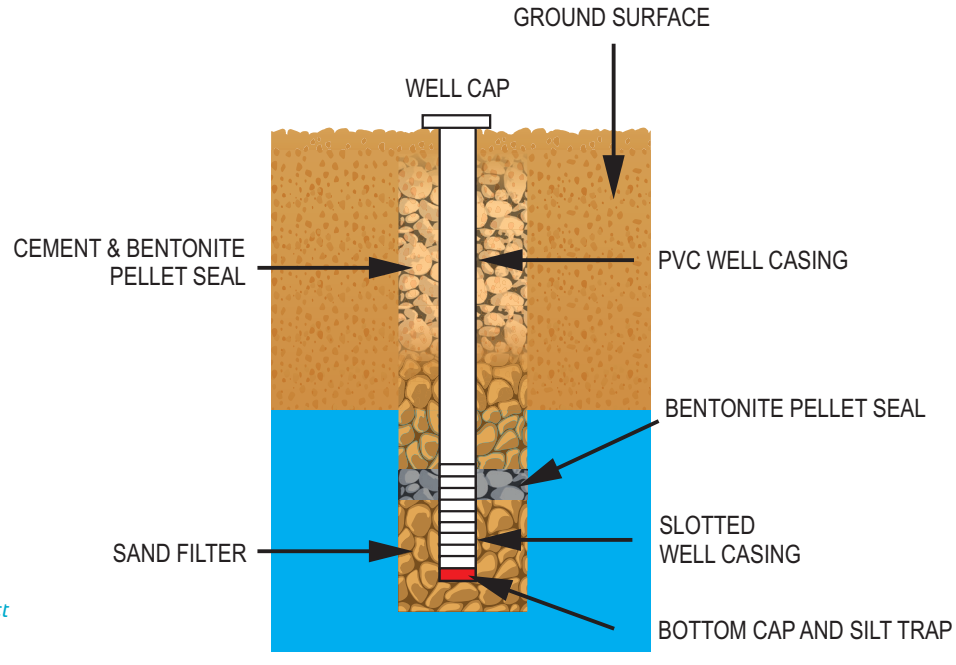

Figure 4: Details of a typical bore used to extract groundwater.

CONSTRUCTING WATER SMART DEVICES

Water Smart measures such as rain gardens and infiltration devices collect and treat stormwater and they can also be designed to infiltrate the treated water to the surrounding soil. This is beneficial in maintaining the surface / groundwater connection and natural water cycle, however there are certain considerations to ensure unwanted impacts on groundwater are minimised. There are also instances when infiltration to surrounding soils is not appropriate – such as when the ground water table is already close to, or at, the surface. Refer to Practice Note 3 – Infiltration Devices, for further information.

An important design requirement for Water Smart measures, particularly for medium to large scale developments, is to ascertain the groundwater depth which can be difficult. The NSW Resource Atlas provides some guidance (www.nratlas.nsw.gov.au) or small scale field testing can be undertaken by excavating a hole at the site of interest. The water table will generally fluctuate throughout the year depending on seasonal conditions and rainfall rates. A conservative approach is to undertake investigations during the wetter period of March to August when the water table is likely to be closer to the surface.

Water Smart measures such as raingardens, infiltration devices, porous paving and constructed wetlands require a certain depth before groundwater is encountered. Low lying areas, that become easily water logged after rain, would be unsuitable for locating such features. As a general guide, at least 0.5m depth to groundwater is required for installing Water Smart measures, however this depth should be increased for measures associated with medium to larger developments.

Figure 5 provides a graphical representation of the relationship between the water table and infiltration devices. If the water table is shallower then the infiltration device can be lined to prevent infiltration to the surrounding soil, in this case the outlet should be connected to the site stormwater drainage system

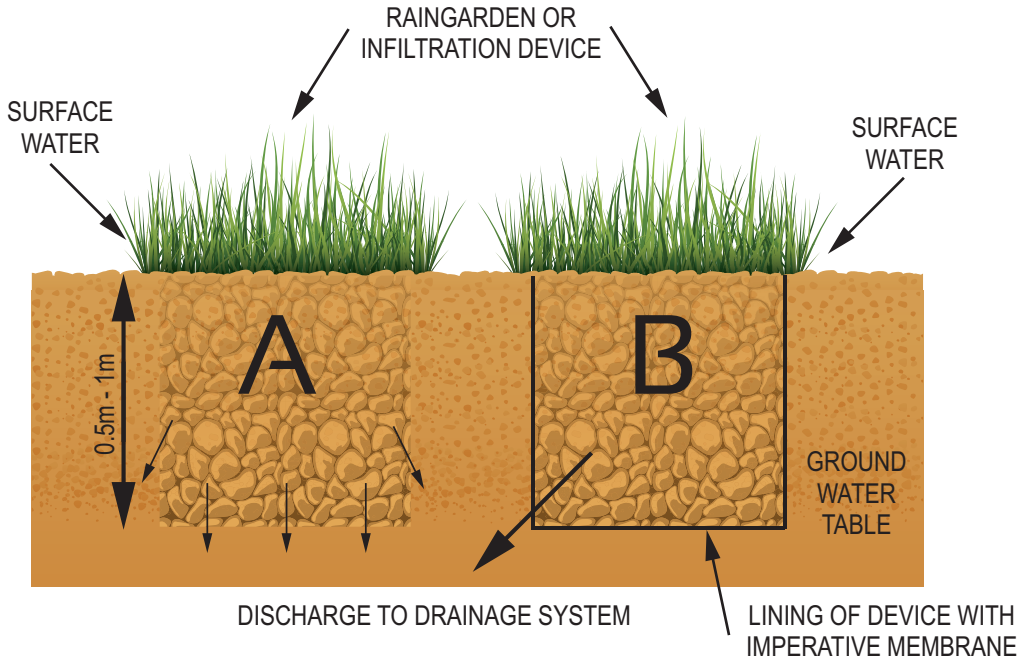

Figure 5 – Groundwater and Water Smart Measures
a) Infiltration to groundwater
b) Higher water table, clay soils or protection of groundwater

USEFUL WEBSITES & GUIDES

Definition:
Definition & general information: by Wikipedia http://en.wikipedia.org/wiki/Groundwater and Answers: http://www.answers.com/topic/groundwater

Groundwater Foundation Television Commercial: http://youtu.be/AHUIcUm0tnw

Groundwater in NSW:
NSW Resource Atlas identifying groundwater mapping: www.nratlas.nsw.gov.au

NSW Government Department of Natural Resources:
Legislation, water access, trading, approvals and licences: www.dnr.nsw.gov.au/water/licensing.shtml

Groundwater Licence: frequently asked questions: http://www.water.nsw.gov.au/Water-licensing/About-licences/Water-Act-1912/act1912_ground/default.aspx

Sydney Groundwater Management Handbook – A guide for Local Government. Prepared by the Sydney Coastal Councils Group Inc. www.coastalcouncils.com.au

General Information:
CSIRO Urban Water Program – search under "groundwater": www.csiro.au/csiro/channel/ich37.html
CRC for Catchment Hydrology – search under "groundwater": www.catchment.crc.org.au

REFERENCES

Hunter Water Corporation, Tomago Sands Scheme, Hunter Water S170 Register Doc No. 3630052. http://www.hunterwater.com.au/Resources/Documents/Heritage-Assets/Local/Tomago-Sands-Scheme.pdf

SCCG, Sept 2006. Sydney Coastal Councils Group Groundwater Management Handbook – A guide for Local Government. First edition September, 2006. Prepared by the Sydney Coastal Councils Group Inc. www.coastalcouncils.com.au

See link: www.nratlas.nsw.gov.au

DEVELOPED BY

A project delivered by the Hunter and Central Coast Regional Environmental Management Strategy (HCCREMS): a program of the Environment Division of Hunter Councils Inc.

This project has been assisted by the NSW Government through its Environmental Trust.

HCCREMS MEMBER COUNCILS

Address for Correspondence:
Environment Division
Hunter Councils Inc.
PO Box 3137
THORNTON NSW 2322
Phone: (02) 4978 4020
Fax: (02) 4966 0588
Email: execassist@huntercouncils.com.au