INTRODUCTION to URBAN SALINITY

LOCAL GOVERNMENT
SALINITY INITIATIVE

Department of
Natural Resources

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Photographs: various sources
Authors: Melissa Ryan formerly DIPNR and Sian McGhie DNR

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Urban Salinity

Urban salinity is a complex issue involving the redistribution of salts, and the impact these salts have on our urban environment. Salts are a natural part of the Australian landscape. Urban salinity occurs in areas where humans have changed natural ecosystems and affected the movement and storage of salts and water in the environment. However, with increasing knowledge and understanding, urban salinity is being managed with appropriate planning, building techniques and materials, as well as salt tolerant vegetation.

The Salinity Process

Urban salinity is caused by a combination of excess water and salt in an urban area, and salt sensitive land uses. The salts can break down materials such as concrete and prevent plants from taking up water.

Salts are present naturally in soil, groundwater, rain and effluent. Additional sources of salt in urban areas include:

- swimming pools
- food products
- fertilisers
- soap and detergents
- industry
- building materials

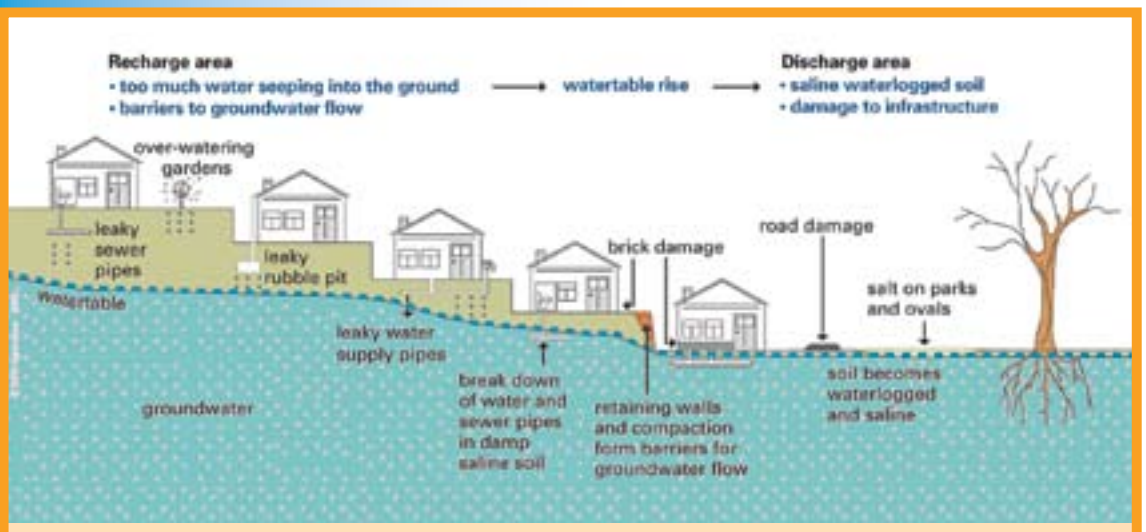
The key to salinity processes is that salts are soluble in water. As water gains access to our buildings and infrastructure, salts can be carried with it. The salts may then chemically react with the building materials causing rust for example. Or when the water evaporates, salt crystal formation leads to physical stress on the building material.

Water from sources such as rain, leaking pipes and pools, and the over-watering of gardens, can add to the natural water cycle and conduct salts into building materials.

Some building methods may also contribute to the development of salinity. Compacted surfaces can restrict groundwater flow and concentrate water and salts in one area. By cutting into slopes for building, groundwater or saline soil may be intercepted and exposed. In addition, fill used to build up an area may be a source of salts or be less permeable, preventing good drainage.

Urban salinity can be a result of some or all of these changes to the storage and movement of salts and water in the urban environment.

Rarely, even at salty sites are white salt crystals as obvious as in this photo. Photo: DNR



This diagram by NSW Department of Primary Industries illustrates many of the ways development may impact on landscape processes and how development may be impacted by salinity processes.

The Impact of Urban Salinity

The movement of excess water and salts in parks and gardens can affect plant growth and even cause plant death. Soil properties can be altered significantly, making it very hard to revegetate areas.

Sports grounds and recreation areas affected by urban salinity may become unattractive and unusable. Pockets of remaining vegetation in and around the urban landscape may also be affected. This can have serious consequences including the disappearance of native flora and fauna and poor downstream water quality.

Urban infrastructure such as roads, buildings, water and sewage pipes can be degraded by urban salinity to such an extent that they have to undergo expensive repair or premature replacement.

Damage to bricks and mortar caused by salinity. Photo: NSW DPI.

Salinity Indicators

Salinity indicators are signs or symptoms that suggest areas have, or have had a problem. The 'Indicators of Urban Salinity '(DLWC 2002) and ' Salinity Indicator Plants' (DIPNR 2005) booklets in the Local Government Salinity Initiative (LGSI)series, deal with this topic in more detail.

It should be noted that the presence of salinity indicators does not guarantee that salinity is the cause of the problem. Further investigation should be carried out to confirm the cause.

There are two main types of salinity indicators - vegetation indicators and building indicators.

- Vegetation Indicators

  The effect of salts on plants varies between species, between individual plants in a species and throughout the stages of a plant's development. Saline water in the soil profile can be toxic to a plant and wilting will occur when water and nutrient uptake is inhibited. Limited water within the plant will reduce the production of food via photosynthesis and will lead to stunted growth. The accumulation of excess salt within plants is toxic and can turn leaves yellow so that a plant's ability to produce food is further reduced. This discolouration may lead to defoliation as the plant can no longer cope with the amount of salt present in its living tissue. Some plants will die.

  As an environment becomes saline, vegetation communities change. Plants less tolerant of salt will die first, leaving only those more salt tolerant. Again, we must be careful not to assume an area is affected by salinity just because there are salt tolerant plants growing on the site. However, when there is a noticeable presence of salt tolerant plants, we can use them as an indicator to suggest salinity has been, or is an issue and then undertake more involved testing to confirm or disprove this.

  Some salt tolerant plants include:

  - Cumbungi (Typha sp.)
  - Sea Barley Grass (Critesion marinum)
  - Annual Beard Grass (Polypogon monspeliensis)
  - Couch grass (Cynodon dactylon)
  - Salt sandspurrey (Spergularia marina)
  - Reed species such as (Juncus sp.).

Salinity indicator plants such as Spiny Rush can tolerate wet and salty conditions. Photo: DNR

Salinity indicators at this site include road damage, sea barley grass, bare soil and salt crystals. Photo: NSW DPI

Salinity indicators at this site include white salt crystals, unexplained water seepage, clear water and salt tolerant plant species. Photo: DNR

- Building Indicators

Buildings affected by urban salinity often have white staining, or efflorescence, where salt crystals have accumulated. A "tide mark" on a building indicates how far water has moved vertically up walls by capillary action. Over time there may be a growth of crystals which destroy mortar and brickwork grain by grain as they expand. Metals may also corrode quickly and roads may rut and pothole faster than expected from normal traffic use. For more detail see the 'Roads and Salinity' (DIPNR 2003) and 'Building in Saline Environments (DIPNR 2003), booklets from the Local Government Salinity Initiative series.

Salinity may cause structural damage to bricks and mortar. Photo: DNR

Render showing signs that excess water and salt are present. Photo: NSW DPI

Tide mark on wall indicating the presence of water. This could be groundwater close to the surface or a leaking pipe. Photo: NSW DPI.

Measuring Salinity

Salts in water or soil conduct electricity. This conductivity is used to determine the concentration or amount of salt in soil or water. The higher the Electrical Conductivity (EC), the greater the amount of salts present.

The extent of damage caused by salts depends on the concentration and distribution of salt as well as the type of salts present. For example, if the salts are deep in the soil profile there may be little contact with building materials unless they are large site excavations or deep service trenches. If the salts are mostly sulphates rather than sodium chloride, their action is more aggressive on common cement.

The severity will also vary depending on a complex range of parameters such as the amount of water available to mobilise the salt, salt tolerance of the vegetation, type of building materials used, and time. A certain level of salts in one area may do little or no damage but the same level of salinity in another area may cause significant damage. The impact of salts on building materials is also dependent on the continual wetting and drying process which concentrate salts, so the rate of evaporation is important as well.

Salt crystals forming under paint on a wall after numerous wetting and drying cycles.
Photo: NSW DPI

Where Does Salinity Occur?

In Australia there are many areas with a salinity hazard ie, physical attributes such as topography, geology, climate and soils that make an area prone to salinity. Land use, land management, vegetation cover and type, affect the likelihood of salinity impacts in these areas, as well as the consequences of the impacts.

There are a number of information sources on salinity hazard. Many of these are listed in 'Broad Scale Resources for Urban Salinity Assessment' (DLWC 2002), a booklet in the Local Government Salinity Initiative Series.

To effectively manage salinity, it is important to understand how salinity is occurring at each specific site. For example, is the predominent cause a rise in groundwater levels, poor drainage, salty soils, impacts of urban land use or a combination of these. Information gained from site investigations may provide an understanding of how salinity may impact upon any planned urban development, and what impacts development may have on salinity processes. The cumulative impacts of development, poor planning, construction and management of developments may over time predispose a non or low saline site to salinity. The 'Site Investigations for Urban Salinity' (DLWC 2002) booklet in the Local Government Salinity Initiative series, provides a framework methodology on how to investigate a site for urban salinity management purposes.

Stormwater detention basin with indicators of salinity impact. Photo: DNR

Water movement affected by the railway line has encouraged salt accumulation at the soil surface. Photo: NSW DPI

Efflorescence on the wall of a public building. Photo: NSW DPI

Salt action has damaged this sandstone wall in central NSW. Photo: NSW DPI

Avoiding the Damage of Urban Salinity

The cost of urban salinity includes:

- repair and maintenance of infrastructure (public and private);
- preventative measures for minimising future damage;
- increased operational costs caused by decreased water quality;
- environmental costs, such as the loss of flora and fauna;
- social costs, such as the loss of amenity, recreation and heritage areas.

For more information on the costs of urban salinity see the LGSI booklet 'Costs of Urban Salinity' (DIPNR 2005)

Heritage buildings can also be affected by salinity. Photo: NSW DPI

Damage to infrastructure depends on the porosity and the mechanical strength of building materials, as well as the concentration and type of salts present. By being aware of salinity and how it can affect our urban infrastructure we can take action to prevent or minimise ongoing costs. If there is potential for salinity, then we need to design, construct and maintain urban infrastructure differently. We can use different quality cement and exposure class building materials to maximise salt resistance. The careful use of a damp-proof course in brickwork and damp-proof membranes below concrete slabs also helps prevent water and salt getting into buildings. By changing water use habits in our gardens and how we dispose of or reuse effluent and stormwater, we can also reduce the risk of salinity.

What is Being Done?

In March 2000, representatives from industry, developers, land managers and community leaders met with government departments to discuss how to tackle the issue of salinity. The result was the NSW Salinity Strategy, launched in August 2000. The NSW Salinity Strategy is a whole-of-government approach to the problem of salinity and involves agencies such as the Department of Natural Resources and the Department of Primary Industries, which are committed to delivering the actions set out in the strategy.

The Local Government Salinity Initiative (LGSI) is one of these actions. The LGSI provides urban salinity training, education and technical support to local government. Local Government is a key stakeholder in urban salinity since it is responsible for infrastructure such as roads, water, stormwater, and sewerage facilities, as well as carrying out planning and development functions.

Catchment Management Authorities (CMAs) are key stakeholders in salinity management. CMAs are regional bodies that work in partnership with farmers, local groups, Aboriginal communities, local government, industry and State Government agencies to develop the best policies and programs for natural resource management at a catchment level. They are also responsible for administering joint State-Commonwealth funding packages, money which goes directly into practical improvement works. CMA projects dealing with urban salinity range from investigations and local government and community water use efficiency projects, to supporting local government formulation and implementation of urban salinity action plans.

Waterwise demonstration garden at Wagga Wagga Botanic Gardens. Photo: DNR

Western Sydney Case Study

The Western Sydney Salinity Hazard map launched in December 2000, and extended in 2002, shows the widespread extent, and variability of salinity hazard in western Sydney. Many groups and individuals are working to ensure the economic, social and environmental impacts of this hazard are minimised.

For example, Councils and agency representatives formed the Western Sydney Salinity Working Party in 2000. This group successfully applied for state and federal funding to undertake several actions including:

- Hiring a salinity co-ordinator
- Developing the Western Sydney Salinity Code of Practice
- Training local government staff
- Developing leaflets
- Running urban salinity conferences.

Work to date has centred around minimising the impact of salinity on new development and minimising the impact of new development on salinity processes.

The Western Sydney Salinity Code of Practice suggests a decision based on

1. salinity hazard of the locality of the proposed development,
2. size of the development, and
3. type of proposed development,

should be used to determine an appropriate level of salinity investigation and management response. This recognises that some activities disturb the vegetation, soil and local water balance more than others and thus have a greater potential of impacting on salinity processes or being impacted by salinity. Also, that there are more opportunities within larger developments to make decisions about layout, density and types of infrastructure suitable for the level of salinity hazard.

- Reducing the amount of water we apply to our gardens to minimise adding to groundwater levels.
- When irrigation is necessary, using a timer and drip irrigation system to limit leakage into the groundwater system.
- Planting a garden of water efficient plants.
- Keeping lawn areas to a minimum.
- Mulching gardens to reduce the need to water.
- Ensuring garden beds are not placed up against walls so that moisture barriers in brickwork remain effective .
- Requesting salt resistant building materials when constructing or renovating a house.
- Maintaining taps, gutters and downpipes so they don't leak.
- Encouraging salinity awareness, understanding and management in the local community.

Salinity damage is minimised to the area below the damp proof course (DPC)in this building. Photo: Campbelltown Council

The LGSI Series

This booklet 'Introduction to Urban Salinity' (DNR 2006), is one in a series on urban salinity. Others in the series include:

- 'Indicators of Urban Salinity' – contains photographs of a range of salinity indicators and explains what might be the cause of salinity.
- 'Broad Scale Resources for Urban Salinity Assessment' – discusses some of the resources available to determine if salinity is, or is likely to be, an issue in a particular region.
- 'Site Investigations for Urban Salinity' - provides a methodology for assessing and quantifying the impact of salinity on a proposed urban development and the impact that development may have on water and salt processes.
- Roads and Salinity – looks at how salt and water processes can affect road structure and decrease lifespan, as well as road strategies to prevent this and minimise the role roads can play in salinity processes.
- 'Building in a Saline Environment' – gives ideas on how to build structures less susceptible to salt damage, explains how salts get into buildings and cause damage, and how these processes can be minimised.
- 'Waterwise Parks and Gardens' - contains information on creating and maintaining sustainable, water efficient landscapes.
- 'Salinity Indicator Plants' - provides a statewide overview of salinity indicator plants.
- 'Groundwater Basics for Understanding Urban Salinity' - presents some basic groundwater concepts necessary to understand urban salinity processes.
- 'Costs of Urban Salinity' - provides a literature review and analysis of existing information related to the economics of urban salinity.
- 'Land Use Planning and Urban Salinity' - presents an overview of the ways land use planning can play an important role at council level in preventing and managing urban salinity.

Booklets from the LGSI series are available from the DNR Information Centre 02 9228 6333, info@dnr.nsw.gov.au or downloaded from the websites www.naturalresources.nsw.gov.au.
www.nsw.shop.gov.au

The Future

Salt is a natural part of our landscape. Salinity is a problem that challenges engineers, designers of infrastructure, government agencies and the community. There needs to be a collective community effort to change current habits that exacerbate salinity. At the same time, more salinity-friendly practices need to be adopted.

The NSW Salinity Strategy provides a framework within which the problem of salinity can be addressed and managed. By knowing how salinity occurs, what salinity looks like, and how to manage it, urban planners and managers will be better prepared when planning new urban developments and managing those currently affected by salinity. The success of salinity control depends on community and development industry action with government support, guidance and education.