Dirk H. R. Spennemann

The Creeping Disaster

Dryland and Urban Salinity and its Impact on Heritage

Natural and anthropogenic disasters exert a continual toll on our historic heritage buildings and it is only prudent to assess the extent and potential impact of these phenomena.[1] The effect of dryland and urban salinity on heritage places is a good example of initially slow acting and then exponentially accelerating anthropogenic disasters.

Human-induced dryland and irrigation salinity and the concomitant losses in agricultural production are problems in many countries of the world.[2] These have also been recognised as a major form of land degradation in rural areas, particularly in southeastern and western Australia.[3] Only recently have government administrators, councillors, and local politicians awakened to the fact that salinity is not just a "brown" (agricultural) issue, but that it also very much affects the towns and communities in rural Australia. Dryland salinity currently affects about 2.5 million hectares of land, mostly in southern Australia. The 1999 Salinity Audit for the Murray-Darling Basin, the largest river catchment covering most of southeastern Australia, found that the current economic impact of Aus$ 46 million (US$ 30 million) per year is likely to increase over the next century to Aus$80 million per year (1999 dollars).[4] Nationwide primary and secondary damage is expected to total Aus$300 million (US$200 million) per year in the next five years.

Nature of the Problem

The human-induced natural disaster is caused by alterations of the water regime of many catchments following either massive land clearing or artificial irrigation. Rising water tables dissolve salts trapped in the rock strata and soil column and create highly saline ground water conditions. Urban salinity has become recognised as a growing problem. Rising ground water tables, coupled with dissolved salts, pose a major threat to the structural integrity of our infrastructure, such as sewers, pipes, and roads, but also sporting fields and parklands.[5] Historic buildings, archeological sites, and now entire historic towns several hundred miles inland suddenly face marine decay conditions.

The walling of stone and brick structures is prone to the ingress of moisture into the fabric. Most frequent are rising damp, where ground moisture is drawn into the masonry surfaces and the mortar bonds by capillary action, falling damp (e.g., leaking roofs, etc.), and penetrating damp (vie dew deposition or ingress by wind pressure). The extent of the damp is determined by the hygroscopic indices of the constituent materials, the availability of moisture, and the degree of evaporation. The level of rising damp (head) can be as high as 4m above ground level.[6]

A damp-proof course is a course of stone or other material introduced between the foundation and the walling, and used to prevent intrusion of water into the wall by means of capillary action. Damp-proof courses were traditionally made of slate, but tar, bitumen, and (today) plastic lining were also used.[7] While these damp-proof courses can decay in their own right, due to chemical decomposition, they more commonly fail due to differential settling of the foundations or are by-passed by inappropriate building alterations or landscaping.

Moisture ingress, per se, does not present a major threat to a structure, but sets up conditions ripe for wet rot of timbers, flaking of renders, moulding of wall papers, and so forth. Compounding the problem of rising damp is that in urban salinity environments soluble salts from the ground water and soluble compounds from the material are carried with the rising moisture to the surface of the building material, adjacent to the external atmosphere. There, the water evaporates and the salts re-crystallise in the pore spaces or on the surface. As crystallised salts

occupy a greater space than dissolved ones they set up great mechanical stress exceeding 138,000 kPa (20,000 psi), causing internal rupturing of the building fabric.[8] In addition, salts attract moisture—and by implication more salts in solution— leading to the growth of salt crystals ("blooms"). Over time, the masonry elements collapse (spall), setting up conditions for structural failures to occur.[9]

Chloridation effects are not confined to structures but affect archeological sites and deposits as well. In general, all porous materials in contact with soil moisture are susceptible to salt attack. Unlike structures, however, small artefacts are usually so thin that the stresses created by the expansion of the salt can cause artefacts to break up. The artefactual material is at risk mainly during the initial moistening phase, when the ground is not yet perpetually waterlogged and the moisture levels in the ground are subject to fluctuations. Once the item has been removed from the saline environment and is allowed to dry, the salts will expand and cause the object to flake, eventually destroying it.[10]

There is a wide range of pottery in the European material culture in Australia, ranging from low-fired irdenware (glazed ceramics) to hard-fired, very homogeneous porcelain. The latter is very much evidence of the economically better off. Since porcelain is impermeable to moisture it will last in immersion in saline or even marine waters, while normal pottery decays in a similar way to bricks. Thus, over time, the salinity will further skew the social representation of our heritage.

Rising damp and salt attack, chimney of cook house, Murray Downs Homestead, Swan Hill, NSW. Note the salt efflorescence at the bottom and the extent of the mortar loss. Photo by the author.

The bulk of the artefactual material in the Aboriginal sites in much of southeastern Australia is comprised of quartz tools. The crystalline structure of quartz allows the ingress of moisture along fissure lines. Seasonal ground water fluctuations can lead to the crystallisation of saline moisture in the quartz resulting in increased fracturing of quartz artefacts while still in place. There is a real prospect of large-scale destruction of archeological material while still in the ground and seemingly protected.

In many cases the historic buildings cannot be divorced from their surrounds as some of the projected cultural values derive from their setting. These cultural landscapes can comprise rural portions, such as vineyards, orchards and field systems, or urban areas. The latter can range from fully-landscaped gardens to purpose-planting of food, herbal and utility trees around homesteads, and from botanical gardens to street tree plantings. In these situations, salinity is likely to have variable effects on the health and viability of individual trees, shrubs, and other plants. Depending on their salt tolerance, some plants will either grow more slowly and become stunted or die, but taken together these effects will demonstrably alter and most likely diminish the character of a heritage place.[11]

Extent of the Problem

Historic structures, which make up the streetscapes and hearts of most rural towns of the Murray-Darling Basin, are certainly at risk.[12] At present the extent of the problem is being analysed in greater detail. One case study has looked at the impact of urban salinity on the built environment of Wagga Wagga, a town situated on the western slopes of southern New South Wales (NSW) approximately 500km southwest of Sydney and 440km north of Melbourne.[13] Wagga Wagga has been one of the first NSW towns to suffer from the consequences of urban salinisation.[14] The extensive land clearing and the area's climate, topography, geology, soils, and vegetation have all contributed to the

increase in salinity in the region.[15] Approximately 60% of the urban area of Wagga Wagga is identified as being at risk of salinity damage.[16] The city's particular susceptibility to salinity problems has been attributed to its location in a constricted catchment and an unstable water table.

Mitigation Options

Historic buildings and monuments are the most immediate and visible aspects of our cultural heritage. They provide links to our shared past and act as emotional anchors in an ever-faster changing present. For that reason, conservation movements the world over are working to preserve those places deemed culturally, historically, and socially significant. It is imperative that the salinity-derived decay processes are halted before the building fabric is severely damaged, because the loss of significant cultural heritage places, which are emotional anchors to our past, has immense social costs.[17] If several less significant places in an ensemble are lost, the character of a town will change. Heritage buildings and streetscapes are tourist attractions which furnish revenue for several places.

The principles of moisture ingress and the impact saline solutions have on the structural integrity of building fabric are well understood.[18] A number of mitigation options exist before and after ingress of saline water has occurred. Most of the strategies are intrusive into the building's fabric, such as repair of a damp-proof course; electro-osmotic systems; high capillarity tubes; inserting moisture-impenetrable floors; injection of a moisture barrier; and perimeter drains.[19]

Institutional Attitudes

This, however, requires that government agencies, communities, and the individual householders are prepared to take action. While the current and projected costs are immense and should place salinity high on the public agenda,[20] many urban communities do not perceive salinity as a major problem,[21] despite public education programs.[22] Often outright denial occurs due to a perceived stigma and a real, or perceived, decline of property values. There is an urgent need for town planners and heritage managers to appreciate the potential dangers posed by dryland salinity and rising ground water tables. But does this happen?

Kristy Koen conducted a limited survey of town planners and heritage managers in the Southern Riverina to assess their awareness of the potential dangers posed by dryland salinity and rising ground water tables to heritage places. The survey encountered a generally low level of awareness, as well as denial that the problem existed in their shire, whilst it was well recognised in the neighbouring shire. Her findings demonstrated the need for a more systematic assessment of the problem across the entire Murray-Darling Basin.

This author carried out a survey of the perceptions of local government heritage managers related to the incidence of salinity and its impact on heritage in 149 local government areas in the Murray-Darling Basin. It showed that salinity is regarded primarily as a rural problem affecting predominantly agriculturally productive land. Urban areas were not seen at risk. In comparison to other threats potentially impacting on the cultural heritage places in the local government areas salinity was seen as one of the least significant threats; in Australia, only extremely rarely occurring earthquakes received a lower ranking.[23] The general level of apathy toward the issue is worrisome.

Outlook

Even though the process of salinisation is slower than that of most natural disasters, the same problems of disaster preparedness and mitigation occur. Because of the slow onset, the perceived stigma and associated loss of property values, most communities are in a state of denial, akin to the social phenomena observed for earthquake preparedness. Unfortunately, this state of denial also extends to the heritage professionals, who, at face value, rightfully contend that techniques exist to treat salt-affected buildings. What most professionals fail to recognise, however, is that the salinisation and rise of the urban water tables will not place one or two buildings at risk, but a large suite of significant structures in a town, and that successively several towns will be affected. Unless planning and mitigation of potential impacts occur before the structures exhibit signs of salinisation, much of the heritage of rural southeastern Australia may be damaged.

Notes

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18 Smith op cit.—Weaver op. cit.—Spennemann op cit (note 9).

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Dirk H.R. Spennemann, Ph.D., is an associate professor at Charles Sturt University in Albury, NSW, Australia, where he teaches cultural heritage management courses in the Parks Management and Ecotourism degrees. His primary research interest is the management of human impacts and natural disasters on cultural heritage sites <dspennemann@csu.edu.au>.