Managing Urban Development for Waterway Resilience

Maurice Mathews, Sunshine Coast Regional Council

We have reached a point in SE Queensland where some of our impacted estuaries are responding to reduction in point source pollution loads (sewage and industrial). However, in other estuaries, such as the Maroochy River, the data show that waterway health is driven by the quality of catchment runoff, rather than point sources. It is my view that, as the population expands, and with the sewage issue increasingly under control, waterway health protection will need to focus increasingly on stormwater runoff quality and quantity, both from the extensive areas under active development, and from built urban landscapes. However the diffuse source catchment pollution issue poses difficulties for catchment managers, not least because it is difficult to quantify both the problem and the sources, so as to justify control measures which will inevitably impact on some sector of the local economy.

Natural aquatic ecosystems have a level of resilience to external stressors applied through contaminated stormwater runoff, such as toxicants, nutrients and sediment. In the case of toxicants and nutrients there are well accepted methodologies for assessing risk and trigger values, however turbidity and sediment pollution and biological response is much more complex: refer Figure 1

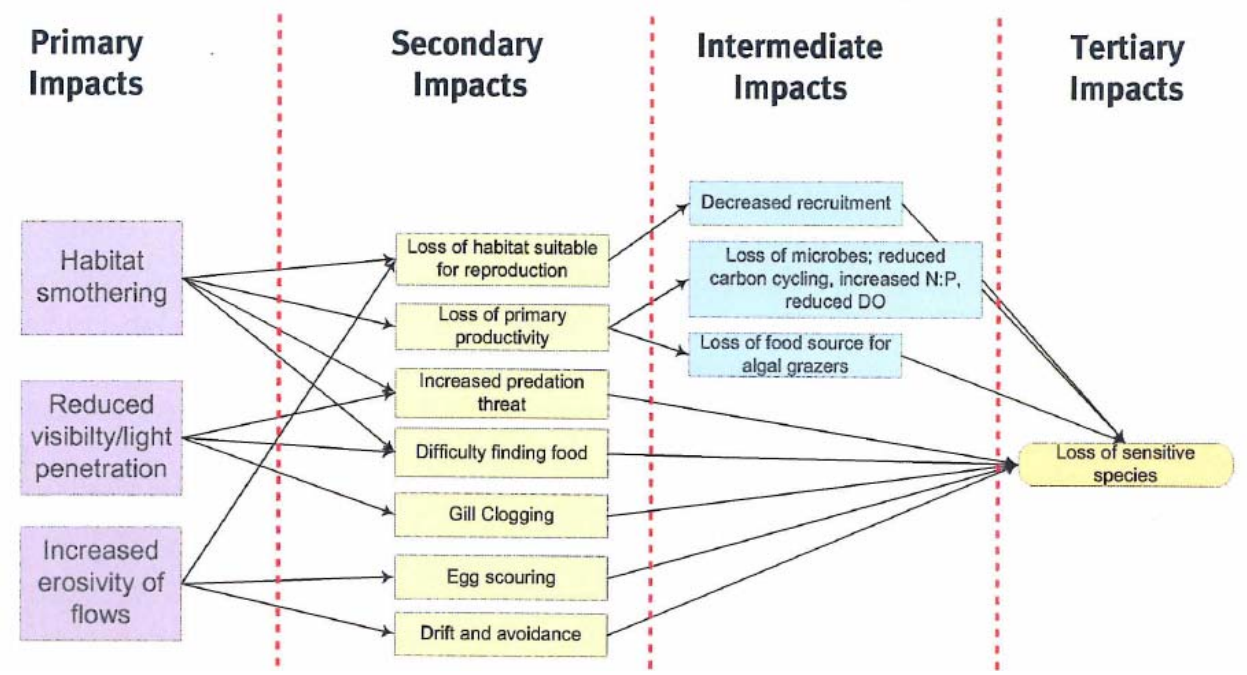


Figure 1 Conceptual model of mechanisms of sediment impacts in freshwater aquatic systems. (Source: Setting Water Quality Objectives for Salinity and Sediment in Freshwater Streams in Queensland Tech Report Jason Dunlop and Glen McGregor QDNRW 2007)

To add to the complexity, turbidity levels fluctuate greatly with the stage of flow, while sediment impacts can be from multiple sources in a catchment and are cumulative over extended time periods. Much of our waterways ambient monitoring is essentially of dry weather conditions, providing little understanding of what loads are coming from where in wet weather, leading to a reliance on modelling approaches, typically with inadequate

local data, to try and understand cause and effect for management purposes. It is not helpful that the state's water quality objectives relate to long term dry weather medians. This is of little value in determining acceptable wet weather limits for land developments, and over what spatial and temporal scales loadings may apply.

What data is available suggests that waterways have a very limited tolerance to turbidity and sediment[1]. Many studies report adverse ecosystem impacts arising from exposure to less than 50 NTU, while one NZ study[2] of the Okura estuary NZ reported that sediment deposition of 25mm over a one week period resulted in 100% mortality of the benthic community, with no recovery after 2 years.

The primary cause of both sediment and turbidity pollution is soil erosion in the catchment. There are a range of government supported programs in inland areas to reduce on-farm soil erosion, and these tend to be well-supported by agribusiness, which has a strong incentive to preserve the value of both its land and water resources.

This is not the case in urbanising coastal catchments where those responsible for land clearing and soil disturbance:- land developers and government infrastructure providers have, with few exceptions, a poor record in preventing erosion, and sediment export to adjacent streams. Measurements of stormwater quality runoff from "best practice" land development sites during even frequent events are typically in the range of 500 to 5000 mg/L total suspended solids, and turbidity 750 to 8000 NTU. As surrounding pastoral lands and forested areas are producing little or no runoff during such events, in-stream water quality, of higher order streams, is dominated by the effect of this construction runoff .

Figure 2 Landscape Change Associated with Rapid Urban Growth in South East Queensland – a new suburb under construction, 2001 - 2008, and stream runoff quality during construction (right) SCRC photos.

[1]: Setting Water Quality Objectives for Salinity and Sediment in Freshwater Streams in Queensland Tech Report Jason Dunlop and Glen McGregor QDNRW 2007)

[2] National Institute of Water and Atmospheric Research Reported in Duration of Construction and Subsequent Water Quality Impacts, Proc Urbanisation and Waterway Health Earl Shaver 2008

The intensification of land use from bushland to rural to urban is accompanied by major

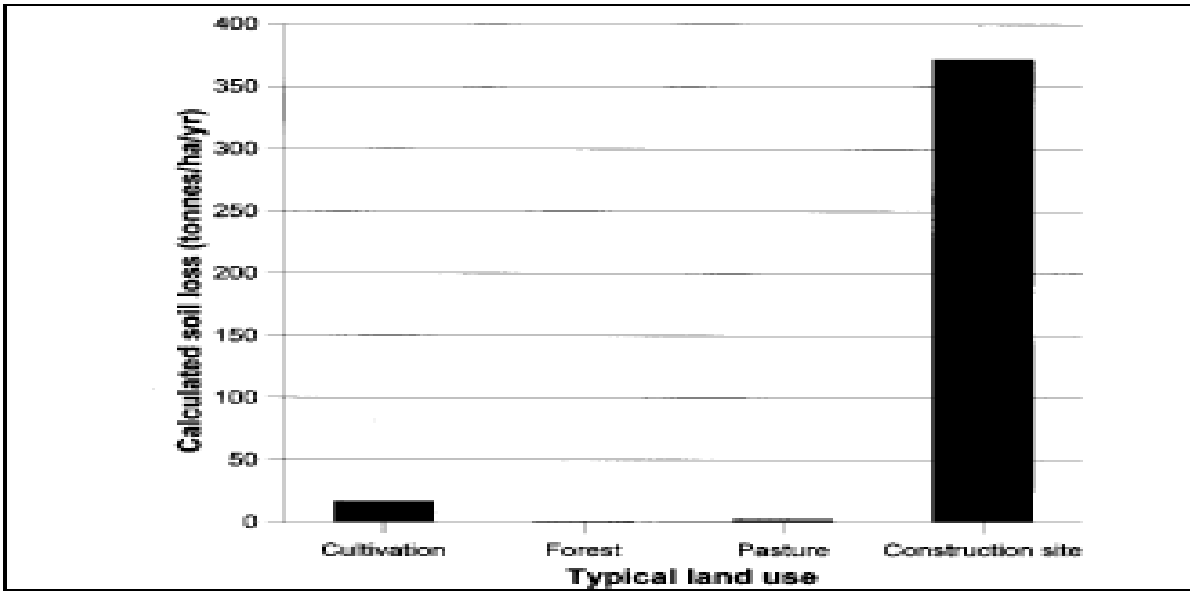


Figure 3 Calculated Annual Soil Losses for Different Land Uses NSW Landcom 2004

changes to catchment runoff quality and quantity. Figure 3 shows calculated annual soil loss for various land uses in a moderate erosion hazard situation.

Most state governments have no effective program involving soil conservation specialists backed by legislation, in place to reduce soil erosion and sedimentation in urbanising areas. Essentially this has been left to local government through the planning and development process.

A conceptual framework for managing urban stormwater quality is provided as Figure 4 below.

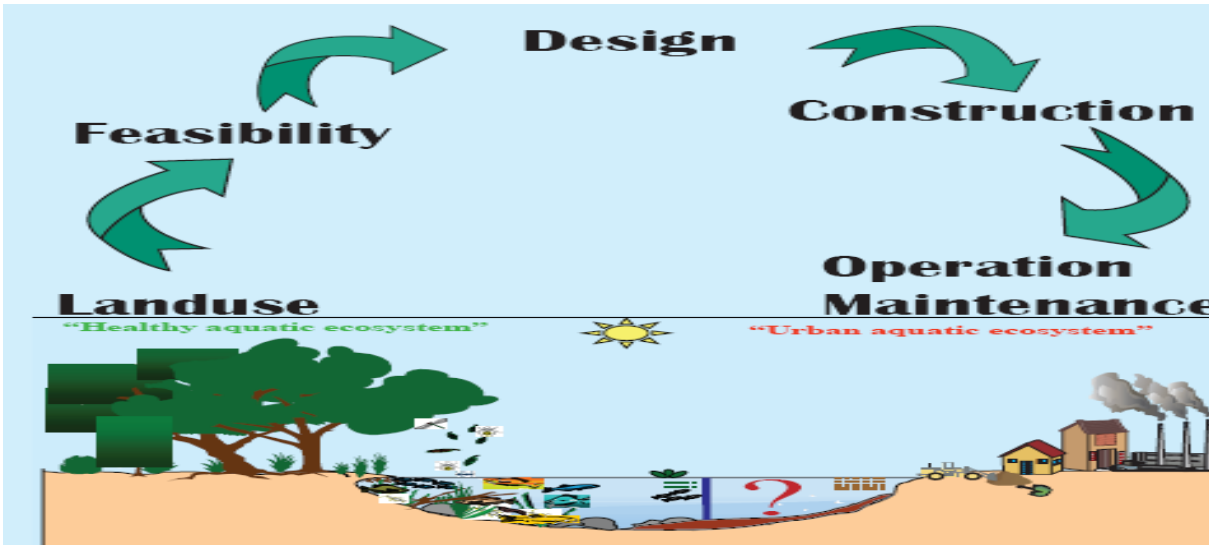


Figure 4 River Health Scorecard Plotted Against Monthly Rainfall

The urbanisation process comprises distinct functional stages:

1. Land capability and land use planning
2. Concept and feasibility
3. Design
4. Construction and asset delivery
5. Operation and maintenance

The way each of these is managed has implications for waterway health outcomes, yet new developments are rarely considered within this holistic framework. These issues also are approached differently by the different disciplines of the “first circle” – strategic planners, civil and project engineers, environmental specialists, development engineers and planners, then asset delivery engineers and, finally, asset maintenance engineers and parks maintenance staff. In the outer circle we have the water researchers and the stormwater industry who are important for our understanding of impacts and best management practices. There is rarely a shared understanding between all these parties.

The waterway health implications of local government’s land use decision-making are not well understood, and are widely not considered at Material Change of Use. Industry in many cases resist carrying out site investigations to determine site constraints such as erosion hazard at early development approval stages (material change of use, and reconfiguration).

This is on the basis that these investigations are expensive, and if approval were refused on some other grounds, the money would be wasted. However - when an applicant receives land use and reconfiguration consent without such studies, and approaches Council later for Operational Works/Construction approval, it is near-impossible to refuse consent on the grounds that the land is then found to be inherently unsuitable for the type or intensity of development, because of eg extreme erosion hazard

Ultimately most Councils fall back on a DA approval requirement to “implement best practice” during Operational Works in accordance with one or other engineering guideline. The upshot is that the industry focus, working in a competitive marketplace, is minimalist compliance with the guideline, rather than on the impact on the receiving water.

In contrast, our Regional Plans and Planning Schemes invariably specify that development must not degrade our waterways or must meet the water quality objectives. Perhaps due to the difficulties outlined above, our primary focus in assessing developments against these objectives has been on the urban built form through Water Sensitive Urban Design and the MUSIC model which give us a good handle on the impacts and management of water **after** the land development phase is complete.. However we have no such methodology for assessing or managing the impacts of the far more damaging land development phase ie land clearing, earthmoving, construction and building.

Water Sensitive Urban Design is an essential component of integrated water management and we need to continue the momentum with its implementation. However it will be of little value if our waterways are already degraded during the construction process.

An analyses of sediment loads over the first 20 years of the life of an urban settlement shows that most of the load comes from construction phase, when the sediment load can be managed most cost-effectively. However government funding for research and capacity building is primarily allocated to the operation and maintenance of the urban built form (ie post-construction).

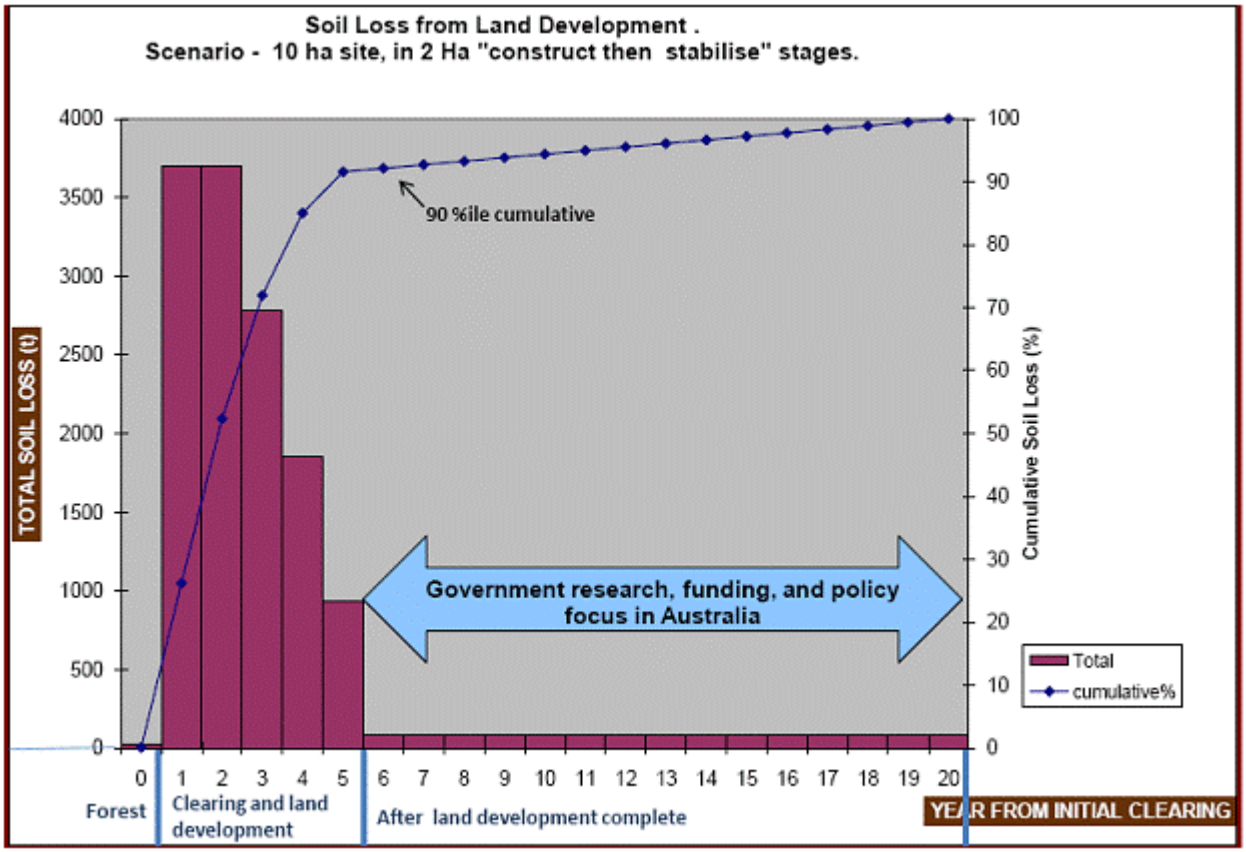


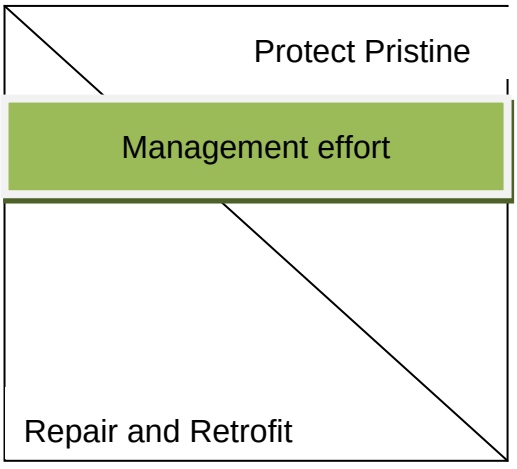
Figure 5 Histogram showing around 90% of the cumulative soil loss over the first 20 year life of an urban subdivision occurs during the land clearing, earthworks and construction period (see also Figure 2).

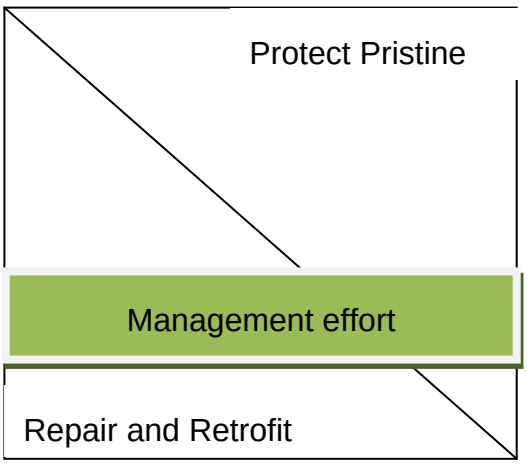
Further, there is rarely any consideration of hydro-modification of streams after land clearing. Once a site is cleared there is a step increase in runoff volumes and frequency, and further increase when top soil is removed and clay subsoils are exposed. Evidence of fresh stream channel erosion is typically evident downstream of construction sites (and new urban settlements). Everything increases again with cut and fill earthmoving and channel works. None of the best practice guidelines currently available adequately address this issue.

Managing for Waterway Resilience

Immediate priorities:

- Implement comprehensive local government and industry capacity building program in erosion and sediment control, with individual modules aimed at each sector eg consulting engineers, civil contractors, etc.
- Develop strategy for integration of E&SC with Water Sensitive Urban Design (WSUD) so that streams are protected throughout the development process, and newly commissioned WSUD features are not damaged by construction sediment.
- Develop better enforcement tools with realistic penalties to discourage poor performance.
- Develop industry partnerships and incentive programs to showcase best practice.
- Provide centralised guidance to local government for optimal institutional arrangements and processes to get better informed land-use decision making, and more effective development management. A major institutional/process issue with local governments is the “silo syndrome” where the part of Council which knows what needs to be done, is not the part that has its hands on the control levers.
- Develop a state enforcement program based on the environmental legislation to provide the environment with a safety net, as local government has intrinsic difficulties in striking a triple bottom line balance when it comes to pressing local political and economic priorities.
- There needs to be federal and state funding support for erosion and sediment control for research into impacts and better technology, and capacity building, commensurate with the funding being allocated to WSUD.
- Develop holistic catchment based strategies for WSUD implementation to give cost-effective outcomes, rather than piecemeal adoption. At the subdivision scale WSUD may be successful, but if the total discharge leaving the new WSUD site is say 1% of the total flow arriving from urban areas upstream , then it`s effect will probably be immediately negligible. However it will clearly still be a worthwhile exercise if the stream is pristine, the catchment has a natural land cover, and further major developments are about to occur and, all those developments will likewise be fitted with effective WSUD controls. The following diagrams suggest different catchment-based management approaches which we might use to decide management priorities.





Prevention in environmental management is almost always more cost-effective than cure (which is often simply not possible). The intended message here is that we need to think beyond process and design, to the wider catchment cost-effectiveness of our actions , bearing in mind what we are trying to achieve.