Appendix 2: Restoration Case Studies

1. Introduction

Over the past 30 years there has been a substantial increase in river restoration efforts worldwide (Alexander and Allan, 2007; Giller, 2005) and this has been accompanied by advances in the science of river restoration (Ormerod, 2004; Roni et al., 2002). There are now a number of useful reviews of restoration which help to identify what makes for successful restoration outcomes and commonly occurring problems. However, despite the amount of restoration activity occurring there are few clear success stories and the scientific basis for restoration is incomplete (Brooks and Lake, 2007).

Restoration in the United States

In the United States there has been an exponential increase in river restoration projects since the 1990s and restoration now plays an important part in environmental management. The National River Restoration Science Synthesis (NRRSS) project has compiled a database of over 37,000 restoration projects being carried out mainly in the United States (Bernhardt et al., 2005a; Bernhardt et al., 2005b). These range in size from small community-based activities reliant on voluntary and 'in-kind' support through to large restoration projects which have been running for decades and involve expenditure of billions of dollars. The picture that emerges is that a comprehensive analysis of restoration progress in the United States is not possible because of lack of records and piecemeal information. Of the 37,000 projects reviewed only 10 percent indicated that monitoring of progress or effectiveness was being carried out, although more expensive projects of the order of about US$1 million were likely to be monitored. This lack of monitoring or sufficient recording of project objectives, budgets or efficacy means that opportunities to learn from project successes and failures are being lost.

Restoration in Europe

In Europe, waterways and lakes have suffered from various forms of control, manipulation and pollution for the past 6,000 years so that there are now few rivers with natural flows and that are in a pristine condition (Nienhuis and Leuven, 2001). In Western Europe eutrophication from intensive agriculture and farming is a particular problem (Gulati and van Donk, 2002). The River Thames in Britain is one of the first well documented cases of successful restoration. The Thames had become seriously polluted by the early 1800s. Restoration started in the 1960s and largely through the building of sewage treatment plants the fish fauna of the river underwent a remarkable recovery (Gameson and Wheeler, 1977). There are now numerous cases of restoration being undertaken throughout Europe (e.g., see reviews in van Andel and Aronson, 2006; Nienhuis and Gulati, 2002). However, river restoration efforts in Europe are often

complicated and compromised, especially for the large rivers because they flow through several countries (e.g., Weiring et al., 2010), and where flood protection and transport are of over-riding priority to restoration (e.g., Buijse et al., 2002).

Restoration in Australia

In Australia the construction of weirs, floodplain levees, dams and inter- and intra-catchment water transfer schemes have had a major impact on natural river systems. Flow regulation affects all the major Australian rivers and such regulation is acknowledged as a major cause of deterioration in many Australian river and floodplain ecosystems (Arthington and Pusey, 2003). There is now a national commitment to ecologically sustainable development and water reform, including restoration.

Brooks and Lake (2007) have collated and synthesized data on restoration projects in Victoria, Australia. Most of the 2,247 projects reviewed focused on riparian management including fencing, off-river watering points (to keep stock out of the riparian zone), native plant revegetation, weed management and willow removal. The rest mainly included bank stabilisation, habitat improvement and channel reconfiguration. Although financial information is often missing, it appears that a conservative estimate of total expenditure (not accounting for 'in-kind' and volunteer support) is that AU$131 million has been spent in Victoria on river restoration over the 1999-2001 period, or AU$44 million per year. Riparian management was the least expensive activity whereas projects involving stormwater management were the most expensive. In rural areas, riparian restoration is seen as an effective way to improve water quality by reducing sediment and nutrient inputs, stabilising riverbanks and limiting channel incision. As found in the United States, records of monitoring are often scarce or incomplete. Of the 2,247 Victorian cases examined, only 14 percent appeared to include monitoring or evaluation but information was inadequate for determining whether monitoring was being carried out to check that construction projects remained intact and that planted vegetation had survived. It was also not clear from the information recorded if monitoring data was used to evaluate the success of the project in achieving the restoration goals. Opportunities to use experience gained from past river restoration is limited. Another problem that has occurred is that organisational restructuring and poor data management have resulted in data and historical information relating to restoration projects being lost.

Restoration in New Zealand

Over the last 20 years there have been increasing attempts at restoration of New Zealand freshwater ecosystems (Quinn, 2009) and guidelines for restoration of aquatic habitats have been published (e.g., Collier, 1994; Rowe, 2004; Sorrell et al., 2004; Suren et al., 2004). Quinn (2009) summarised the range of restoration activities occurring in New Zealand, from individual landowners fencing and replanting along riparian zones

through to nationally significant projects involving Fonterra and the government (Dairying and Clean Streams Accord), and regional coalitions between Maaori and regional and central government, and multi-million dollar budgets (e.g., Lake Taupoo $81.5 million and Rotorua/Te Arawa lakes $144 million). Stream and lake restoration case studies are being documented, and show progress towards many aspirations, on dairy (e.g., Wilcock et al., 2007; 2009) and drystock farms (Dodd et al., 2008 a,b,c; Quinn et al., 2007; 2009). Monitoring of intensive action to restore Lake Okaro has also shown significant benefits since 2003 (e.g., Paul et al., 2008; Özkundakci et al., 2009; Gibbs and Özkundakci, 2010). There are active research programmes on aquatic restoration within New Zealand Crown Research Institutes (CRIs), universities[1] and non-government organisations (NGOs[2]) and there is considerable collaboration between these organisations and with stakeholders.

Restoration and indigenous communities

Worldwide there are now many river restoration initiatives focused on the values of indigenous communities and also benefiting from the input of Traditional Ecological Knowledge (TEK). There are numerous websites and on-line resources available which focus on restoration from the perspective of indigenous peoples.

The **Indigenous Peoples' Restoration Network (IPRN)[3]** operates under the auspices of the Society for Ecological Restoration International[4]. The network's mission is:

- *"to support native and tribal communities in need of technical assistance for environmental restoration and cultural rehabilitation; and*
- *"to assist leaders and practitioners in their efforts to apply traditional ecological knowledge within their own vision of political, economic and cultural sovereignty."*

Their website provides many useful links to databases, resources, references and indigenous groups and organisations worldwide, including New Zealand, Australia and the Pacific Rim.

In the United States, the **American Indian Environmental Office (AIEO)[5]** coordinates the United States Environmental Protection Agency (USEPA) environmental protection efforts in Indian Country, with a special emphasis on building tribal capacity to administer their own environmental programs.[6] The American Indian Tribal

[1] http://www.niwa.co.nz/our-science/freshwater/research-projects/all/restoration-of-aquatic-ecosystems and http://www.lernz.co.nz/index.html
[2] http://www.landcare.org.nz/regional-focus/central-north-island/waikato-lakes-catchments/
[3] Contact with IPRN has been established by Dr Gail Tipa, g.tipa@xtra.co.nz, ph 64 3 4894534
[4] http://www.ser.org/iprn/default.asp
[5] Contact with AIEO has been established by Dr Gail Tipa, g.tipa@xtra.co.nz, ph 64 3 4894534
[6] http://www.healthfinder.gov/orgs/HR3413.htm

Environmental Portal provides specific details relating to environmental policies, practices and laws.[7]

Restoration resources and support

In addition to the resources and networks being developed by indigenous groups, there are now worldwide initiatives to support and encourage river restoration. The following international centres aim to share technical knowledge and resources on river restoration:

Pacific
Australian River Restoration Centre (ARRC)

Asia
Asian River Restoration Network (ARRN)
Japan River Restoration Network (JRRN)

Europe

European Centre for River Restoration (ECRR)
The River Restoration Centre (UK) (RRC)
Danish Centre for River Restoration (Dansk Center for Vandløbsrestaurering – DCVR)
Netherlands Centre for River Studies (NCR)
Italian Centre for River Restoration (Centro Italiano per la Riqualificazione Fluviale – CIRF)

North America

River Restoration Northwest

Project WET[8] is a non-profit organisation which aims to support and educate children, parents, teachers and the wider community on water education.[9] Project WET operates worldwide and achieves its aims through training workshops, organising community events and festivals, and building international networks.

The Queensland-based **International WaterForum** is a joint venture between the International WaterCentre, the International Riverfoundation, the University of Queensland, Griffith University, Queensland Government and Brisbane City Council.[10] Their aim is to improve the business of water and river management by facilitating opportunities for education, professional development, knowledge sharing, networking and recognition of excellence within water and river management. The International

[7] http://www.epa.gov/tribalportal/trprograms/env-programs.htm
[8] Contact with Project WET has been established by Dr Gail Tipa, g.tipa@xtra.co.nz, ph 64 3 4894534
[9] http://www.projectwet.org
[10] http://www.watercentre.org/news/international-waterforum

WaterForum is also responsible for organising the **International Riversymposium**, a conference that focuses on water and river management. The 13th International Riversymposium is scheduled for 11-14th October 2010, in Perth.[11]

Case studies

There are numerous documented cases of river restoration worldwide. Many of these are of little direct relevance to the Waikato River because of differences in climate, hydrology and ecology. The following selection of case studies has been chosen because they provide lessons that could benefit restoration of the Waikato River. They have been chosen because they are good examples of:

- Approaches that can be taken (e.g., Glen Canyon, Columbia River Basin, Willamette Basin, South East Queensland).
- The complexity and expense of restoration projects (e.g., Colombia River Basin, Willamette Basin, Murray River, South East Queensland).
- Restoration of traditional fisheries, important to indigenous communities (e.g., Colombia River Basin).
- Engagement with indigenous communities as part of the restoration process (e.g., Colombia River Basin, Willamette Basin, Murray River).
- Community involvement (e.g., South East Queensland).
- Mitigating the impact of hydro dam operation (e.g., Glen Canyon).
- Regional significance (e.g., Murray River, South East Queensland).

Glen Canyon

The Glen Canyon dam case is an example of where it is recognised that science cannot provide certainty of a desired outcome, and with collaborative input from the community and stakeholders a Collaborative Adaptive Management (CAM) approach was taken (NRC, 1999). The Glen Canyon dam is located on the Colorado River just south of the Arizona-Utah border. The Colorado River then passes through Marble Canyon before entering the Grand Canyon National Park and flowing into Lake Mead, formed by the Hoover dam. The area is home to several American Indian tribes and as well as its cultural importance it has exceptional ecosystem values and is a World Heritage Site. The Glen Canyon dam and its operations have profoundly altered the hydrology and temperature regime of the river with significant effects on the Colorado River ecosystem and the surrounding desert country.

The Glen Canyon dam Adaptive Management Program (AMP) was established in 1997 with the aim of co-ordinating research and monitoring of the downstream ecosystem

[11] http://www.riversymposium.com/

and resources. A Federal Advisory Committee which includes input from stakeholders has responsibility for facilitating the program and making recommendations on actions to improve the downstream ecosystem and resources. Scientific experimentation is integrated into the management actions.

Although the Glen Canyon case had been promoted as an example of the successful application of CAM, it has also been severely criticised by Susskind et al., (2010). They maintain that the programme has failed to increase the understanding of stakeholders and has not resulted in them making informed management recommendations. The result is that it has not stabilised or improved the river ecosystem, despite the expenditure of several millions of dollars over the past 13 years. Susskind et al., (2010) maintain that this failure has arisen because of fundamental flaws in the set-up of the Adaptive Management Program, with only partial stakeholder representation, confused and uncertain decision-making authority and lack of responsibility, and an ineffective dispute resolution process.

Columbia River Basin

The 2,000 kilometres long Columbia River is the largest river in the Pacific Northwest. Its catchment lies within seven United States states and British Columbia, Canada. The river's ecology and resources make a significant contribution to the economy of the Pacific Northwest region. About eight million people live within the catchment basin and the river has 14 hydropower dams. Traditionally, the Columbia River and its tributaries supported the largest salmon fishery in the world. With the extensive development of the river catchment there has been substantial habitat loss and degradation and contamination by chemical pollutants now pose a risk to fish, wildlife and humans[12].

Some of the local Indian tribes regard salmon to be part of their spiritual and cultural identity, and fishing is still the preferred livelihood of many tribal members. Treaties between individual tribes and the federal government acknowledge the importance of salmon and steelhead, and guarantee fishing rights. To mitigate the effects that hydro dams have on fish migration, hatcheries now operate along the river. In 1977 four Indian tribes with treaty fishing rights on the river formed the Columbia River Inter-Tribal Fish Commission (CRITFC)[13] to coordinate their activities in fisheries management and restoration. They have also developed a holistic salmon management plan that aims to increase survival at each stage of the fish's anadromous[14] life cycle.

[12] http://www.cleanwaternetwork.org/sites/default/files/Columbia%20River%20One-Pager%20final.pdf
[13] http://www.critfc.org/
[14] Fish that migrate from the sea up rivers to spawn.

Restoration in the lower river is co-ordinated by the Lower Columbia River Estuary Partnership (LCREP)[15]. This Partnership integrates the restoration activities of multiple stakeholders from 28 cities, nine counties and the states of Oregon and Washington. They also have responsibility for implementing the Comprehensive Conservation and Management Plan for the Lower Columbia River.

The United States Senate is currently considering legislation that would authorise the United States Environmental Protection Agency to provide clean-up technical assistance and help to river stakeholders (including state and local agencies, tribal governments, industry, landowners and environmental groups). The legislation would also authorise a budget of US$40 million annually.

Willamette Basin

The Willamette Basin restoration programme has many parallels with the Waikato River restoration proposal. The Willamette River is 301 kilometres long and is a major tributary of the Columbia River, draining a densely populated region of the Pacific Northwest of the United States. The river and its tributaries form a basin called the Willamette Valley.

The area has been home to several American Indian tribes for at least 10,000 years, many having a close association with the river and depending on it for food, clothing, tools, transportation and spiritual sustenance. Widespread development and increases in population over the past few hundred years has resulted in the river becoming seriously polluted. Fisheries have declined and the water was unsafe for drinking or swimming.

Faced with continuing catchment basin development and a growing population the Willamette Restoration Initiative (WRI) was charged with developing the Willamette Restoration Strategy (WRI, 2001). The strategy sets out to:

- protect and restore fish and wildlife habitat;
- enhance populations of other declining native species;
- improve water quality; and
- improve management of floodplains.

The Willamette Restoration Initiative's activities are controlled by a board of directors, selected to represent the various interests and perspectives of the wider community, including those of local Indian tribes. The board has representatives of local government, utilities, tribes, academia, watershed groups, soil and water conservation districts, agriculture, forestry, environmental groups, and state and federal government.

[15] http://www.lcrep.org/about-us

The strategy was developed through a collaborative process and represents a holistic, integrated action plan. It incorporates existing restoration initiatives and builds on the existing knowledge of the system. It incorporates a variety of restoration approaches and by recognising the multiple and diverse values held by stakeholders, it attempts to balance the goals of a healthy environment, a high quality of life and a strong economy.

The strategy has identified 27 critical actions which fall into four restoration focus areas of:

- clean water;
- water quantity;
- habitats and hydrologic processes; and
- institutions and policies.

The strategy provides ways to measure restoration progress and to determine if the critical actions are achieving the restoration outcomes intended. Importantly, although the strategy provides a foundation for action, it is recognised that a flexible approach is needed and that there needs to be continuous assessment and revision to incorporate improved understanding and possibly changing restoration needs.

An interesting approach taken as part of the Willamette Basin restoration has been the use of alternative futures analysis (Baker et al., 2004). This involved modelling three alternative scenarios which captured future landscapes for the year 2050, based on different development options. The Plan Trend 2050 scenario assumed that current policies and trends continue. The Development 2050 scenario represented a loosening of current policies and a market-driven approach. The Conservation 2050 scenario assumed that ecosystem protection and restoration were accorded higher priority, although still within the bounds of what stakeholders considered realistic. The modeling results have been used to guide the basin-wide restoration strategy.

Restoration of the Willamette basin is recognised as being extremely complicated and requiring long-term commitment. Recent estimates just for restoration of streamside vegetation and streamside habitat throughout the Willamette basin ranged from US$593 million to US$1.2 billion (Michie, 2010).

Murray River

Restoration of the Murray River is Australia's largest river restoration project and is one of the largest restoration projects in the world. The Murray River is 2,756 kilometres long and runs through the three states of Victoria, New South Wales and South Australia. It is navigable for 1,986 kilometres, has four dams, 16 weirs and 15 navigable locks and

provides domestic water supply for over 1.5 million households. Aboriginal occupation along the river goes back 40,000 years.

Flow regulation of the river was introduced to make the supply of water more reliable but it has significantly changed the river ecosystem and water quality has deteriorated. Native fish have declined in numbers and in range, vegetation has been affected and some areas of land have become affected by salt. In 2002, in response to this deterioration the Murray-Darling Basin Ministerial Council established the Living Murray program.[16]

The Australian, New South Wales, Victorian, South Australian and the Australian Capital Territory governments together made an initial commitment to the Living Murray Project of A$500 million over a five year period from 2004–05 and a further A$150 million over eight years. The Living Murray has established five programmes through which to direct restoration activities:

- **Water Recovery,** which addresses over-allocation of water resources in certain parts of the River Murray system and reclaims water for delivery to icon sites.
- **Water Application,** which ensures that water is delivered to achieve ecological benefits at the icon sites.
- **Environmental Works and Measures,** which aims at developing infrastructure which will help make the best use of water in the River Murray system.
- **Communication and Community Consultation,** which will ensure that local communities, key stakeholders and the public are able to receive information and offer their input.
- **Indigenous Partnerships,** which establishes a partnership programme so that the social, spiritual, cultural, environmental and economic interests of indigenous communities are considered.

South East Queensland[17]

The South East Queensland Healthy Waterways project has several useful parallels with the Waikato proposal especially in the terms of partnerships and collaboration, capacity building, monitoring and reporting. The project was initiated to address concerns about degrading water quality in the waters of Moreton Bay and inland waterways. Deteriorating water quality was linked to sewage discharges, and run-off and deposition of fine-grained sediments into Moreton Bay.[18]

[16] http://www.thelivingmurray.mdbc.gov.au/index.html
[17] Contact with the SEQ Healthy Waterways project has been established by Dr Bruce Williamson, Diffuse Sources, bruce.williamson@diffusesources.com, ph 64 3 5484342
[18] http://www.healthywaterways.org/HealthyWaterways/Home.aspx

Fundamental to the project is the SEQ Healthy Waterways Partnership, a collaboration between government, industry, researchers and the community. In many ways, the approaches that are being taken are unique. The partnership includes representatives of seven state agencies, three national agencies, four state corporations, 11 local governments, 37 industries, nine research institutes and 40 community and environmental groups. Together they developed a restoration strategy which includes 12 action plans based on a combination of issue-based, enabling and area-based plans:

Issue -based action plans

- Point Source Pollution.
- Non-Urban Diffuse Source Pollution.
- Water Sensitive Urban Design.
- Protection and Conservation.
- Coastal Algal Blooms.

Enabling action plans

- Ecosystem Health Monitoring Program.
- Communication, Education and Motivation.
- Management Strategy Evaluation.

Area-based action plans

These focus on Moreton Bay and three separate catchments.

In total there are over 500 actions in the strategy that the partners have committed to implementing.

Another important aspect of this project is the Ecosystem Health Monitoring Program (EHMP). It is one of the most comprehensive marine, estuarine and freshwater monitoring programs in Australia and delivers a regional assessment, or Report Card, of the ambient ecosystem health for each of 19 catchments, 18 river estuaries and Moreton Bay.

Dam decommissioning and removal

With the large number of dams affecting river ecosystems in the United States, attention has turned to the option of their removal or ways of mitigating their impacts (e.g., Donnelly et al., 2005; O'Connor et al., 2008). The Federal Energy Regulatory Commission (FERC) has mandated changes in hydro dam operation to address environmental conditions including increased minimum flows, improved fish passage (both upstream and downstream), periodic high flows and riparian protection measures. Where mitigation cannot be achieved, dam removal is now seen as a legitimate option for

consideration, especially where fish passage needs to be improved. Examples of successful dam removal have occurred in the United States, Canada, and Europe.

Although there are more than 75,000 listed dams in the United States (greater than 1.8 metres high), there are also an estimated two million smaller dams (Shuman, 1995). As such, the majority of dams that have been removed and are currently being considered for removal are relatively small, non-hydroelectric dams, particularly run-of-river structures. It is estimated that since 1912, 750 dams have been decommissioned with the rate increasing in recent years (O'Connor et al., 2008). It is important to note however that in the United States many of the structures being removed have reached the end of safe operational life or are obsolete. For example, there are many dams built in the 1800s to power textile mills which have now ceased to operate. The dams no longer serve any useful purpose and their removal is essential if the rivers they dam are to be restored to a natural state.

Lessons from past restoration attempts

Based on the many documented examples of restoration activities, there are some general observations and conclusions that can be made about river restoration, what needs to be considered, what makes for a successful outcome and what needs to be avoided:

1. Restoration is expensive – restoration projects on a catchment scale can typically require budgets of many millions of dollars.
2. Restoration is long-term – it may be several decades before significant restoration is achieved.
3. Collaboration is needed – restoration often requires participation, co-operation and collaboration from many parties including state and local government agencies, industry, universities, and representatives of indigenous groups, environmental care groups, sports groups and the wider community.
4. Build on existing initiatives – attempts should be made to build on existing restoration and environmental management and monitoring activities.
5. Define outcome – the overall outcome that is desired from restoration needs to be defined.
6. Set agreed objectives – it is important to have clearly defined and agreed restoration objectives that will meet the desired outcome, and all partners need to be committed to achieving these.
7. Use traditional knowledge and science – successful restoration relies on incorporating traditional knowledge (in this case maatauranga Maaori) and science. Also, scientific input must incorporate multi- and inter-disciplinary approaches (e.g., drawing on physical, chemical, geomorphological and ecological expertise).

8. Use science – use the extensive and growing body of restoration science to inform actions, monitoring and analysis.
9. Track expenditure and progress – records of expenditure and completion of specific restoration activities need to be recorded and audited.
10. Monitor – progress towards completing restoration activities, achievement of objectives and progress towards the overall outcome need to be monitored and the results publicised.
11. Learn from monitoring – monitoring results need to be analysed to determine the effectiveness of the actions undertaken.
12. Use adaptive management – because the outcome of specific restoration actions will not be reliably predictable there needs to be ongoing review of progress and if necessary modification and resetting of objectives and actions.
13. Outreach – there needs to be easy access to project information, objectives, planned actions, resources and monitoring results to all stakeholders and the community.
14. Plan for the future – restoration projects are typically of a long duration and this needs to be considered when setting up administrative and management systems. Staff turnover and operational restructuring need to be allowed for with robust systems able to survive in the long-term. Planning has to include information security, and backup and archiving. Standardised data systems and mandatory reporting are needed and changes in computing systems need to be considered so that information is not lost.

2. References

Alexander, G.G.; Allan, J.D. (2007). Ecological success in stream restoration: Case studies from the Midwestern United States. *Environmental Management 40*: 245–255.

Arthington, H.; Pusey, B.J. (2003). Flow restoration and protection in Australian rivers. *River Research and Applications 19*: 377–395.

Baker, J.P.; Hulse, D.W.; Gregory, S.V.; White, D.; Van Sickle, J.; Berger, P.A.; Dole, D.; Schumaker, N.H. (2004). Alternative futures for the Willamette River Basin, Oregon. *Ecological Applications 14(2):* 313–324.

Bernhardt, E.S.; Palmer, M.A.; Allan, J.D.; Alexander, G.; Barnas, K.; Brooks, S.; Carr, J.; Clayton, S.; Dahm, C.; Follstad-Shah, J.; Galat, D.; Gloss, S.; Goodwin, P.; Hart, D.; Hassett, B.; Jenkinson, R.; Katz, S.; Kondolf, G.M.; Lake, P.S.; Lave, R.; Meyer, J.L.; O'Donnell, T.K.; Pagano, L.; Powell, B.; Sudduth, E. (2005a). Synthesising U.S. river restoration efforts. *Science 308*: 636–637.

Bernhardt, E.S.; Palmer, M.A.; Allan, J.D.; Alexander, J.; Barnas, K.; Brooks, S.; Carr, J.; Clayton, S.; Dahm, C.; Follstad-Shah, J.; Galat, D.; Gloss, S.; Goodwin, P.; Hart, D.; Hassett, B.; Jenkinson, R.; Katz, S.; Kondolf, G.M.; Lake, P.S.; Lave, R.; Meyer, J.L.; O'Donnell, T.K.; Pagano, L.; Powell. B.; Sudduth, E. (2005b). Synthesizing U.S. river restoration efforts. *Science* supporting online material. http://www.sciencemag.org/cgi/content/full/sci;308/5722/636/DC1

Brooks, S.S.; Lake, P.S. (2007). River restoration in Victoria, Australia: Change is in the wind, and none too soon. *Restoration Ecology 15(3)*: 584–591.

Buijse, A.D.; Coops, H.; Staras, M.; Jans, L.H.; van Geest, G.J.; Grifts, R.E.; Ibelings, B.W.; Oosterberg, W.; Roozen, C.J.M. (2002). Restoration strategies for river floodplains along large lowland rivers in Europe. *Freshwater Biology 47*: 889–907.

Collier, K.J. (ed). (1994). The restoration of aquatic habitats. Wellington, Department of Conservation. 171 p.

Dodd, M.B.; Thorrold, B.S.; Quinn, J.M.; Parminter, T.G.; Wedderburn, M.E. (2008a). Improving the economic and environmental performance of a New Zealand hill country farm catchment: 1. Goal development and assessment of current performance. *New Zealand Journal of Agricultural Research 51(1)*: 127–141.

Dodd, M.B.; Thorrold, B.S.; Quinn, J.M.; Parminter, T.G.; Wedderburn, M.E. (2008b). Improving the economic and environmental performance of a New Zealand hill country farm catchment: 2. Forecasting and planning land use change. *New Zealand Journal of Agricultural Research 53(1)*: 143–153.

Dodd, M.B.; Quinn, J.M.; Thorrold, B.S.; Parminter, T.G.; Wedderburn, M.E. (2008c). Improving the economic and environmental performance of a New Zealand hill country farm catchment: 3. Short term outcomes of land use change. *New Zealand Journal of Agricultural Research 53*: 155–169.

Donnelly, C.R.; King, L.; Phillips, M. (2005). Once removed – decommissioning Finlayson Dam. International Water Power and Dam construction. http://www.waterpowermagazine.com/story.asp?storyCode=2028607

Gameson, A.L.H.; Wheeler, A. (1977). Restoration and recovery of the Thames Estuary. *In:* Cairns, J.; Dickson, K.L.; Herricks, E.E. (eds). Recovery and Restoration of Damaged Ecosystems. The University Press of Virginia, Charlottesville (VA): 72–101.

Gibbs, M.; Özkundakci, D. (2010). Effects of a modified zeolite on P and N processes and fluxes across the lake sediment–water interface using core incubations. *Hydrobiologia*: 1–14, DOI 10.1007/s10750-009-0071-8.

Giller, P.S. (2005). River restoration: seeking ecological standards. *Journal of Applied Ecology 42*: 201–207.

Gulati, R.D.; van Donk, E. (2002). Lakes in the Netherlands, their origin, eutrophication and restoration: state-of-the-art review. *Hydrobiologia 478*: 73–106.

Michie, R. (2010). Cost estimate to restore riparian forest buffers and improve stream habitat in the Willamette Basin, Oregon. State of Oregon Environmental Quality, Water Quality Division, Water Management Section. DEQ 10-WQ-007. http://www.deq.state.or.us/wq/tmdls/docs/WillametteRipCost030310.pdf

Nienhuis, P.H.; Gulati, R.D. (eds) (2002). Developments in Hydrobiology. Ecological restoration of aquatic and semi-aquatic ecosystems in the Netherlands (NW Europe). Kluwer Academic Publishers, The Netherlands. 233 p.

Nienhuis, P.H.; Leuven, R.S.E.W. (2001). River restoration and flood protection: controversy or synergism? *Hydrobiologia 444*: 85–99.

NRC (1999). Downstream: Adaptive management of Glen Canyon Dam and the Colorado River ecosystem. National Academy Press, Washington, DC.

O'Connor, J.; Major, J.; Grant, G. (2005). Down with the dams: Unchaining US rivers. *Geotimes*. March 2008. http://www.geotimes.org/mar08/article.html?id=feature_dams.html

Ormerod, S.J. (2004). A golden age of river restoration science. *Aquatic Conservation: Marine and Freshwater Ecosystems 14*: 543–549.

Özkundakci, D.; Hamilton, D.P.; Scholes, P. (2009). Effect of intensive catchment and in-lake restoration procedures on phosphorus concentrations in a eutrophic lake. *Ecological Engineering*. http://dx.doi.org/DOI:10.1016/j.ecoleng.2009.11.006

Paul, W.J.; Hamilton, D.P.; Gibbs, M. (2008). Low-dose alum application trialed as a management tool for internal nutrient loads in Lake Okaro, New Zealand. *New Zealand Journal of Marine and Freshwater Research 42:* 207–217.

Quinn, J.M. (2009). Special issue on restoration of aquatic ecosystems. *New Zealand Journal of Marine and Freshwater Research (43)*: 653–657.

Quinn, J.M.; Croker, G.F.; Smith, B.J.; Bellingham, M.A. (2009). Integrated catchment management effects on run-off, habitat, instream vegetation and macroinvertebrates in Waikato, New Zealand, hill-country streams. *New Zealand Journal of Marine and Freshwater Research 43(3)*: 775–802.

Quinn, J.M.; Dodd, M.B.; Thorrold, B.S. (2007). Whatawhata catchment management project: the story so far. Proceedings of the New Zealand Grassland Association 69: 229–233.

Roni, P.; Beechie, T.J.; Bilby, R.E.; Leonetti, F.E.; Pollock, M.M.; Pess, G.R. (2002). A review of stream restoration techniques and a hierarchical strategy for prioritizing restoration in Pacific Northwest watersheds. *North American Journal of Fisheries Management 22*: 1–20.

Rowe, D. (2004). Lake restoration. *In*: Harding, J.S.; Mosley, M.P.; Pearson, C.P.; Sorrell, B.K. (eds). Freshwaters of New Zealand. Christchurch, New Zealand Hydrological Society and New Zealand Limnological Society: 39.1–39.16.

Shuman, J.R. (1995). Environmental considerations for assessing dam removal alternatives for river restoration. *Regulated Rivers: Research & Management 11(3-4)*: 249–261.

Sorrell, B.; Reeves, P.; Clarkson, B. (2004). Wetland management and restoration *In*: Harding, J.S.; Mosley, M.P.; Pearson, C.P.; Sorrell, B.K. (Eds). Freshwaters of New Zealand. Christchurch, New Zealand Hydrological Society and New Zealand Limnological Society: 40.1–40.12.

Suren A.; McMurtrie, S.; O'Brien, L.M. (2004). River restoration. *In*: Harding, J.S.; Mosley, M.P.; Pearson, C.P.; Sorrell, B.K. (eds). Freshwaters of New Zealand. Christchurch, New Zealand Hydrological Society and New Zealand Limnological Society: 38.1–38.20.

Susskind, L.; Camacho, A.E.; Schenk, T. (2010). Collaborative planning and adaptive management in Glen Canyon: A cautionary tale. *Columbia Journal of Environmental Law 35(1)*: 53 p.

Van Andel, J.; Aronson, J. (eds). (2006). Restoration ecology: the new frontier. Blackwell Publishing, USA. 341 p.

Wiering, M.; Verwijmeren, J.; Lulofs, K.; Field, C. (2010). Experiences in regional cross border co-operation in river management. Comparing three cases at the Dutch-German border. Water Resources Management. January 2010.

Wilcock, R.J.; Betteridge, K.; Shearman, D.; Fowles, C.; Scarsbrook, M.R.; Thorrold, B.S.; Costall, D. (2009). Riparian protection and farm best management practices for restoration of a lowland stream in an intensive dairy farming catchment: a case study. *New Zealand Journal of Marine and Freshwater Research 34(3)*: 803–818.

Wilcock, R.J.; Monaghan, R.M.; Thorrold, B.S.; Meredith, A.S.; Betteridge, K.; Duncan, M.J. (2007). Land-water interactions in five contrasting dairying catchments: issues and solutions. *Land Use and Water Resources Research 7*: 2.1–2.10.

WRI (2001). Restoring a river of life: The Willamette Restoration Strategy Overview. http://ir.library.oregonstate.edu/jspui/bitstream/1957/58/1/WRS_OVER.pdf