Dredging and Land Reclamation in the Derwent

A guidance document to support Best Practice Management

Derwent Estuary Program

CARING FOR OUR COUNTRY

The Derwent Estuary Program (DEP) is a regional partnership between local governments, the Tasmanian state government, commercial and industrial enterprises, scientists, and NRM based groups to restore and promote our estuary. The DEP was established in 1999 and has been nationally recognised for excellence in coordinating initiatives to reduce water pollution, conserve habitats and species, monitor river health and promote greater use and enjoyment of the foreshore. Our major sponsors include: Brighton, Clarence, Derwent Valley, Glenorchy, Hobart and Kingborough councils, the Tasmanian state government, Southern Water, Tasmanian Ports Corporation, Norske Skog Boyer, Hydro Tasmania and Nyrstar Hobart Smelter.

Contributing authors

The Dredging and Land Reclamation in the Derwent Guidance document has been prepared with the assistance and advice of many stakeholder organisations and individuals. Ruth Eriksen (Aquatic Science) was the primary consultant for developing the document, in partnership with the DEP.

Photo credits front cover

New Town Bay: Derwent Estuary Program

Seagrass: Graeme Edgar

Spotted Handfish: Graeme Edgar

Pied Oystercatcher: Derwent Estuary Program

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Executive Summary

The Derwent Estuary Program (DEP) is a regional partnership between local governments, the Tasmanian state government, commercial and industrial enterprises and community-based groups, focused on restoring and promoting the estuary. The estuary is a significant natural and cultural asset, widely used for recreation, boating, fishing and marine transport. The estuary is affected by a number of environmental issues, including extreme heavy metal and other toxicant contamination, loss of estuarine habitat and threats to associated species.

As part of the management program for the estuary, the DEP released the "*Derwent Estuary Water Quality Improvement Plan for Heavy Metals*" in 2007, funded through the Australian Government Coastal Catchments Initiative. The WQIP included a series of recommendations for management actions to reduce risks associated with contaminated sediments, with the aim of improved management and protection of estuarine habitats and species. A key recommendation was that dredging guidelines and protocols should be developed to avoid disturbance of contaminated sediment.

More recently the DEP has also completed the project "*Sedimentation and erosion control in the Derwent Metropolitan region"* (funded by NRM South). This project provided funds to extend the dredging guidelines to include reclamation by virtue of the common potential environmental issues raised e.g. decline in water quality, impact on estuarine habitat and species, changes to coastal processes and issues with the quality and disposal of fill and dredge materials.

This document aims to provide guidance to decision makers and project managers involved in dredging and reclamation proposals in the Derwent.

Topics include:

- Summary of historical and current level of reclamation and dredging encountered in the Derwent
- Environmental issues associated with reclamation and dredging
- Summary of the planning and assessment processes in Tasmania
- Management of reclamation and dredging projects
- Assessment checklists
- List of Resources

Interviews were held with a group of stakeholders identified by DEP. These included Councils bordering the mid and lower estuary, Crown Land Services, EPA Division, TasPorts, DPIPWE and Marine and Safety Tasmania. A summary of planning processes and schemes, along with relevant State and Commonwealth legislation was prepared as result of the interviews. A series of checklists and flow charts were developed based on local planning schemes and other information pertinent to the assessment of the environmental impact of reclamation and dredging in the Derwent. Guidance on management and assessment is drawn from relevant National protocols and guidelines, and the scientific literature.

Additionally, a series of case studies have been developed in consultation with planning agencies to illustrate a range of activities, key concerns or issues relating to reclamation and dredging proposals and some of the environmental and planning issues encountered. These are available as a separate document to accompany the guidelines, and may be expanded as particular projects progress.

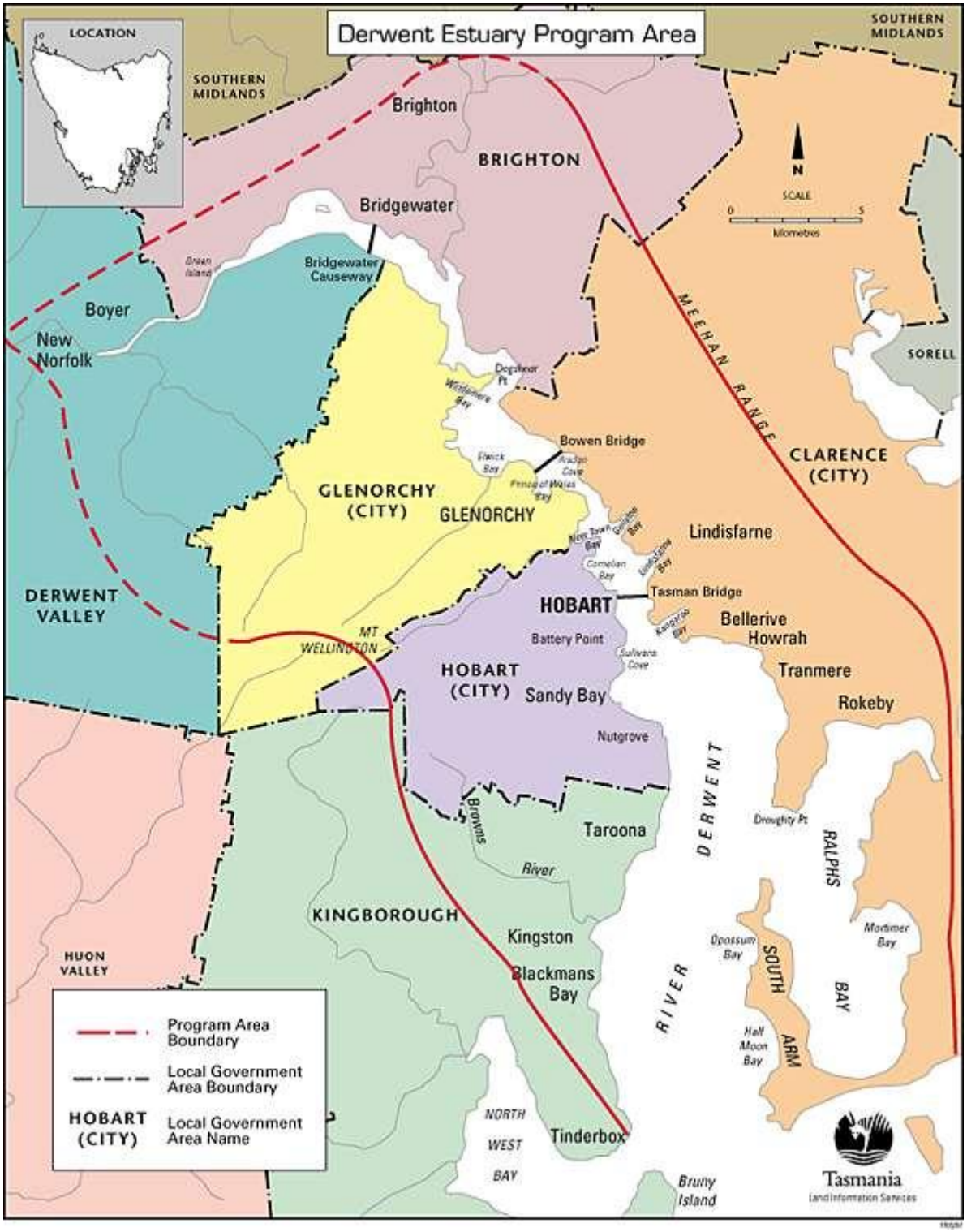


Figure 1 Program boundary for the DEP showing Local Government areas.

Definitions…

The following definitions of reclamation and dredging are drawn from local planning authority schemes and schedules.

Reclamation: *Extension, draining or alteration of the foreshore area into intertidal/sub-tidal areas, involving the filling in of submerged land. Reclamation may involve filling with natural or introduced materials, particularly for the purpose of supporting a building or structure being erected over the land.*

For the purposes of this document, reclamation does not include beach nourishment activities.

Dredging*: An activity undertaken to clean, deepen or widen harbours, waterways or channels for the purpose of navigation, construction, or reclamation. It involves the movement and/or removal of marine sediments. Dredging may be for capital, maintenance or environmental programs.*

PART 1 Dredging and Reclamation in the Derwent

Introduction

Reclamation and dredging are practices most commonly associated with development in the coastal zone, often in areas with intense pressure for competing land uses. Reclamation can include the construction of levees, channels, and canals, the draining and filling of wetlands and other fragile estuarine systems. Some countries such as Singapore, Korea, Japan, Hong Kong, Netherlands and the UK rely extensively on land reclamation to meet the needs of growing populations and associated demand for more industrial and residential land. In Australia, pressure for additional land in the vicinity of major port facilities is often a driver for reclamation activity, particularly in response to growth in major mining and resource processing areas. Residential resort developments and canal type estates also put pressure on the coastal environment.

Dredging activities are primarily associated with maintenance of existing shipping, navigation or access channels (maintenance dredging), or capital dredging projects where there is a need for the construction of new or deeper channels. Land reclamation projects are often developed in tandem with capital or maintenance dredging works, with the dredge spoil used to provide fill material for accreted land.

Reclamation in the Derwent

The Derwent Estuary Program area is shown in Figure 1. Within this area there has been some significant historical reclamation activity, particularly around the Hobart waterfront area around Sullivans Cove, Hunter Street and Macquarie Point in the early 1800's. The remnant "cliffs" visible behind the Private Secretary's cottage on Macquarie Street are all that remain of the original foreshore in Hobart. Elsewhere, low lying foreshore areas and wetlands were typically reclaimed for tips and for commercial and industrial use by infilling. The Kangaroo Bay foreshore sports ground and the Eastlands commercial site for example are located on the site of a former wetland, as is Wentworth Park at Howrah. Former wetlands at Geilston Bay and Lindisfarne Bays are now recreational and park areas. Areas of Cornelian Bay, Selfs Point, New Town Bay, Wilkinsons Point at Elwick Bay and the Boyer paper mill grew from similar reclamation projects. Much of the Derwent foreshore underwent "hardening" as a result of reclamation and intense coastal development (see Figure 2). This is particularly evident in the middle and parts of the lower reaches of the estuary.

A more recent example of attempted reclamation in the Derwent estuary was the agricultural draining of a section of estuarine wetland known locally as Murphys Flats. The wetlands cover an area of approximately 66 hectares, and are included in the Directory of Wetlands of National Importance, as part of a larger complex of wetland extending from New Norfolk to Granton. Further south in the estuary, extensive shoreline modification includes an artificial wetland created at the mouth of the New Town Rivulet to treat stormwater (see Figure 3).

Interviews with Councils indicate that the current level of approved land reclamation occurring in the Derwent is low, with Councils (Kingborough, Hobart, Clarence and Glenorchy) typically processing one or two applications a year. Applications are generally associated with commercial or industrial operations, such as redevelopment of marina facilities, construction of jetties, and extension of available land for commercial or industrial purposes. Some small parcels of land have been reclaimed in residential areas, and these appear to be mostly associated with waterfront access e.g. jetties, boat ramps (see Figure 4) and "creeping" or extension of waterfront land. Reclamation under these circumstances typically occurs in an incremental fashion, and may not always be carried out with the appropriate approvals. There have been several instances where reclamation projects have occurred illegally, or continued outside the scope of the initial approval.

Figure 2 Examples of foreshore hardening in the Derwent estuary.

Dredging in the Derwent

The level of dredging occurring in the Derwent is low compared to estuaries and coastal areas elsewhere in Australia. Victoria for example annually removes in excess of half a million cubic metres of dredge spoil from shipping and boating channels in Port Phillip Bay alone. Dredging in the Derwent is generally associated with smaller projects such as redevelopment or expansion of marinas, or maintenance of deep water access at boat construction facilities. A canal development in Ralphs Bay assessed by the Tasmanian Planning and Commission (formerly the RPDC) as a Project of State Significance would have been the single largest dredging and reclamation project to occur in the Derwent, resulting in a minimum of 900,000 cubic metres of material removed by dredging. The project was not approved (see *Appendix Case Studies*). The redevelopment of Prince of Wales Bay, and the establishment of a Maritime Precinct has been the recent focus of the Department of Economic Development.

Maintenance and capital dredging of ports and navigation waterways in Tasmania is the responsibility of the TasPorts Corporation, however TasPorts Hobart have not undertaken any maintenance dredging in the Derwent in the past 20 years, due to the deep water nature of the port.

Whilst the level of dredging in the Derwent is considered low, large areas of highly contaminated sediments mean that the environmental impacts from dredging and resuspension of sediments are likely to be severe. This guidance document aims to address the need for consistent processes for planning, assessment, monitoring and compliance within the DEP boundary.

Environmental issues associated with reclamation and dredging

The water/land interface is a critical area for maintaining water and habitat quality, and land reclamation or dredging in sensitive areas, or using poor techniques can cause significant disruption to these functions. Potential impacts of reclamation and dredging on the marine, intertidal and foreshore environments are listed below.

Filling in and loss of coastal habitats

The Derwent estuary supports a wide variety of habitat types including seagrass meadows, wetlands, saltmarsh, rocky reefs and tidal flats, as well as riparian vegetation along the foreshore. If unchecked, land reclamation can result in fragmentation, degradation and total loss of "keystone" habitats. Some marine environments are more sensitive than others, for example fish nursery areas, and these areas will require a higher level of protection and management.

Loss of seagrass habitats

Seagrass communities are a key indicator of water quality, and their health reflects the level of pressure experienced due to catchment and coastal activity. Seagrass meadows provide important habitat and nursery areas for many marine organisms, as well as stabilising sand and mud. They are sensitive to poor water quality, including high levels of sediment and turbidity.

Loss of wetlands

Wetlands provide valuable wildlife habitat, fish spawning grounds and nurseries, provide flood and erosion control, and trap nutrients, silt and contaminants by acting as natural filters. Reclamation in wetland areas can significantly impact ecosystem function.

Changes in currents, sediment transport and other coastal processes

Constructed land may modify siltation and sediment movement as natural currents and sediment transport patterns are disturbed. Significantly altering the shape and nature of foreshore areas through reclamation may have implications for long-shore drift, leading to changes in natural erosion or deposition areas, or acceleration of these processes.

Hardening of the shoreline

Foreshore "hardening" occurs when large tracts of foreshore are created or stabilised using concrete, rocks, gravel etc. which can result in scouring, loss of beaches, and loss of access by littoral species. Public access and amenity are also affected.

Decline in water quality

Disturbance and resuspension of sediments during dredging and reclamation activities results in water quality impacts, most visible as an increase in suspended sediments, turbidity and changes in the optical properties of water. Associated decreases in dissolved oxygen levels, smothering effects and release of nutrients and toxicants can impact both pelagic and benthic communities.

Disturbance of contaminated sediments

The majority of the estuary is affected by historical contamination by heavy metals, with the middle and upper estuary most severely impacted. Detailed sediment surveys conducted by DEP show the areas of highest risk as those with concentrations in excess of the ANZECC/ARMCANZ Interim Sediment Quality Guidelines. Distribution maps for heavy metals are included in the Appendices.

Structural integrity of the constructed land

The structural integrity of the constructed land is a significant issue, particularly in high energy areas. Careful thought needs to be given to the design of structural and reinforcement features, particularly those surfaces exposed to wave, current or tidal action.

Loss of habitat for threatened species

Protected species in the Derwent include more than 10 species of migratory birds protected under international treaties. All species of marine mammals, pipefish, sea horses and sea dragons are protected. Endangered or vulnerable species in the Derwent include the spotted handfish, the Australian grayling *Prototroctes maraena*, the live bearing seastar *Parvulastra vivipara (*formerly *Pateriella vivipara),* and the seastar *Marginaster littoralis* .These species are vulnerable to poor water quality and habitat loss caused by high sediment loads. Particular attention should be paid to critical life stages (e.g. spawning), when planning works in areas of habitat suitable for threatened species (see Case Study this Section).

Potential for acid sulfate soils

Acid sulfate soils (ASS) are naturally occurring soils containing iron sulphide minerals, which when disturbed or exposed to oxygen, are oxidised and acid is produced as a result. The acidic runoff can contaminate ground and surface waters, and cause heavy metals to be released from contaminated sediments. Wetlands are especially vulnerable to impacts from disturbance of ASS, particularly if water levels and flows change significantly. Soils in which the sulfides have not been oxidised are often called potential acid sulfate soils (PASS). Dredging and reclamation both have potential to expose acid sulfate soils by manipulation of water levels and/or exposure of material to air.

Nature and quality of fill material used in reclamation

Certain materials are unsuitable for use in land reclamation due to their tendency to break down, for example wood debris, old tyres, and metal. Reclamation materials must be solid, inert and non-hazardous, and may include uncontaminated soil and rocks. Contaminated material (e.g. soil or dredge spoil) may result in the leaching of chemicals into the environment.

Introduction of weeds

Weeds may easily be relocated or spread during foreshore works, particularly when moving equipment between areas of high and low infestation. Dredging in areas infested with rice grass (*Spartina anglica*) should be avoided as it can spread readily from small pieces of rhizome. See Appendix 1 for a list of other common coastal and estuarine weeds present in South East Tasmania.

Introduced Marine Pests (IMP)

Dredging works can result in the transportation of IMP from one port to another, particularly in instances where specialised equipment is brought in for dredging operations. This can lead to new exotic marine pest invasions. The Asian kelp *Undaria pinnatifida* (Wakame) may also spread rapidly in areas where natural algal cover has been disturbed or removed. IMPs may also spread when moving dredge spoil from one area to another, and in the dredging process itself.

Noise and air quality

Noise and air quality may be affected by the movement of trucks and dredging infrastructure and the dredging operation may also cause auditory impacts. Odours caused by the disturbance of acid sulfate soils, and anoxic sediments may be problematic at some sites.

Cultural heritage

The Derwent foreshore is rich in Aboriginal and European heritage. There are many locations along the foreshore where middens may be found, and these are vulnerable to disturbance when works are undertaken on or near such locations. All Aboriginal heritage places are protected and require a permit through the Aboriginal Heritage Office if any impact is possible. Assessments or surveys may be required, and work must cease if objects of cultural significance are found during construction.

See Appendix 2 for a list of Reserves, and sites on the Register of the National Estate.

Figure 3 Self's Point industrial area showing extensive modification of the shoreline.
The reclaimed and in-filled wetland at the mouth of New Town Rivulet is also visible (Google Earth image).

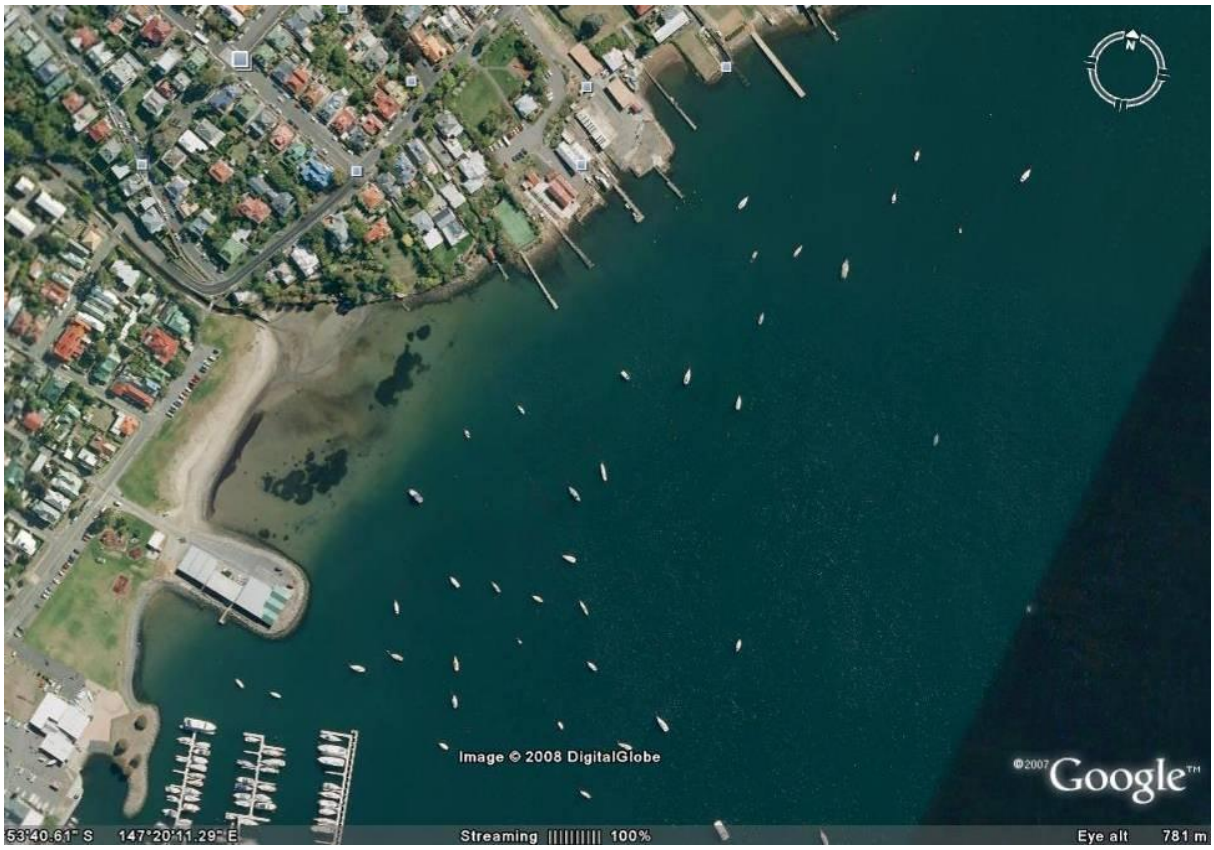


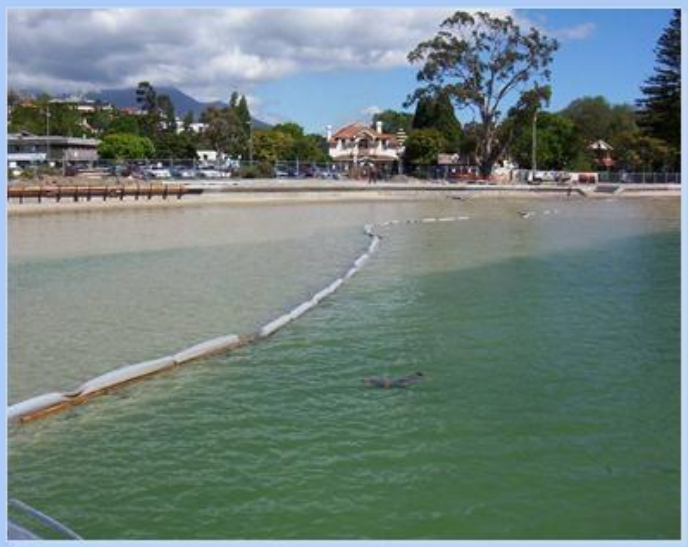
Figure 4 Foreshore reclamation associated with residential, light industry (slipways) and recreational boating use at Marieville Esplanande, Battery Point.
(Google Earth image).

The marine environment is fragile and planning to protect habitat and species from adverse effects is an integral component of Best Practice Environmental Management.

Case Study Little Sandy Bay November 2008

Foreshore construction works have the potential to significantly impact on water quality and habitat of littoral and aquatic species. Construction and repair works to an extensive section of seawall in Sandy Bay were recently halted due to the discovery of a spawning population of the Spotted Handfish (Brachionichthys hirsutus). The Spotted Handfish is endemic to the lower Derwent estuary and is listed as endangered under the EPBC Act 1999. Key threats to sustainable populations of the Spotted Handfish are the loss of spawning substrate and decline in habitat quality due to poor sediment and water quality. Spawning occurs in September/October when females annually lay 80 – 250 eggs that are wrapped in a membrane around a vertical structure, most typically the Stalked ascidian or "sea tulip". The eggs are guarded by the female for 7 – 8 weeks until they hatch as fully formed juveniles, with no dispersive larval stage. Spotted Handfish are found in water between 2 and 30 m depth, but most commonly in 5-10 m.

Council response to the discovery of the spawning populations was to declare a "Stop Work" status on the construction works.



Council enforced a condition to require the contractor undertaking the works to install a silk mesh screen to prevent turbidity and suspended solids associated with the works from impacting on the Handfish habitat

Projects such as this seawall reconstruction are often high profile within the local community, and impacts are highly visible. As part of the tender process the contractor was required to develop and adhere to a sediment and erosion control plan, designed to limit the impact of construction works.

Projects of this nature should ensure that the potential impacts of works in the intertidal zone, and the management of stockpiles of material on the foreshore zone are adequately managed and protected. The consequences of not fully addressing or planning for environmental impacts include delays in construction works, additional operational and management costs, and damage to habitats and species vulnerable to poor water quality.

Photos: Daniel Ray(Aquatic Science) and Sam Ibbott (Marine Solutions)

PART 2 Regulation and Planning Framework within Tasmania

Introduction

Planning and development controls of foreshore lands are heavily influenced by land tenure. Conflicts for use of foreshore land are great, and are hampered by the jurisdictional and institutional complexity of the land/sea interface. Six local planning authorities manage more than 220 km of foreshore within the DEP boundary, with 49% of the foreshore privately owned, 30 % state owned, 9% council owned, and 9% associated with roads and associated corridors. The remaining 2% is Commonwealth land. All land below high water falls under the jurisdiction of the Crown.

Reclamation is considered to be "accretion to the land", and as such is dealt with by local Planning Authorities in accordance with the *Land Use and Planning Approvals Act 1993*. Planning Schemes for "Derwent" Councils are listed in the Resources section at the end of this document. Some Planning Schemes (e.g. Kingborough) include specific Schedules aimed at protection of wetlands, waterways and coastal areas, and may include specific reference to dredging and reclamation based activities e.g. maintenance dredging, canal estates, land reclamation, works in wetlands etc. Other planning schemes make no specific reference to these activities, but rather refer to the overarching principles of the *State Coastal Policy 1996* and the *State Policy for Water Quality Management 1997*.

Some areas of the estuary (see Figure 3) have special zoning for reclamation for industrial land use, and are earmarked for further reclamation e.g. the Self's Point area, which is subject to planning under its own Act (*Self's Point Land Act 1951*).

Due to the complexity of the statutory issues surrounding dredging and reclamation activities, a summary of the planning and assessment framework in Tasmania is included here to briefly define the processes, roles and responsibilities of regulatory and referral agencies.

Resource Management and Planning System

All planning decisions made in Tasmania fall under the umbrella of Tasmania's Resource Management and Planning System (RMPS). All the legislation that contributes to the RMPS has five common objectives that drive decisions about the use of land and natural resources in the State. These are to:

- promote the sustainable development of natural and physical resources and the maintenance of ecological processes and genetic diversity
- provide for the fair, orderly and sustainable use and development of air, land and water
- encourage public involvement in resource management and planning
- facilitate economic development in accordance with these objectives, and
- promote the sharing of responsibility for resource management & planning between the different spheres of government, the community & industry in the State.

The RMPS covers:

- local planning schemes that are prepared and administered by Councils
- State Policies applicable to particular issues, which must be adhered to by both local and State government
- A single appeal system involving the Resource Management Planning Appeal Tribunal (RMPAT), and
- A suite of 5 key statutes which gives legislative effect to the RMPS objectives above.

These 5 key statutes are:

- Land Use Planning and Approvals Act 1993
- The Environmental Management and Pollution Control Act 1994
- State Policies and Projects Act 1993
- Resource Planning and Development Commission Act 1997
- Resource Management and Planning Appeal Tribunal Act 1993

Key legislation

The Land Use Planning and Approvals Act

The *Land Use Planning and Approvals Act 1993* (LUPAA) is the central Act within the RMPS. It provides the framework and key components for strategic and statutory land use planning and development. LUPAA requires that a Local Council Planning Scheme must:

- aim to further the objectives of the RMPS
- be consistent with any State Policies, and regional land use strategies
- have regard to the Council Strategic Plan.

LUPAA provides for the creation, application and administration of planning schemes by planning authorities. Planning controls on land use are applied in the form of zones and associated development controls. Planning policies, including local and State Policies, must be taken into account when making a decision on a planning permit application. The Tasmanian Planning Commission (TPC) is responsible for assessing planning schemes, and planning scheme amendments that are prepared by local planning authorities. Appeals of decisions made by local planning authorities are resolved through RMPAT.

Environmental Management and Pollution Control Act

The *Environmental Management and Pollution Control Act 1994* (EMPCA) is the primary environment protection legislation in Tasmania. The role of EMPCA is to integrate local government and State planning assessment, and environmental management and approvals. Three classes of activities are identified under EMPCA (Levels 1 to 3), reflecting the range of potential environmental impacts. Local government authorities have responsibility for the environmental regulation of smaller scale activities (Level 1) and "*must use its best endeavours to prevent or control acts or omissions which cause or are capable of causing pollution*" (Section 20).The implementation of approved activities, along with any conditions, is regulated through a permit process under LUPAA.

State Coastal Policy and State Policy for Water Quality Management

The *State Coastal Policy 1996* has a central objective of sustainable development of the coastal zone. All activities, uses and developments which may impact on the coast, are required to meet the objectives of the State Coastal Policy. The three main guiding principles of the policy are:

- protection of natural and cultural values of the coast;
- use and development of the coast in a sustainable manner; and
- integrated management and protection of the coastal zone is a shared responsibility.

Under the *State Coastal Policy Validation Act 2003*, the coastal zone is defined as the area encompassing "*State Waters and all land to a distance of 1 km inland from the high water mark*". The State Coastal Policy is implemented by planning authorities, through the use of Planning Schemes. Where there is a discrepancy between the State Policy and the provisions of a Planning Scheme, the State Policy takes precedence. A review of the State Coastal Policy in 2004 resulted in a proposed new policy, which was rejected by the Tasmanian Planning Commission, and the government is currently investigating options to review its coastal management framework.

The *State Policy on Water Quality Management 1997* has the central objective of sustainable management of Tasmania's surface and groundwater resources by protecting or enhancing their qualities while allowing for sustainable development. To aid the objective to protect or enhance water quality, Protected Environmental Values (PEVs) must be set for all Tasmanian surface waters, including estuarine and coastal waters. PEVs describe the current uses and values of the waterways, and have been documented in a consultative process that involved all interested industry and community groups. The PEVs are useful in determining what key indicators should be monitored and the respective target levels for protecting or improving water quality for the designated uses of the specific waterway. In general, point source pollution should be managed to protect the PEVs by implementation of best practice environmental management, and by compliance with emission limits set by the regulatory authority. The PEVS for the Derwent estuary are shown in Appendix 3.

Threatened Species Protection Act & the Environment Protection & Biodiversity Conservation Act

Threatened species are native species which are listed under State and federal legislation to receive special protection. Tasmanian species become listed under the *Threatened Species Protection Act 1995* due to restrictions in their abundance range or habitat, or threatening processes likely to impact in population reduction. Management options to protect listed species include declaring areas of critical habitat, preparing recovery and threat abatement plans and instigating interim protection orders. Interim protection orders prevail over planning schemes, and can include the prohibition or regulation of any activity likely to affect the habitat adversely.

Activities that are likely to have an impact on matters of national environmental significance, for example listed threatened species and ecological communities, or listed migratory species may also trigger an assessment under the federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC). This assessment is conducted by the Australian Government, and the assessment is triggered by the referral of the matter to the Minister for the Environment.

Nature Conservation Act

In addition to individual threatened species, a number of threatened coastal vegetation communities are defined under Schedule 3a of the *Nature Conservation Act 2002* (e.g. riparian vegetation, wetlands, salt marsh). Subject to some minor exemptions, a Forest Practices Plan may be required to remove any volume of threatened coastal vegetation communities.

Crown Lands Act

In Tasmania, the majority of coastal land is Crown Land covered by the *Crown Lands Act 1976*. The Act governs the management and use of Crown Land, including land that is licensed or leased from the Crown. Crown Land Services (DPIPWE) are responsible for the assessment of all applications for the use of Crown Land, including the private use of land reserved under the *Crown Lands Act 1976* and the *National Parks and Reserves Management Act 2002* (administered through Parks and Wildlife). All land below high water falls under the jurisdiction of the Crown. Developments involving Crown Land may also require approval from Council under LUPAA 1993 (for example construction of a building on a proposed land reclamation site). The *Crown Lands Act 1976* specifically refers to reclamations from the sea in Section 53.

Other key legislation

Other key legislation and policies for the management of estuarine / coastal environments include:

- *National Environment Protection Council (Tasmania) Act 1995*
- *Living Marine Resources Management Act 1995*
- *Natural Resource Management Act 2002*.

A summary of the various agencies involved in dredging and reclamation activities and their role and responsibilities are shown in Table 1. A brief summary of the legislation appears in Appendix 4.

Agency	Role (relevant Policy or Act)	Comment
Commonwealth	Protection of the environment relating to matters of national environmental significance (*Environmental Protection and Biodiversity Conservation Act 1999*)	Includes threatened species, wetlands of national importance, migratory species and places of natural heritage. *Sea Dumping Act 1981* may be triggered for activities in waters under Commonwealth jurisdiction
Crown Land Services	Management of Crown Reserves, including land under water (*Crown Lands Act 1976*)	CLS work closely and cooperatively with other agencies in the management of State land and public reserves
Marine Resources Division	Sustainable fisheries management, including jurisdiction below High Water Mark (*Living Marine Resources Management Act 1995*)	Input required if marine farming operations are likely to be impacted, or if activity has a serious effect on the marine environment, including disturbance of or discharge to the bed of any State waters
TasPorts	Responsible for maintenance & capital dredging within Port limits (*Tasmanian Ports Corporation Act 2005*)	Historically does not occur in the Derwent
Parks & Wildlife Services	Manage National Parks, World Heritage Areas and Conservation Areas (*Nature Conservation Act 2002* and the *National Parks and Reserves Management Act 2002*)	Includes management of National Parks, World Heritage Areas, Conservation Areas and recreational reserves. In some cases management includes water over land
Resource Management & Conservation	A division of DPIPWE, RMC administers the *Threatened Species Act 1995*, and is involved in assessment of applications	Includes Development and Conservation Assessment, Biodiversity Conservation branches, Threatened Species Division
Marine and Safety Tasmania	Referral agency for matters involving pilotage, navigation, marine & vessel safety, State jetties and anchorages /moorings (*Marine and Safety Authority Act 1997*)	Not generally involved in the assessment of environmental issues. Advice limited to operational impacts. Undertakes barway and maintenance dredging, but not in Derwent
Environment Protection Authority	Environmental management and pollution control matters, including prevention, reduction & remediation of environmental harm (*Environmental Management and Pollution Control Act 1994*)	Assessment, approval and regulation of Level 2 activities, in conjunction with the local planning authority. (In rare circumstances, the EPA Board my call in Level 1 activities for assessment)
Council	Implement *Land Use Planning and Approvals Act 1993* with regard to *State Coastal Policy 1996*, *State Policy on Water Quality Management 1997*, and *Local Government Act 1993*	Assessment, approval and regulation of Level 1 activities
Tasmanian Planning Commission	Assessment of projects declared under the *State Policies and Projects Act 1993*. Developing planning codes.	Includes directives to guide the content of Planning Schemes, and assessment and provision of recommendations for PoSS.
Aboriginal Heritage Tasmania	Administrative services for all land tenures under the *Aboriginal Relics Act 1975*	AHT work in a partnership approach with Aboriginal community organisations

Table 1 Role of key agencies with respect to dredging and reclamation in the Derwent estuary.

Level 1 assessments

Local Councils are responsible for the assessment, approval and regulation of Level 1 activities, which must be undertaken in accordance with the local planning scheme. The planning scheme is a regulatory instrument that sets out the requirements that apply to new use and development.

Level 1 approved activities are deemed to pose the lowest level of risk to the environment, and are generally smaller industrial type activities.

Current planning scheme details for Derwent Councils are listed in the Directory of Resources.

A planning scheme typically consists of two main parts:

- a map or plan which divides the Council area into different land use zones, precincts or overlays,
- the "ordinance" which describes the conditions under which use and development can take place in different zones, precincts and overlays.

A Planning Scheme classifies development and use into 4 categories, as outlined in Table 2. These are "exempt", "permitted", "discretionary" and "prohibited". An example of a planning scheme schedule outlining acceptable solution (permitted use), an alternative solution (discretionary use), and a prohibited use relating to reclamation and dredging is shown in Table 3.

Category	Explanation	Comment
Exempt	Does not require a planning permit.	Exemptions are specifically outlined in the planning scheme.
Permitted Use (Section 58 LUPAA)	Required for all development and use, unless exempted.	Development meets the *acceptable solution* (conditions under which works are deemed to comply) as detailed in the planning scheme. Must be approved, but approval may be subject to conditions set by Council.
Discretionary Use (Section 57 LUPAA)	Must meet performance criteria, and must be advertised for 14 days. Submissions from third parties considered in approvals process.	Development meets the *alternative solution* (requiring justification) as outlined in the planning scheme. Approval may be subject to conditions set by Council.
Prohibited Use (Section 43A LUPAA)	A use or development that is banned and cannot be approved.	Activity or use does not comply with the planning scheme. Planning scheme must be amended to allow the use to be assessed.

Table 2 Summary of categories used in Planning Schemes to classify use or development of land (including land under water).

The approval process for a Level 1 activity is described in Figure 5. Applicants should refer to the Local Government Authority Tasmania webpage (see Directory of Resources) for more detailed information on the application process, and Section 58, 57 and 43A approval processes.

Applicants are encouraged to discuss the nature of the proposed works with Council and other relevant authorities early in the project planning process.

Council require evidence of the approval of the landowner (Crown, Council or other) prior to the lodging of an application. The Council may impose controls of an environmental nature by attaching conditions to the permit issued under LUPAA (see Figure 5).

Occasionally, a Level 1 activity may be "called in" for assessment as a Level 2 activity by the Environment Protection Authority (EPA) Board. If approved, the activity may be regulated as either Level 1 or Level 2 in accordance with the Boards Determination. The Board is an independent statutory body, established as the key decision-maker under EMPCA 1994.

Item	Acceptable Solution (Permitted Use, deemed to comply)	Alternative Solution (Discretionary Use, requires justification)
5.2.1.8 Canal Estates	Canal estates are not permitted	Canal estates are not permitted
5.2.1.9 Dredging and/or reclamation	All applications for dredging and/or reclamation must be considered under the Alternative Solution	Council may approve dredging and/or reclamation in any circumstances where it can be shown that: (a) the level of disturbance of seagrass beds or other sensitive ecosystems is minimised; and (b) a plan of management for the disposal of extractive material is prepared which adequately explains the processes and procedures to be followed in winning, transport and disposal of all extractive materials obtained; and (c) initial and long term environmental impacts can be managed (e.g. soil acidity); and (d) adequate treatment of land /water interface including design of batters if reclamation is to occur; and (e) wave action is analysed where appropriate; and (f) cumulative impact within the area is insignificant; and (g) sources of sedimentation are identified and conditions can be imposed to reduce the supply of sediment if above natural rates of sediment movement are identified.

Table 3 Examples of discretionary and prohibited use for the Derwent estuary (Kingborough Planning Scheme 2000).

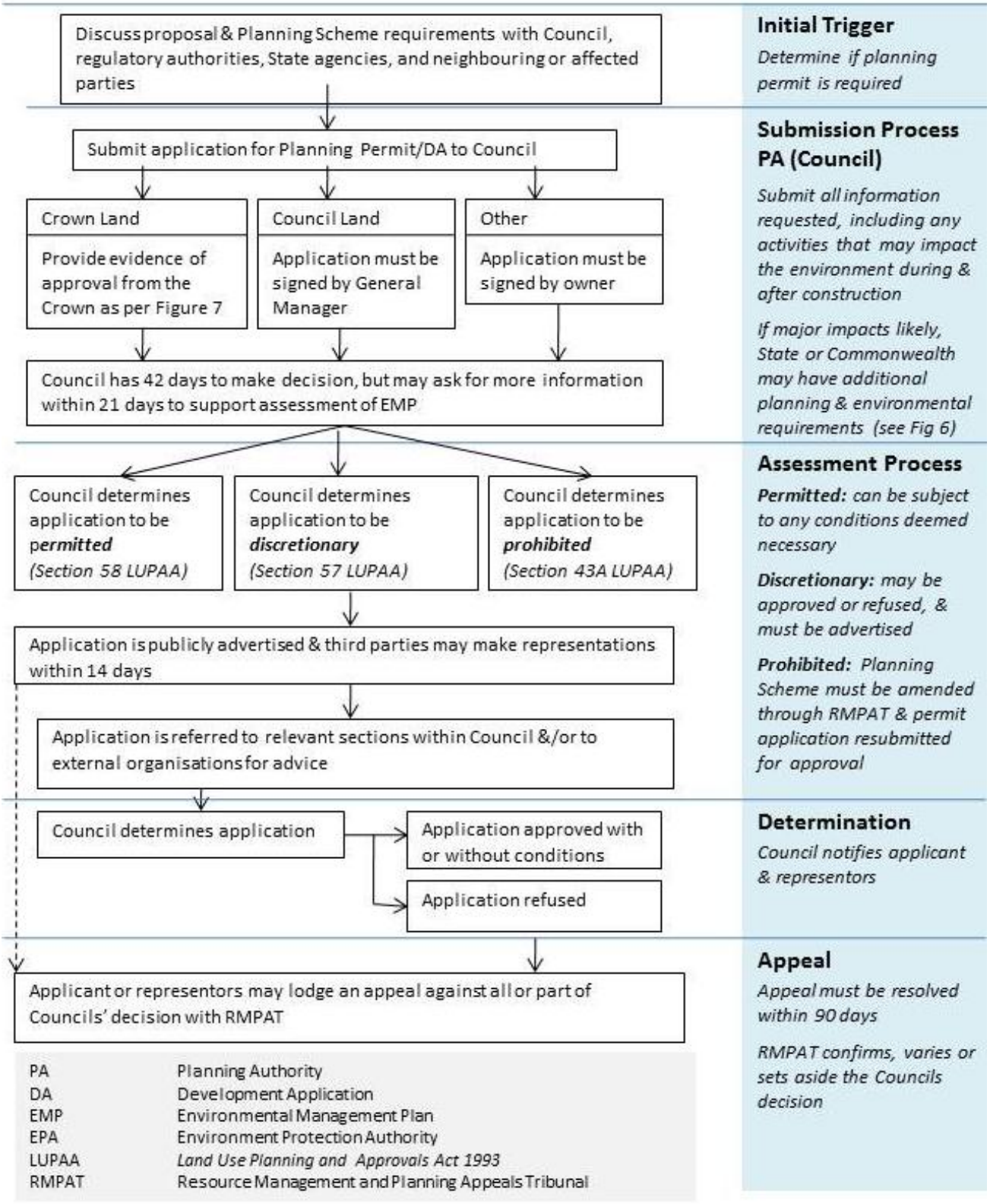


Figure 5 Flowchart for assessment of a Level 1 activity.

Level 2 assessments

Level 2 activities are defined in Schedule 2 under EMPCA 1994, and are generally larger industries or mining activities, or activities which have a greater potential to cause significant environmental harm.

There are 3 classes of activity within Level 2, listed below. The EPA provides guidance on the information required for each assessment category:

- Class 2A - Level 2 activities that are minor in scale or consequence, only have the potential for local environmental impacts that may be easily avoided or mitigated and which are unlikely to generate significant public interest. Notice of Intent (NOI) optional.
- Class 2B - Level 2 activities that involve complex or multi-jurisdictional assessment or complex environmental issues, which require approval from another State or Federal authority, or are likely to generate a lot of public interest. Requires NO1.
- Class 2C - Level 2 activities that involve any of the issues for Class 2B, but which require more stringent assessment or longer timeframes to make sure that all the issues are addressed. Requires NOI.

Note that assessment and regulation as a Level 2 activity may occur for smaller scale proposals that involved the deposition of waste (including dredge spoil) within the waters of the State (see Schedule 2 EMPCA 1994).

Level 2 activities that require a permit

The majority of proposed Level 2 activities will need to obtain a permit under the *Land Use Planning and Approvals Act 1993*. Council should be consulted to determine whether the proposal requires an application, and this is determined by referral to the planning scheme.

Once a permit application is submitted for a Level 2 activity, the planning authority must refer the application to the EPA Board for environmental assessment. The planning authority concurrently assesses the land use planning aspects of the permit application. If the EPA Board recommend refusal, the Planning Authority must refuse the application. If the Board recommend approval, the Planning Authority may still accept or reject the development based on planning issues. A flow chart describing the assessment process is included as Figure 6. Refer to the EPA website for more detailed description of 2A, 2B, and 2C processes.

Level 2 activities that do not require a permit

Where a proposed level 2 activity does not require a permit application under the planning scheme, the project proponent must refer the activity directly to the EPA Board for environmental assessment.

Directors powers to “call in” Level 1 activities

In rare situations, circumstances may arise that require the Director to direct Council to refer a Level 1 application to the EPA Board for environmental assessment, as if it were a level 2 activity.

Once approved, all activities must comply with any conditions set down by the board and/or the planning authority.

Notice of Intent

Under section 27B of EMPCA 1994, a proponent may be required to lodge a Notice of Intent to the Board prior to submitting a full application. A Notice of Intent effectively begins the statutory process by informing the Board of the proposed project, prior to the submission of a Development

Proposal and Environmental Management Plan (DPEMP). This provides an opportunity for the Board to consider potential environmental issues before the submission of a full DPEMP, which can be a costly and time consuming process.

A NOI is a good way to summarise the proposal and ensure major issues are discussed early in the project development.

Elements that must be included in the NOI are listed below:

- the name and contact details of the person lodging the application
- the name of the proposed project and its location
- background of the project proponent, including details of the proponent's experience and financial capacity to undertake the project and his, her or its contact details
- a description of the proposed project, including its key physical components
- an outline of the proposed location of the project and a general site location map
- an outline of the stakeholder consultation process undertaken or proposed to be undertaken, including the consultation method, stakeholders consulted or to be consulted and the issues raised or to be raised
- a general description of the physical environment that may be affected by the project
- the key environmental, health, economic and social issues identified for the project to date
- the surveys and studies proposed or underway in relation to the key issues for the project
- the proposed timetable for the project
- any other details that the Board may consider relevant to the project.

Requirements for full applications are detailed on the EPA website, and should be discussed with Environment Division staff before submission.

Level 3 assessments

Projects of State Significance are large scale projects with significant environmental and economic implications that have been declared under the State Policies and Projects Act 1993. These are assessed as a Level 3 activity.

All Level 3 activities are assessed by the Tasmanian Planning Commission (formerly the RPDC). Following a detailed integrated impact assessment process, the assessment report and recommendations are submitted to the Minister. The recommendation goes to parliament, and the Governor makes the final determination. See the TPC website for further information.

The TPC can recommend that a Project of State Significance be regulated by a number of agencies. Level 3 activities are not covered by this guidance document.

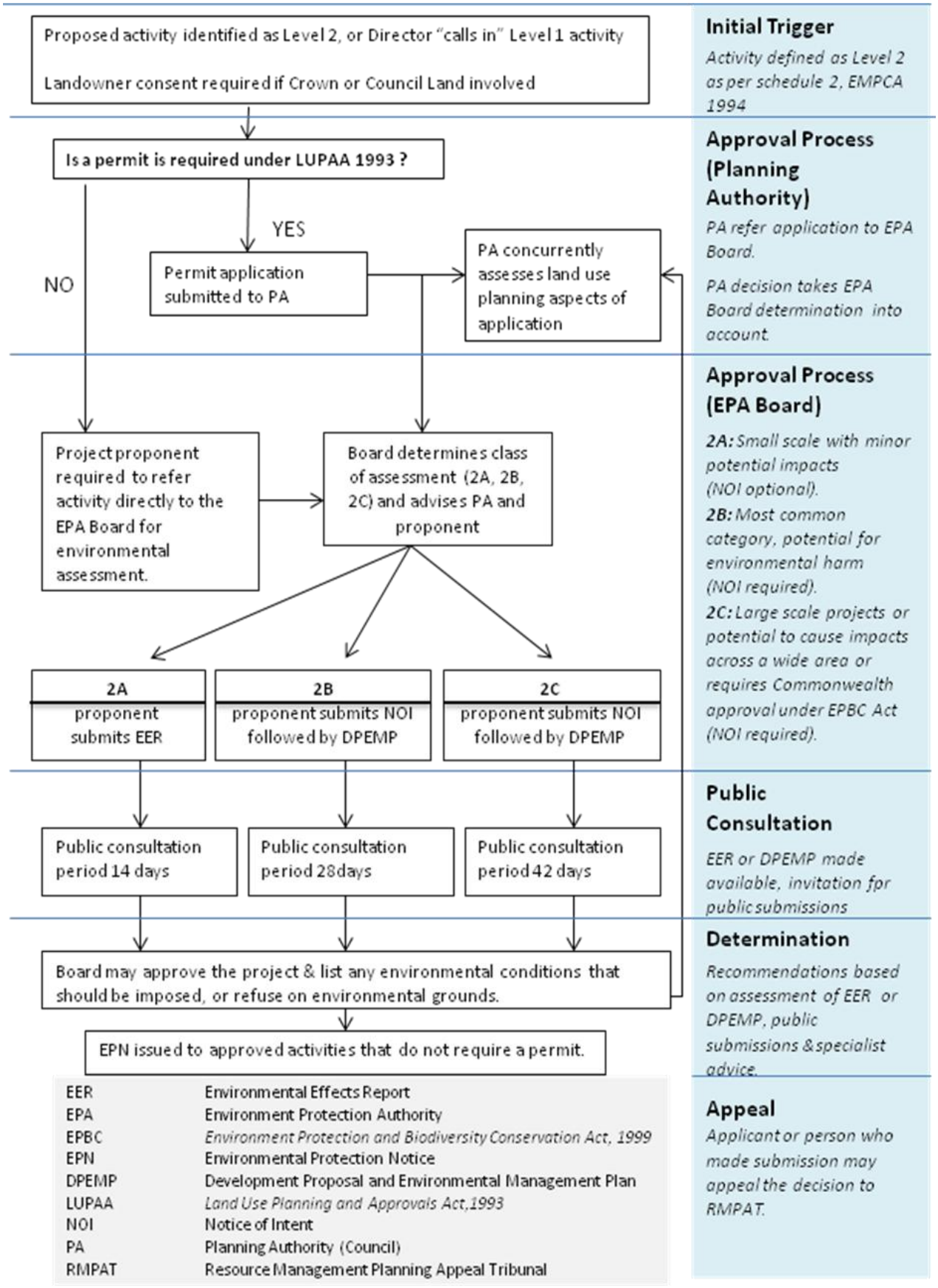


Figure 6 Flowchart for assessment of Level 2 activities.

Crown Land assessments

Anyone planning to use or develop Crown Lands for business or personal use must seek approval from Crown Land Services (CLS) prior to the commencement of any work. Approval is usually formalised by the granting of a license or a lease agreement, issued under the *Crown Lands Act 1976*.

A proposal for reclamation works would, in most circumstances, require formal authority to undertake that work, and ultimately a formal agreement for occupation of maintenance of the reclaimed land. A proposal to undertake dredging works would require formal approval and authority to undertake the dredging activity- but if ongoing occupation of the subject site is not intended, a formal agreement to occupy the Crown land may not be required.

Licenses are usually short-term, for non-exclusive use or occupation, and are approved for specific circumstances and purposes. A lease agreement between the Crown (as land owner) and the applicant, would normally be issued for exclusive use, for a specific purpose, and for a specified term. Development proposals, or change of use cannot be undertaken without the authority of the Minister (or the Ministers delegate). Charges for the application process apply.

There are three key criteria in the assessment of all applications to use Crown Land:

- the individual merits of the application
- the management objectives of the land (as outlined in legislation)
- a public benefits test

When assessing applications to use Crown Land, the Crown will often seek advice from 2 expert panels; the Technical Advisory Group (TAG) and the Public Benefits Assessment Committee (PBAC). Members of the panels are drawn from government agencies, including Crown Land Services , Parks and Wildlife Service (PWS), Mineral Resources Tasmania (MRT), Policy Conservation and Assessment Branch (PCAB), Aboriginal Heritage Tasmania (AHT) and Coastal and Marine Branch (EPA). The recommendations of these assessment groups are forwarded to the Minister (or their delegate) for approval.

The complexity of applications to lease or develop Crown Land vary from site to site, and early contact with CLS is advised to discuss potential environmental and tenure issues.

In most instances, a Development Application (DA) to the local Council is also necessary to meet the requirements of the local planning scheme. Consent from the Crown, as land-owner is required to lodge the DA-pursuant to *Land Use Planning and Approvals Act 1993*.

Applications to use Crown Land are assessed by the TAG and PBAC using the following:

- What allocation, if any, has the area been given by the Crown Land Assessment and Classification Project (CLAC)?
- What public benefit does the proposal have – economic, social, environmental?
- Is public access to the area or public use of the area affected? Is it enhanced or made worse?
- Are there any impacts on the natural values of the area? Are the values likely to be enhanced or made worse?
- Are there any impacts on the heritage values of the area? Are the values likely to be enhanced or made worse?

- Are there any planning issues, such as zoning issues or impact on scenic values?
- Does the proposal have environmental impacts – e.g. water, soil, air pollution?
- Are the land &/or the proposed development likely to be affected by sea-level rise?
- Is the proposal for a minor or major development?
- Is the development of a temporary or longer-term nature?
- Are there any implications for the Crown's risk exposure in terms of liability?

Applications are assessed as minor or major projects. Minor projects are assessed by CLS, whilst major projects are referred to the Environment Protection Authority Board (DPIPWE). Large scale projects involving high impact development and use should initially submit a Notice of Intent (NOI) to CLS. A project is considered large scale if it satisfies the requirements for Major Project assessment (Level 2 activity as defined under *EMPCA 1994*). There are specific guidelines available from CLS on what information is required in a NOI, available from the CLS website (see Directory of Resources). A summary of the assessment process is shown in Figure 7. Length of tenure for use and development of Crown Land is negotiated case by case.

The *Crown Land Act 1976* contains specific reference to the issue of land reclamation from the sea (Section 53). Land may be reclaimed for the purpose of use by marine boards, TasPorts, councils, or for industrial, commercial or recreational use following approval from the Crown.

For minor works where entry to Crown Land is required (e.g. pipeline or water meter installation), a Works Application must be lodged (see DPIPWE website for further details.)

Reserve Activity Assessments

The Reserve Activity Assessment (RAA) process is the Environmental Impact Assessment system the Parks and Wildlife Service (PWS) employ to assess whether activities conducted on land managed by PWS are environmentally, socially and economically acceptable. Areas that are reserved are protected under the *National Parks and Reserves Management Act 2002.* A significant portion of the middle and upper estuary is included in the Derwent Conservation Area, and is managed by PWS

The RAA process tests whether proposed activities meet the requirements of legislation, plans and policies. The process weighs the risks and benefits of a proposed activity and assists the PWS in deciding whether an activity should proceed, proceed with conditions or not proceed. Comprehensive information on assessments and a detailed RAA manual are available on-line for proponents considering development or use of areas within reserves and Conservation Areas. As with Crown Land assessments, applications may be referred to other government agencies with an interest or specific expertise in aspects of the proposed development or use.

References

GHD 2007 "Report for Improving NRM Related Decision making with in Local Government: Task 1 Drivers of NRM Related Decisions" prepared for Southern Tasmania Councils Authority

DEP 2009 "Derwent Estuary Environmental Management Plan" DPIPWE

DPIWE 2003 "Waterways and Wetlands Works Manual" Department of Primary Industries, Water and the Environment

Page, L and Thorpe, V 2010 "Tasmanian Coastal Works Manual: A Best Practice Management Guide for Changing Coastlines" Department of Primary Industries, Parks, Water and Environment

PWS 2010 "Reserve Activity Assessment Manual" Version 1 July 2010 Department of Primary Industries, Water and the Environment

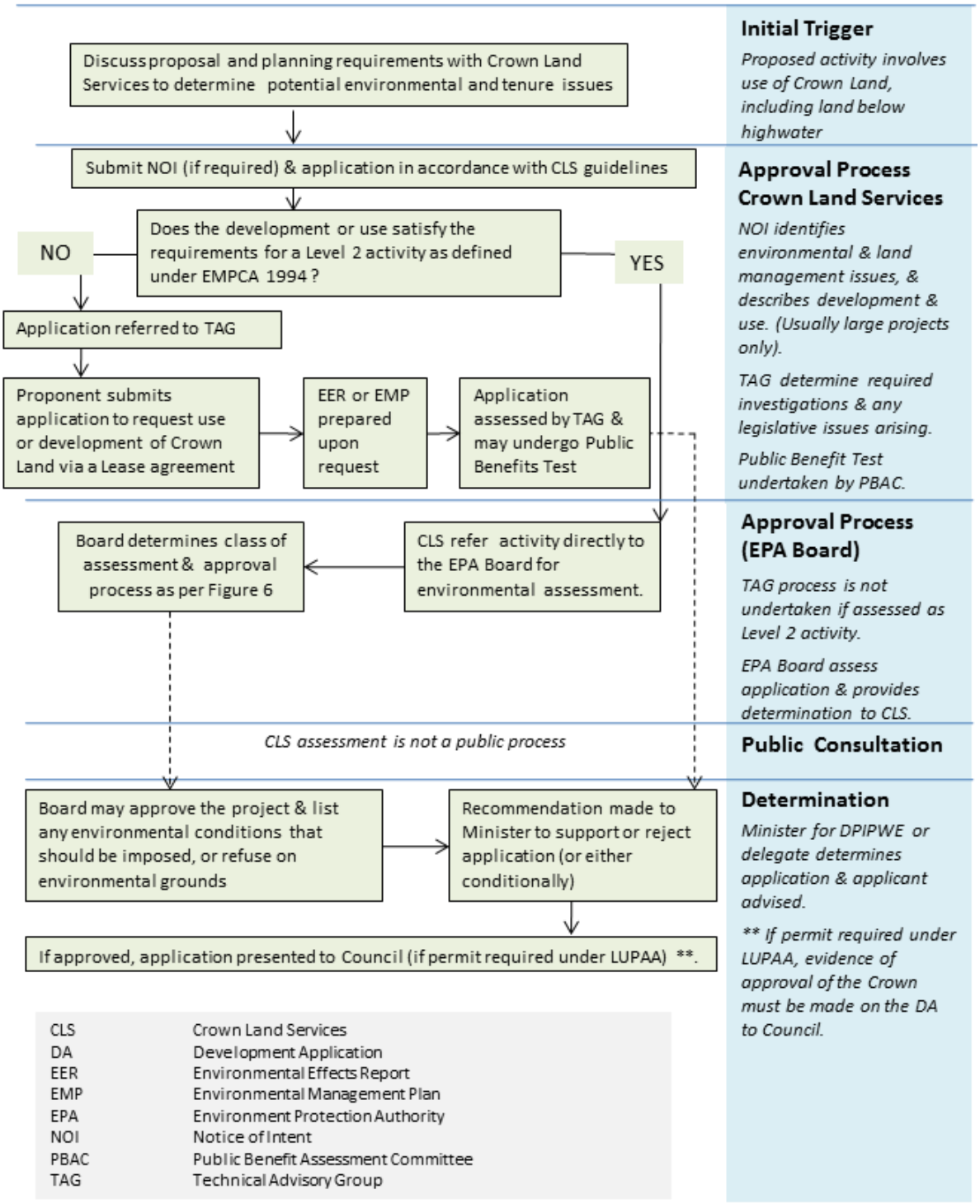


Figure 7 Flowchart for assessment of activities on Crown Land.

Unauthorised or "enhanced" reclamation

Carrying out works without planning approval has occurred from time to time in the Derwent, on both commercial and residential sites. A recently publicised case of estuarine land reclamation has highlighted some of the issues associated with works conducted outside the approvals process, uncertainty over land tenure, and the ongoing monitoring and compliance of projects in the Derwent. Public attention was drawn to incremental land reclamation in Prince of Wales Bay involving the construction of a concrete pier structure, later determined to have been undertaken without the necessary approvals from Crown Land Services or the Glenorchy City Council.

The issues associated with illegal works include:

- *No clear documentation on the size and nature or works or appropriate management of environmental issues.*
- *Insufficient planning and controls to limit siltation, ecological damage and water quality problems.*
- *Possible damage to existing infrastructure, and access to existing facilities.*
- *Changes to local currents and hydrodynamics.*
- *Possible use of inappropriate materials for reclamation.*
- *Engineering, design and stability issues.*
- *Disturbance and exposure of highly contaminated sediments.*
- *Issues arising if the land in questions is to be sold, or the lease transferred to a new owner.*

An application for works through the appropriate planning authorities would have ensured that these impacts were controlled and limited, and that works were carried out with appropriate monitoring for compliance with any conditions attached to the approval.
Retrospective approval is not a short-cut for failing to seek the necessary approvals. A full assessment of the works, the materials used, and the likely environmental impacts of the reclamation works is still required. If approval is not granted, penalties may be enforced by the relevant authorities. These include an order to remove the material or structure, remediation works to the satisfaction of the relevant authorities, or other penalties including fines.

Under EMPCA 1994, the unlawful disposal of waste is prohibited, and penalties apply for works carried out without the necessary approvals and conditions.

Land reclamation at Prince of Wales Bay (Source Google Earth)

PART 3 Environmental Management of Dredging & Reclamation Activities

The use of waste for reclamation of land from the sea is not permitted in the Derwent (Source DEP).

Injection dredging of a sandy barway (Photo Marine Resources).

Reclamation: Planning Considerations

All reclamation works proposed in the Derwent require planning approval, as there are no discretionary or minimum works limits prescribed in the Planning Schemes or relevant legislation. The assessment and approval process followed (i.e. Level 1 vs. Level 2 activities as defined in EMPCA Schedule 2) will depend on the degree of risk of environmental harm. All projects will have a number of common environmental issues that will need to be addressed. Before commencing reclamation activities, an Environmental Management Plan (EMP) or Environmental Effects Report (EER) should be prepared to the satisfaction of the regulatory agencies. The plan should consider:

- the purpose of the reclamation
- alternatives to undertaking reclamation
- significant natural and cultural features of the site
- the physical constraints of the site (such as susceptibility to storm surge, reclamation extent, erosion and siltation)
- the source of material used in the reclamation
- environmental impacts of the project on surrounding air, soil and water quality
- mitigation or remediation measures to be put in place, and methods for monitoring the effectiveness of those measures through a monitoring program.

Consideration of these issues during the design stage will have long term environmental and economic benefits, whereas dealing with problems after they have arisen is often time consuming and costly.

An important part of the application is providing a discussion of alternative options, and a strong justification of why reclamation is necessary. Alternatives to reclamation may include use of jetties, wharf or marina structures.

A development that requires direct access to the sea should be designed to ensure that only the minimum required amount of reclamation is undertaken. This can be achieved by confining most site development to above the intertidal zone and retaining as much of the natural land/sea interface as possible. Reclamation in coastal areas can affect the local hydrodynamics (water movement) and lead to erosion or siltation in unexpected areas.

Quality of fill and "waste" vs "non-waste"

The quality of the fill used for reclamation has a significant impact on the stability and reactivity of the reclaimed area. Reclamation materials must be solid, inert, uncontaminated, non-hazardous, and should not be waste of any kind.

EMPCA defines waste as "discarded, rejected, unwanted, surplus or abandoned matter, whether of any value or not". Rock and soil from excavations, earthmoving, construction or other activities are considered waste. Most materials commonly referred to as "clean fill" in the general community are almost always waste.

"Non-waste", such as clean rock products purchased from quarries are generally suitable, although may still require testing if there is reason to suspect contaminants. Hard rock quarries are able to provide quality controlled fill materials, for example the proportion of fines can be specified thereby reducing turbidity impacts.

Use of waste materials presents greater risks to the environment because of the uncontrolled nature of wastes and the potential for contamination with unknown pollutants. Steel and timber ultimately break down and are therefore not considered suitable fill materials.

Reclamation techniques

Reclamation is normally carried out by raising the level of submerged land above sea level, using approved materials dredged from the site, or excavated from land. Construction methods may involve filling bunded and drained areas with uncontaminated dredge or fill material, or progressive infilling from the shoreline towards the sea. Bunding may be suitable for areas that will be allowed to settle for some time or have other accelerated consolidation efforts applied. Leaving existing sediments in place reduces the amount of fill required. The other major technique involves the removal of soft marine sediments, and replacement with imported fill material, either marine or terrestrial, or a combination of both. This technique requires more fill material, but generally results in faster consolidation.

The proposed use of dredged material in land reclamation should be addressed in the EMP, in particular the potential for acid sulfate soils (ASS). If present, the disturbance, handling, and rehabilitation of affected areas must be addressed in the EMP. Predictive mapping undertaken by CSIRO shows much of the upper and middle estuary is likely to be subject to problems associated with disturbance of ASS. A small area within Ralphs Bay is also identified however; limited data are available for the majority of Ralphs Bay and the lower estuary. Concrete and steel foundations may deteriorate rapidly in the presence of acid sulfate soils.

Most sediments in the Derwent are highly contaminated with metals and therefore unlikely to be approved as a source of fill for reclamation. This activity would be assessed as a Level 2, since disposing of wastes in waters within the limits of the State is listed under Section 7e Schedule 2 of EMPCA.

PARTS 5 and 6 of this document describes the process for assessment, transport and land-based disposal of contaminated soil defined as controlled waste.

Reclamation Environmental Management Plan

The EMP or EER must provide all the information required by Council or the EPA for a comprehensive assessment of the proposal. An EER can often be prepared without specialist help, while an EMP for a larger scale project takes a considerable level of effort and technical input. The level of detail is proportional to the degree of perceived risk and likelihood of environmental harm. It should detail monitoring requirements to ensure that no environmental harm is occurring during the development or use (see PART 4). Additional information on the EMP requirements for Level 2 and CLS applications are found on their respective websites (see Directory of Resources).

Use best practice environmental management principles to ensure impacts from the proposed development are minimal or insignificant.

Generally there will be a requirement to conduct a marine flora and fauna survey if the proposed development is located within 5 km of a known location of a threatened species. Online searches to determine if a marine survey is required can be undertaken by DPIPWE. The survey must be undertaken by a suitably qualified professional, and will need a permit if the survey work has the potential to disturb listed threatened species. Video transects may also be required. Further details can be obtained from DPIPWE.

A permit is also required under the *Living Marine Resources Management Act 1995* by any person undertaking environmental monitoring in State waters. A permit can be obtained by the proponent, or suitably qualified personnel on behalf of the proponent, from the Wild Fisheries Branch DPIPWE.

A basic check-list of items that may need to be addressed is included in Table 4, but applicants should confirm requirements with the appropriate approval agency prior to preparing an application. There may be variations on a case-by -case basis, and *not all items may be required for smaller scale proposals.*

Item	Reclamation	Dredging
Description of the proposed project		
Location	✔	✔
Title details and land tenure	✔	✔
Site characteristics	✔	✔
Surrounding tenure	✔	✔
Rationale and consideration of alternative sites and methods	✔	✔
Description, purpose and land use plan	✔	✔
Total area to be reclaimed/dredged	✔	✔
Location of mean high water mark in relation to reclaimed area	✔	
Existing and proposed final levels (in relation to Australian Height Datum)	✔	
Any associated facilities to be constructed	✔	✔
Site preparation and civil works including construction/dredging techniques, timelines, rate of reclamation, estimated completion date	✔	✔
Method of protecting the land/water interface of the reclaimed area from erosion by the sea (e.g. revetment or other method)	✔	
Description of the existing environment		
Existing land and water use in and around the site, and any issues/constraints	✔	✔
Maps, plans or images showing the location of the project in relation to water bodies, natural vegetation, infrastructure, and other land	✔	✔
Compatibility of the proposal with local management plans, special use areas or zonation	✔	✔
Location of historical sites, environmental protected areas, or other sites of significance	✔	✔
Identification of existing terrestrial / aquatic habitats and communities, their conditions and if they are likely to be directly or indirectly affected	✔	✔
Importance of the area to the Aboriginal community	✔	✔
Description of proposed fill material (reclamation)		
Quantity and supplier of fill	✔	
Analysis of fill quality (must be uncontaminated, and must not be waste)	✔	
Description of deposition techniques	✔	

Table 4 Basic checklist of items for inclusion in an environmental management plan involving dredging or reclamation activities. *Smaller scale activities may not require as much detail; confirm with assessment and approval authorities.

Item	Reclamation	Dredging
Description of material to be dredged		
Quantity of material to be dredged		✔
Maximum daily dredge rate		✔
Waste (dredge spoil) management strategy, including dewatering		✔
Operational controls on dredging process (loading rates etc)		✔
Acid sulfate soil management		✔
***Description of existing water and air quality**		
May include dissolved oxygen, suspended solids, light regime nutrients, and sediment/water contaminants pertinent to the site	✔	✔
Relevant biological indicators (e.g. seagrass, Handfish, algal blooms)	✔	✔
Strength and direction of prevailing wind	✔	✔
***Coastal Hydraulics (existing and potential impacts)**		
Description of existing erosion, sedimentation and accretion areas	✔	✔
Bathymetric surveys	✔	✔
Tidal and current patterns	✔	✔
Sediment transport and dispersion	✔	✔
Wave patterns	✔	✔
Geology and coastal morphology	✔	✔
Existing drainage patterns, storm surge or flood levels	✔	
Groundwater impacts	✔	
Risk of inundation and vulnerability to sea level rise	✔	
***Description of foreshore and aquatic habitats**		
Any threatened or protected species or habitats (may trigger Threatened Species Protection Act 1995 or EPBC Act 1999)	✔	✔
Any commercially important species (e.g. fisheries or aquaculture)	✔	✔
Significance to resident or migratory birds and mammals	✔	✔
Sediment quality (physical and chemical) and contaminant levels	✔	✔
Potential for disturbance of existing soils/sediments, ASS issues	✔	✔
Likely visual impacts	✔	✔
Disturbance of existing infrastructure and public access	✔	✔

Table 4 (cont). ***Basic checklist of items for inclusion in an environmental management plan involving dredging or reclamation activities. *Smaller scale activities may not require as much detail. Requirements should be confirmed with assessment and approval authorities.***

Item	Reclamation	Dredging
***General site management**		
Mitigation and abatement measures to protect the aquatic environment (e.g. containment structures such as silt traps and curtains, or sheet piling)	✔	✔
Water quality monitoring and triggers (e.g. turbidity, dissolved oxygen, contaminant levels)	✔	✔
Riparian and foreshore vegetation preservation	✔	✔
Threatened species protection	✔	✔
Stockpile location and management	✔	✔
Introduced Marine Pest and cyst management strategies		✔
Sediment and erosion control measures	✔	
Weed control and equipment wash down procedures	✔	✔
Storm water management	✔	✔
Noise, air quality (including dust and odour) management	✔	✔
Handling, removal and disposal of waste, including contaminated wastes	✔	✔
Transport and access issues	✔	✔
Cultural heritage issues	✔	✔
Navigation and safety (if boats/barges/platforms are used for construction	✔	✔
Maintenance of public access	✔	✔
Emergency response, including oil spill and fire	✔	✔
Site security	✔	✔
Description of final rehabilitation		
Revegetation of dredge spoil disposal areas (seagrass etc)		✔
Revegetation of stockpile areas	✔	
Stabilisation of batters of reclaimed areas with "rip raps"	✔	
Reinstatement of public access, parking or thoroughfare	✔	✔

Table 4 (cont). ***Basic checklist of items for inclusion in an environmental management plan involving dredging or reclamation activities. *Smaller scale activities may not require as much detail. Requirements should be confirmed with assessment and approval authorities.***

Information on habitats, threatened species and natural values may be obtained from the Natural Values Atlas (DPIPWE), and via the LIST (see Directory of Resources).

Best practice environmental management for reclamation activities

- *Use reclamation only when absolutely necessary, and seek feasible alternatives.*
- *Obtain technical advice from an experienced coastal engineer and coastal geomorphologist.*
- *Plan for sea level rise.*
- *Choose a site that minimises impacts on coastal processes.*
- *Engage and keep stakeholders informed, and seek public input.*
- *Undertake assessments for aboriginal cultural significance and comply with all relevant conditions and legislation.*
- *Minimise the size of reclamation, and the extent of shoreline impacted.*
- *Only use clean (approved) material for fill, and manage any water quality impacts.*
- *Avoid works during critical times such as breeding periods for nearby fish, birds or other wildlife.*
- *Put in place protocols to control the spread of weeds and introduced marine pests.*
- *Minimise damage and rehabilitate site as soon as construction is completed.*
- *Ensure all site personnel are aware of operational constraints required to meet environmental standards and conditions.*
- *Instigate effective monitoring during and after construction to demonstrate performance criteria have been met.*

Reclamation operation in SE Tasmania (Photo Marine Resources).

Dredging: Planning Considerations

All dredging works proposed in the Derwent require planning approval, as there are no discretionary or minimum works limits prescribed in the planning schemes or relevant legislation. The assessment and approval process followed (i.e. Level 1 vs. Level 2 activities as defined in EMPCA Schedule 2) will depend on the degree of risk of environmental harm. Assessments are done on a case-by-case basis, within the planning framework outlined previously. Preliminary discussions with planning and environmental regulatory authorities early in the project timeline are essential, and should include all parties involved in the assessment, or likely to be affected by the project.

A full discussion of alternatives to dredging, and a justification of why dredging must be undertaken are key issues to be addressed to the planning and regulatory authorities satisfaction.

Major areas of concern to be addressed in the preparation of an application for dredging approval are the management of the actual dredging activity itself, and the disposal of the dredged material. These areas should be fully addressed in an EMP presented to the planning/assessment authority, which considers:

- the purpose of the dredging operation
- alternatives to undertaking dredging, including the environmental, social and economic impacts of each alternative
- significant natural and cultural features of the site
- the physical constraints of the site (such as water depth, sediment type, dredging extent, coastal processes)
- environmental impacts of the project on air, soil and water quality
- most appropriate dredge technique, source of dredge equipment and pest management strategies
- whether there are any beneficial uses of the wastes produced
- waste prevention strategies in construction and post-construction phases of project
- waste management and disposal, particularly contaminated waste/ dredge spoil
- mitigation or remediation measures to be put in place, and methods for monitoring the effectiveness of those measures through a monitoring program.

The level of detail required will depend on the nature of the proposal, the scale of dredging to be undertaken and the likely environmental impacts from the proposed works. In areas more remote from pollution sources, sediments are unlikely to be contaminated, whilst sediments closer to urban and industrial areas or slipways are very likely to have significant loads of heavy metal and organic contaminants. There will be significantly different levels of risk associated with activities undertaken in “clean” and “contaminated” areas.

Techniques for the evaluation of sediment quality, identifying risk factors and site specific influences are outlined in PART 5. More information on disposal options is included in PART 6.

Any application for dredging within the Derwent will need to address the significant level of historical heavy metal contamination present in large areas of the estuary, and present a robust case for how the environmental risks associated with disturbing the sediments will be prevented. Identification, prevention and mitigation of any impacts on surrounding air, soil and water quality is a critical component of the application and assessment process. Dredging and disposal methods will form an integral part of the application.

Dredging techniques

Most dredging in Australia is carried out using a trailer hopper dredge (THD) or cutter suction dredge (CSD). THDs are used primarily in maintenance dredging where sufficient navigable depth exists and large volumes are to be removed. THD's consists of a self-propelled ship with a large hopper to contain the dredge spoil. A draghead attached to a suction pipe is lowered to the seafloor and a slurry of sediment & water is pumped into the hopper (see Figure 8). Dredged material settles in the hopper and water drains off through a controllable overflow system. Loading rates and degree of settlement will depend upon the type of sediment. Dredge spoil disposal can be either into the marine environment via doors in the bottom of the hopper, or land based disposal if the hopper load is discharged through a floating pipeline connected to a barge or land based reception facility. THDs create turbid plumes as a result of intake bypass, hopper overflow and the ships propeller. Dredging of fine grained sediments is a concern with this method and environmental controls are usually placed on the overflow and hopper loading rates.

CSDs are usually mounted on a barge and consist of a rotating cutter head that collects a slurry of sediment and water that is pumped through a discharge pipeline. Losses of sediment at the cutter may occur causing localised turbidity, however this results in less efficient dredging and is therefore a concern for dredging contractors. In contaminated areas where very low turbidity and control of resuspension of sediments is required, the cutter head may be replaced with other intake systems. CSDs are used in areas not viable for THDs, and are advantageous where stiff soils and rocks are to be removed, principally in capital dredging projects. Discharge from CSDs is typically into the marine environment, and is the source of most environmental concern with this type of dredging.

For smaller projects where no cutting is required, suction dredges are suitable. A floating grab dredge is used for stiff materials or small volumes in confined spaces which can't be accessed by THDs or CSDs. Sediment losses and associated turbidity may be significant. The use of "prop wash" disturbance to sediment in shallow areas is not an approved technique for sediment movement.

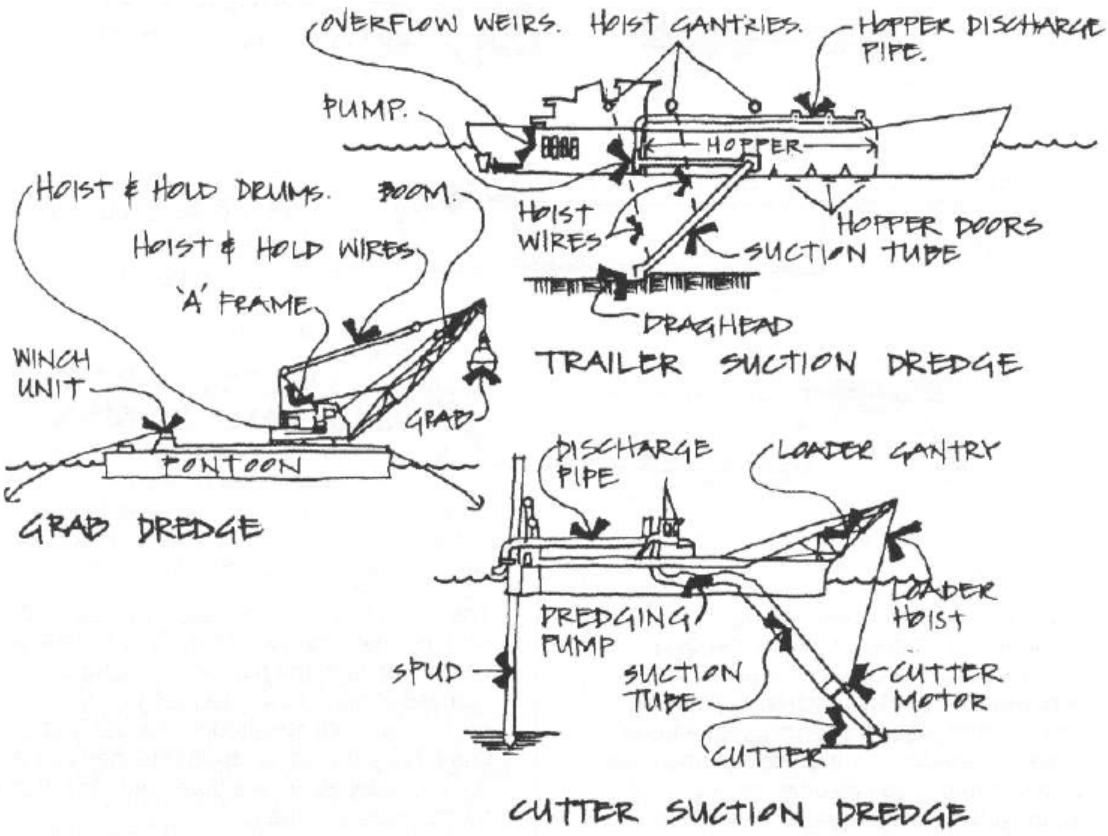


Figure 8 Trailer hopper dredge, cutter suction dredge and grab dredge (SKM Sea Dumping Review, 1996).

Dredging Environmental Management Plan

Environmental Risks Associated with Handling Dredged Material

A basic checklist of items that may need to be addressed for dredging proposals is included in Table 4, but proponents should confirm requirements with the appropriate approval agency prior to preparing an application. *Not all items may be required for smaller scale proposals.*

If marine disposal of dredge spoil is proposed, the assessment of likely environmental impacts must include both the dredge site and the proposed disposal site. The following additional issues should be considered during the development of the EER or EMP.

Contaminant release

Most contaminants found in sediments are associated with fine grained particles in depositional areas, and for this reason silty sediments are more likely to exceed contaminant guidelines than sandy sediments. Controlling the resuspension of fine grained sediments is a key process in managing contaminant release, and in the Derwent resuspension of anoxic (low oxygen) sediments has been shown to an important mechanism for metal release from the sediment. Resuspension of sediments and high turbidity levels during well planned dredging activities is usually localised. However conditions need to be carefully managed and monitored to ensure that the level of resuspension is managed with respect to impacts on surrounding environments, ambient tidal and hydrological conditions, and any threatened species or habitats identified in the desktop study and following investigations. Potential for release of contaminants during dredging should be assessed. Physical control methods such as silt curtains will not be effective in containing dissolved contaminants or soluble nutrients released from disturbed sediments.

Onsite controls of contaminated sediments

Planning for dredging operations must include control measures for limiting escape of sediments, and this may include a combination of operational and engineering controls. Examples include:

- use of silt curtains or screens hung vertically from a floating support to reduce transport of silt and suspended solids from the site. Placement is critical and must take into account tidal flows and currents to be effective. Silt curtains are not effective for dissolved contaminants or soluble nutrients.
- use of sheet piles or cofferdams to physically isolate the dredge area. Use is most effective in shallow, low velocity waters, but requires dewatering of the area to allow dry excavation. A disadvantage is contaminant mobilisation or volatilization during sediment exposure to air.
- timing dredging works to coincide with weather and tidal conditions that will minimise the transport of suspended material.
- timing works to avoid sensitive ecological windows e.g. breeding, spawning or larval stages of threatened or vulnerable species
- using slower production rates or specialist dredge heads when dealing with contamination hotspots.

Sediment loss during transport

Transport includes all operations between the physical removal of sediment during the dredging act (i.e. once material has entered the drag head) and the final disposal or placement of material. Losses most typically occur when mechanical dredging systems use a hopper barge to deliver sediments for ex situ treatment or disposal. Once sediments are placed in a hopper barge, settlement occurs resulting in dense sediments at the bottom, and “free water” on top. Continued loading of the hopper until the free water is displaced by sediment and overflows results in high water column

turbidity and contaminant loss, particularly with fine grained sediments that will not have had time to settle in the hopper. Engineering and operational controls are required to minimise hopper losses.

Acid sulfate soils

Left undisturbed, acid sulfate soils (ASS) are harmless, however dredging has the potential to expose ASS and may result in their prolonged exposure to oxygen (air). When fully oxidised, each kg of (iron sulfide produces1.6 kg of sulfuric acid, causing pH to drop significantly. Soils and sediments may have some neutralising capacity, and this must be assessed when characterising materials. Impacts of poorly managed ASS include contamination of environmental waters, toxicity to flora and fauna as a result of acidity and metal release, and attacks on concrete and steel construction, foundation and infrastructure materials. Treatment and rehabilitation is costly. National protocols on acid sulfate soils and potential acid sulfate soils (PASS) have been developed to provide guidance on the assessment and management of disturbed soils and sediments. DPIPWE have produced Tasmanian Acid Sulfate Soil Management Guidelines (see Directory of Resources). The disturbance of ASS should be avoided wherever possible; where disturbance is unavoidable, preferred management strategies are minimisation of disturbance, neutralisation and strategic reburial.

IMP and resuspension of algal cysts

Larger or specialist dredging operations may require the importation of barges and equipment from outside the Derwent. Introduced Marine Pests (IMP) may be translocated from one location to another unless due consideration to cleanliness and inspection protocols are included in the EMP.

Marine sediments may contain cysts of harmful micro-algal species, and dredging or disturbance may release cysts that have been buried. Assessment of potential for release of harmful species may be required in sensitive areas, or in areas where cysts are considered likely (e.g. near ports and shipping infrastructure). If cysts at levels of concern are encountered, this will need to be factored into the environmental management plan and monitoring requirements.

Impacts on coastal hydraulics

An assessment of the impact of tidal and current patterns, sediment transport and dispersion processes, wave patterns, and any other factors that may impact on the containment of dissolved and particulate dredged material should be considered.

Other stressors

In sediments with high biological oxygen demand (i.e. organic-carbon rich sediments), stressors such as low dissolved oxygen may also result in significant impacts on biological communities. Nutrient fluxes for example are affected by dissolved oxygen, and ammonia release from anoxic sediments resulting from low water column dissolved oxygen can be significant. Ammonia is a stressor and can be toxic under certain environmental conditions. Sulfide is a naturally occurring chemical stressor, and disturbance of anoxic sediments can result in release of hydrogen sulfide. The combined effects of these “natural” stressors can be severe.

Waste minimisation strategies

Feasible ways to reduce the need to dredge, and reduce or eliminate sources of contamination must be considered when dredging proposals are prepared. Options include:

- limit dredging to areas where essential for navigation, flood mitigation or environmental rehabilitation where there is no significant risk to fish, or other animals or plants in surrounding aquatic habitats
- avoid dredging sediments containing contaminants of concern
- use dredging techniques and management practices that minimise disturbance
- select sites where there is no, or negligible need for ongoing maintenance dredging.

Best practice environmental management for dredging activities

- *Limit dredging to essential navigation, flood mitigation or environmental rehabilitation*
- *Avoid dredging contaminated sediments, and assess the risk of disturbing acid sulfate soils*
- *Avoid dredging near areas of significant natural heritage or conservation value*
- *Avoid agitation or jet dredging methods for silty sediments*
- *Obtain technical advice from marine engineers and an experienced coastal geomorphologist*
- *Use the most benign dredging technique and use operational controls to limit impact*
- *Dredge during suitable weather, riverflow and tidal conditions*
- *Handle dredge spoil according to the degree of risk, and limit double handling if possible*
- *Instigate the waste management hierarchy to avoid the production of waste*
- *Avoid smothering sensitive aquatic habitats such as seagrass beds*
- *Avoid works during critical times e.g. breeding periods for nearby fish, birds or other wildlife*
- *Put in place protocols to control the spread of introduced marine pests and weeds.*
- *Manage likelihood of blooms of harmful marine microalgae, either through cyst release or enhanced nutrient concentrations*
- *Ensure all site personnel are aware of operational constraints required to meet environmental standards and conditions*
- *Instigate effective monitoring during and after construction to demonstrate performance criteria have been met.*

References

CSIRO 2008 "Revision of the ANZECC/ARMCANZ Sediment Quality Guidelines" report to Department of the Environment, Water, Heritage and the Arts

DEH 2005 "National recovery plan for four species of handfish" Department of the Environment and Heritage

DEP 2003 "State of the Derwent Estuary: A review of pollution sources, loads and environmental quality data from 1997 to 2003"

DPIWE 2003 "Waterways and Wetlands Works Manual" Department of Primary Industries, Water and the Environment

DPIWE 2005 "General Guidelines for the preparation of a Development Proposal and Environmental Management Plan for Level 2 Activities" Department of Primary Industries Water and the Environment

DPIPWE 2010 "Tasmanian Acid Sulfate Soil Management Guidelines" Department of Primary Industries, Parks, Water and the Environment

EPA Victoria 2001 "Best Practice Environmental Management Guidelines for Dredging"

Page, L and Thorpe, V 2010 "Tasmanian Coastal Works Manual: A Best Practice Management Guide for Changing Coastlines" Department of Primary Industries, Parks, Water and Environment

OSPAR 2004 "Revised OSPAR Guidelines for the Management of Dredged Material" OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic

Sharples, C. 2004 "Indicative Mapping of Tasmanian Coastal Vulnerability to Climate Change and Sea Level Rise: Explanatory Report"

SKM 1996 "Sea Dumping Review: Issues Paper 2- Waste Minimisation" prepared by Sinclair Knight Mertz for Environment Protection Agency

PART 4 Monitoring and Compliance

Monitoring may include diving to sample sediments for a range of parameters (Photo IMAS)

Water quality monitoring is an integral part of assessing impacts from dredging and reclamation (Photo IMAS).

Monitoring and Compliance

Monitoring programs

Monitoring is a critical component of managing the environmental impacts of works in the coastal zone. A well designed monitoring program will give rapid feedback on operations, emission standards and other performance criteria, enabling works to be conducted in a way that minimises environmental harm. The monitoring program outlined in the Environmental Management Plan for the activity will allow the proponent to report on the effectiveness of safeguards put in place to protect the environment, and to report compliance with any specific criteria detailed in the conditions.

EPA Division provides recommendations as to the basic requirements of a monitoring plan, which includes:

- details and results of any pre-commissioning monitoring/studies
- the sites to be sampled
- a site plan showing sampling locations
- the sampling procedures
- the parameters to be analysed
- the frequency of sampling
- the format and frequency of reporting.

For larger projects, post construction monitoring and review may be required at specified intervals to ensure identified longer term impacts are included. Mapping or survey plans of the reclamation "footprint" may be required on completion of construction.

Suitable techniques for monitoring include "before and after" photos, descriptive reports, water quality testing, sediment assessment and habitat assessment. Compliance assessments may include intensive follow up on monitoring, or spot audits.

Permit conditions

If a proposed dredging activity receives environmental and planning approval, any conditions attached to the approval must be adhered to, and incorporated in the Environmental Management Plan.

Permit conditions for dredging are designed to ensure that:

- only the activities approved in the application are undertaken, and at the location specified
- only those sediments that have been characterised through the assessment process and found acceptable for the dredging activity are involved
- the material is handled in the approved manner
- management techniques approved to minimise physical and chemical effects are effectively implemented (e.g. silt screens, cofferdams, temporal restrictions, modified loading rates)
- any necessary pre-treatment (e.g. dewatering, separation, decontamination, windrowing etc) identified during the assessment process is undertaken
- all material is disposed of in the approved manner
- any monitoring requirements are fulfilled and the results reported to the permitting authority in a timely manner.

Permit conditions for reclamation are designed to ensure that:

- only the activities approved in the application are undertaken, and at the location specified
- only fill material that has been characterised through the assessment process and found acceptable for the reclamation activity is used
- the material is handled and deposited in the approved manner
- management techniques approved to minimise physical and chemical effects are effectively implemented (e.g. silt screens, temporal restrictions, sediment and erosion control measures)
- any waste is disposed of in the approved manner
- any monitoring requirements are fulfilled and the results reported to the permitting authority in a timely manner.

Monitoring programs required as part of the permit conditions should be designed to determine whether the works results in effects or impacts different from that expected, and whether the extent of the effects is greater than that expected. An effective monitoring program will allow operations to be assessed, modified or terminated if effects are excessive.

The most common operational monitoring parameter is turbidity, as it gives a real time indication of the extent of sediment disturbance during operations, losses occurring during transfer and transport operations, and the effectiveness of sediment and erosion control with stockpiled materials. It can be easily measured with a number of field devices, and at higher levels is visually obvious. A limit of 5NTU has been proposed for dredge operations where nearby seagrass or other vulnerable communities may be affected. A limit of 50 NTU has been proposed for the release point for dewatering or settlement ponds for dredge activities. Monitoring of dissolved oxygen to determine levels of oxygen depletion may be an effective option for assessing water quality impacts along with turbidity. Measurement of Total Suspended Solids (TSS) provides reliable information on the degree of disturbance, but must be submitted to a laboratory and therefore should not be used as the only indicator of sediment suspension.

ANZECC (2000) suggest that light attenuation may be a better measurement that turbidity in marine environments.

Turbidity does not give reliable information on the potential release of contaminants associated with soils and sediments that may occur during resuspension events. If there are concerns about contaminant release, this should be reflected in the operational and monitoring requirements/conditions attached to the approval.

Dredging guidelines developed for Port Philip Bay suggest that nutrient release from disturbed sediments may be sufficient to trigger algal blooms, and monitoring of harmful algal species was proposed to determine a correlation between dredge and bloom events. Studies in the Derwent suggest natural controls on excessive phytoplankton growth (high natural dissolved organic carbon) may limit opportunity for bloom responses.

Marine Resources and the Development and Conservation Assessment sections of DPIPWE may recommend conditions and monitoring requirements relating to the presence of migratory mammals, controls on practices to manage the risks of Introduced Marine Pests, and impacts on wild and commercial fisheries. Post operation monitoring may be required to demonstrate that there are no long term impacts from the dredging operation and could include benthic community assessment (i.e. video transects).

Environmental Protection Notices

An Environmental Protection Notice (EPN) may be issued in instances where Council (Level 1) or the Director (Level 2 and 3) is satisfied that the activities have, or are likely to, result in environmental harm. AN EPN may also be used to vary permit conditions in accordance with Section 23A.

The EPN can direct the person responsible for the works to halt or delay operations until suitable measures are put in place to prevent, control, reduce or remediate environmental harm. The responsible person has a general environmental duty to prevent environmental harm, and this is described in Section 23A of EMPCA:

A person must take such steps as are practicable or reasonable to prevent or minimise environmental harm or environmental nuisance caused, or likely to be caused, by an activity conducted by that person

In determining whether a person has complied with the general environmental duty, regard must be had to all the circumstances of the conduct of the activity, including but not limited to –

(a) *the nature of the harm or nuisance or likely harm or nuisance; and*

(b) *the sensitivity of the environment into which a pollutant is discharged, emitted or deposited; and*

(c) *the current state of technical knowledge for the activity; and*

(d) *the likelihood and degree of success in preventing or minimising the harm or nuisance of each of the measures that might be taken; and*

(e) *the financial implications of taking each of those measures.*

Section 44 of EMPCA 1994 specifies an EPN may be issued if:

(a) *serious or material environmental harm or environmental nuisance is being, or is likely to be, caused; or*

(b) *serious or material environmental harm or environmental nuisance has occurred and remediation of that harm or nuisance is required; or*

(c) *it is necessary to do so in order to give effect to a State Policy or an environment protection policy; or*

(d) *it is desirable to vary the conditions of a permit; or*

(e) *it is necessary to secure compliance with the general environmental duty .*

Where possible, monitoring should be integrated with regional monitoring programs. The Derwent Estuary Program runs extensive ambient water quality programs at 28 sites throughout the estuary, and has a significant dataset on sediment quality throughout the Derwent. Inclusion of this data in monitoring programs and compliance reporting will add valuable context to any monitoring associated with permit conditions.

References

ANZECC/ARMCANZ 2000 "Australian and New Zealand Guidelines for Fresh and Marine Water Quality"

EPA Victoria 2001 “Best Practice Environmental Management Guidelines for Dredging”

OSPAR 2004 “Revised OSPAR Guidelines for the Management of Dredged Material” OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic

PART 5 Sediment Quality Assessment

Derwent estuary sediment (Photo DEP).

Sediment cores for determining surface sediment properties (Photo DEP).

Sediment quality assessment

One of the most important aspects of the assessment of the environmental effects of dredging is determining sediment quality. Sediment quality can be difficult to characterise because of the inherent variability (heterogeneity) observed in the marine environment, and the multiple potential impacts on habitats, species, water and sediment resulting from intense disturbance.

Key references

The principle document for sediment quality assessment is the ANZECC/ARMCANZ Sediment Quality Guidelines (SQG 2000). The Handbook of Sediment Quality Assessment (2005) is an excellent resource for guiding sediment investigations and describes the most appropriate methodologies for sampling, storage and analysis of marine sediments. The National Assessment Guidelines for Dredging (NAGD 2009) are aimed at ocean disposal of dredge spoil in waters outside State waters, however they provide useful guidance on dredging associated impacts, so elements are adopted here. Both the NAGD and the SQG give detailed information on sampling methodologies, analytical techniques, and the interpretation of sediment quality data and test outcomes.

The NAGD is primarily aimed at the assessment of sediment quality for offshore marine disposal. The ANZECC/ARMCANZ SQG provide guidance on the assessment of sediment quality to determine threats to ecosystem health posed by sediment–associated contaminants. Both sets of guidelines use the same numerical values as "screening" or "trigger" values to determine risk. These trigger values are also adopted here for assessment of Derwent sediments.

Classification of sediments as high risk or low risk is facilitated through a decision tree approach to characterising dredge spoil, and assessing potential impacts. The basic steps recommended for assessment of sediment quality in the Derwent (based on SQG and NAGD) are summarised here. Consult the key references for further information.

Desktop study

Establish contaminants of concern.

It is critical to identify the contaminants likely to be present in the area of the proposed activity. This may be established through a desktop review, covering:

- Past and present land use including industrial processes, agricultural & urban inputs
- local geography and geology
- previous site investigations
- published literature
- any known site specific factors reducing or enhancing contaminant effects.

A summary of potential contaminants of concern in the Derwent is provided in Table 5. Existing water and sediment quality should be described, based on the contaminants on concern identified at the site of interest. A description of the disposal site should be included if marine disposal is proposed (see PART 6 for more information). Based on the review of likely contaminants of concern and the description of the existing environment, the proposed dredge site/s should be classified as "Probably Clean", "Suspect", or "Probably Contaminated". Hotspots requiring further investigation should be identified. Identification of Potential Acid Sulfate Soils (PASS) should be addressed.

Chemical analysis of environmental samples for a wide suite of contaminants is costly, and effort at this stage in establishing which contaminants can justifiably be excluded from the investigation will result in a more cost effective survey.

Contaminant or stressor	Source	Likelihood of presence	% of Derwent esturay sediments exceeding SQG*
Heavy metals	Industry, stormwater, slipways	High in upper and middle estuary, low in lower estuary and parts of Ralphs Bay	68 % (Zinc) 77 % (Lead) 27 % (Copper)
Mercury	Industry	High in upper and middle estuary, low in lower estuary and parts of RB	99 % (Mercury)
TBT	Marine industrial	Hotspots in middle estuary associated with antifouling activities	Unknown
Resin acids	Industry	High in upper estuary, low in middle and lower estuary	Unknown
PCBs	Industry	Limited monitoring suggests low in most of estuary	Unknown
Dioxins	Industry	Limited monitoring suggests low in most of estuary	Unknown
Hydrocarbons	Industry, stormwater	High in upper and middle estuary, low in lower estuary	Unknown
Organochlorine pesticides	Agriculture	Limited monitoring suggests low in most of estuary	Unknown
Ammonia	Occurs naturally	High in sediments where water column dissolved oxygen is low	N/A
Sulphide	Occurs naturally	High where anaerobic decomposition of organic material occurs	N/A
Potential Acid Sulfate Soils	Occurs naturally	High in sediments rich in iron sulphides, more likely in upper and middle estuary	N/A

Table 5 Summary of sediment contaminants of concern, common sediment stressors and the likelihood of presence in the Derwent estuary.
(* State of the Derwent Report 2003, refers to surface sediments only).

Heavy metal distribution in the Derwent

As one of the most significant environmental issues, DEP has datasets available for the distribution of heavy metal contamination in the Derwent. Most of the upper, middle and lower estuary is significantly contaminated with zinc and other heavy metals as a result of historical discharges from the zinc refinery site at Risdon, the paper mill at Boyer and urban inputs to a lesser degree. Figure 9 shows a typical data set for heavy metal contamination in the Derwent, in this instance zinc. Similar maps for arsenic, cadmium, copper, lead, mercury, organic carbon and particle size analysis are included in Appendix 5. See the DEP website for more contemporary data as it becomes available through additional surveys.

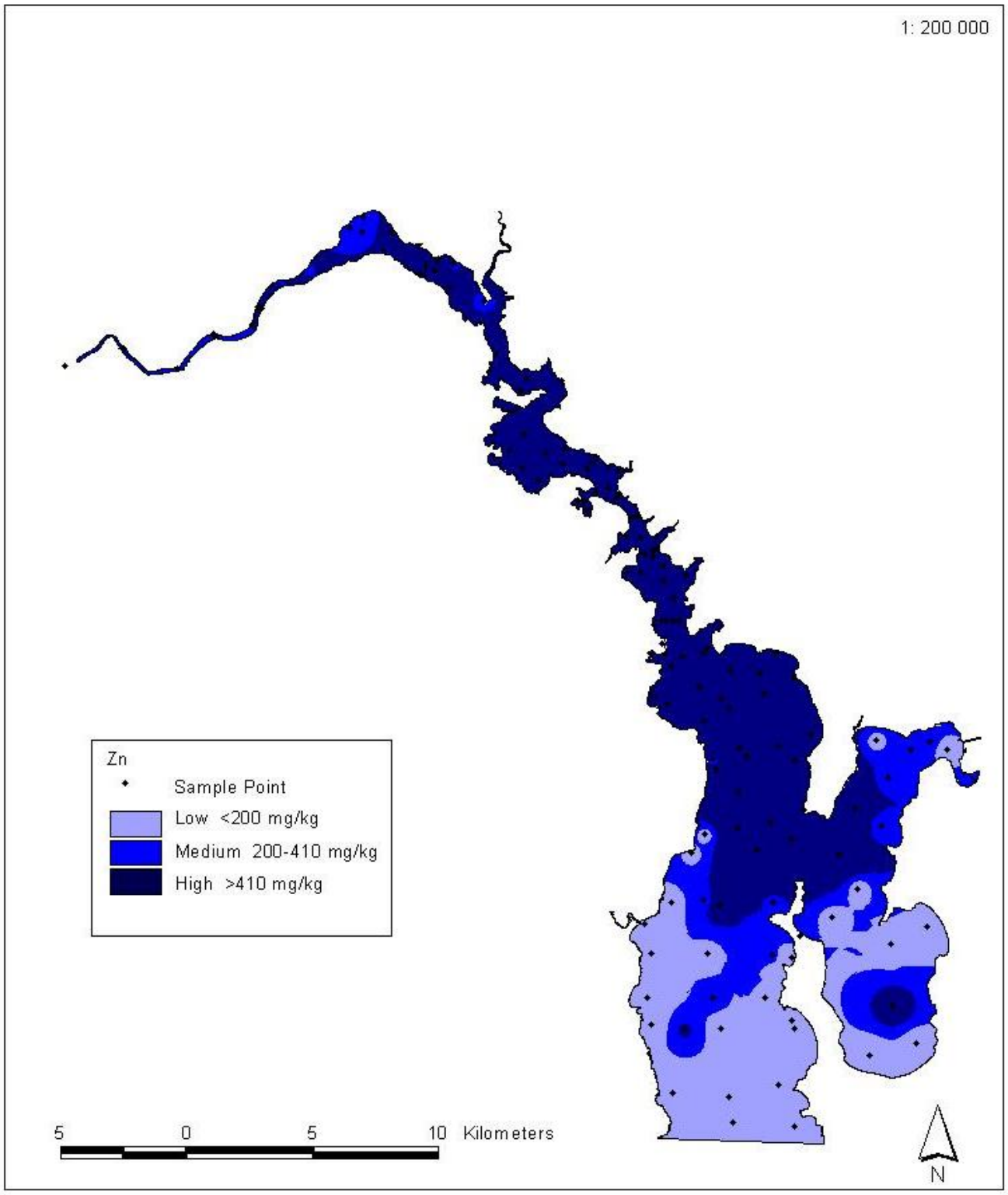


Figure 9 Distribution of zinc in sediments in the Derwent estuary.
"Low" = values less than SQG trigger value (200 mg/kg Zn dry matter basis).
"Medium" = value greater than SQG trigger, but less than SQG-High (410 mg/kg dry matter basis).
"High" = value exceeds SQG-High.

Preliminary sampling

Design preliminary sampling program

Sampling of proposed dredge and (marine) disposal areas must be representative, and adequately describe the distribution of contaminants of concern, both horizontally and with depth. The number of sampling locations required to adequately assess the contaminants of concern at a proposed dredge site is based on NAGD (2009) protocols (see Table 6 and Table 7). The number of samples is based on the need to define the level of contamination, and reflects the level of information obtained through the desktop study.

The desktop review and proposed sampling plan should be discussed with the relevant planning and environmental regulatory authorities before sampling commences. Chemical analyses are costly and thorough planning of the preliminary sampling program will result in better outcomes.

Small projects: less than 50,000 cubic metres

For projects less than 50,000 cubic metres, the entire dredge area should be considered as a single site, and sampling should take place at randomly selected locations within that site, unless sufficient evidence exists to suggest a targeted or non-random approach is more suitable. Expert advice and feedback from regulatory authorities should be sought.

Exemptions

Based on sufficient good quality data, the dredge site and (marine) disposal site should be classified as "probably clean", "suspect" or "probably contaminated". If a site is classified as "probably clean" or "probably contaminated" then the number of sampling locations may be halved (see Table 6).

The number of sampling locations may be reduced if:

- there is recent (< 5 years old) good quality data for the site, covering all of the contaminants of concern identified in the Desktop study ***and***
- there are no new pollution sources identified in the study area since the data above was collected

Volume of potentially contaminated material to be dredged (cubic metres)	Number of sampling locations within the site		
	"Probably clean"*	*"Suspect"*	*"Probably contaminated*"*
0 - 10,000	3	6	3
10,000 - 17,000	4	7	4
17,000 - 23,000	4	8	4
23,000 - 30,000	5	9	5
30,000 - 37,000	5	10	5
37,000 – 43,000	6	11	6
43,000 – 50,000	6	12	6

Table 6 Recommended minimum number of sampling locations within a site for small dredging projects (<50,000 cubic metres, based on NAGD, 2009). *Requires justification, see "Exemptions".

Large projects: 50,000 – 500,000 cubic metres

For projects larger than 50,000 cubic metres, see Table 7 for the recommended number of sampling locations. If there is sufficient good quality information to determine that the distribution of contaminants is relatively uniform, then the whole of the dredge area may be considered to be one site. If the pattern of contamination varies considerably across the dredge area, the area should be divided into distinct sites i.e. contaminated hot spots treated as one site, less contaminated areas around the hotspot treated as one or more sites. The number of sampling locations within each distinct site should then be determined according to the volume of dredged material to be removed.

Exemptions

Following classification as "probably clean", "suspect" or "probably contaminated", the number of samples may be reduced if there is sufficient good quality data from existing surveys to support lower sampling, and the pollution status of the site has not changed, i.e.

The number of sampling locations may be reduced if:

- there is recent (< 5 years old) good quality data for the site, covering all of the contaminants of concern identified in the Desktop study ***and***
- there are no new pollution sources identified in the study area since the data above was collected

Volume of potentially contaminated material to be dredged (cubic metres)	Number of sampling locations within the site		
	"Probably clean"*	*"Suspect"*	*"Probably contaminated*"*
50,000 - 58,000	7	13	7
58,000 – 67,000	7	14	7
67,000 – 75,000	8	15	8
75,000 – 83,000	8	16	8
83,000 – 92,000	9	17	9
92,000 – 100,000	9	18	9
100,000 – 141,000	10	19	10
141,000 – 182,000	10	20	10
182,000 – 223,000	11	21	11
223,000 – 264,000	11	22	11
264,000 – 305,000	12	23	12
305,000 – 346,000	12	24	12
346,000 – 386,000	13	25	13
386,000 – 427,000	13	26	13
427,000 – 468,000	14	27	14
468,000 – 509,000	14	28	14

Table 7 Recommended minimum number of sampling locations within a site for large dredging projects (50,000 – 500,000 cubic metres, based on NAGD 2009). *Requires justification, see "Exemptions".

Projects larger than 500,000 cubic metres

Projects of this scale are considered beyond the scope of this document, and would most likely be assessed as Project of State Significance. The National Assessment Guidelines for Dredging (2009) should be consulted for determining number of sampling locations for proposals of this size.

Determine sampling methodologies

The type of samples & the most appropriate sampling methodologies will be determined by:

- the contaminants of concern
- the likely distribution identified in the desktop study
- the number of samples to be collected
- the proposed disposal method.

For example, dredging in the middle estuary will likely disturb contaminated sediments to a depth of one metre or more, whilst sediment contamination in the lower estuary may result in disturbance of a much smaller layer of contamination (see Figure 10). This needs to be adequately addressed in the sampling program, with sufficient resolution to determine at what depth sediments reflect background or pre-contamination levels. A suitable approach would be to collect cores long enough to capture the expected sediment profile, and slice the cores with high enough resolution to determine the depth of contamination (e.g. 10 cm slices for a deep core, or 2 cm for shallower contamination). It is not necessary to analyse all samples from the core in the first instance. Select surface, deep and intermediate depths and examine the results before proceeding to finer resolution.

Contact the analytical laboratory to ensure that analysis requirements (volume of sample, sample container, preservation, transport, holding time etc) are met.

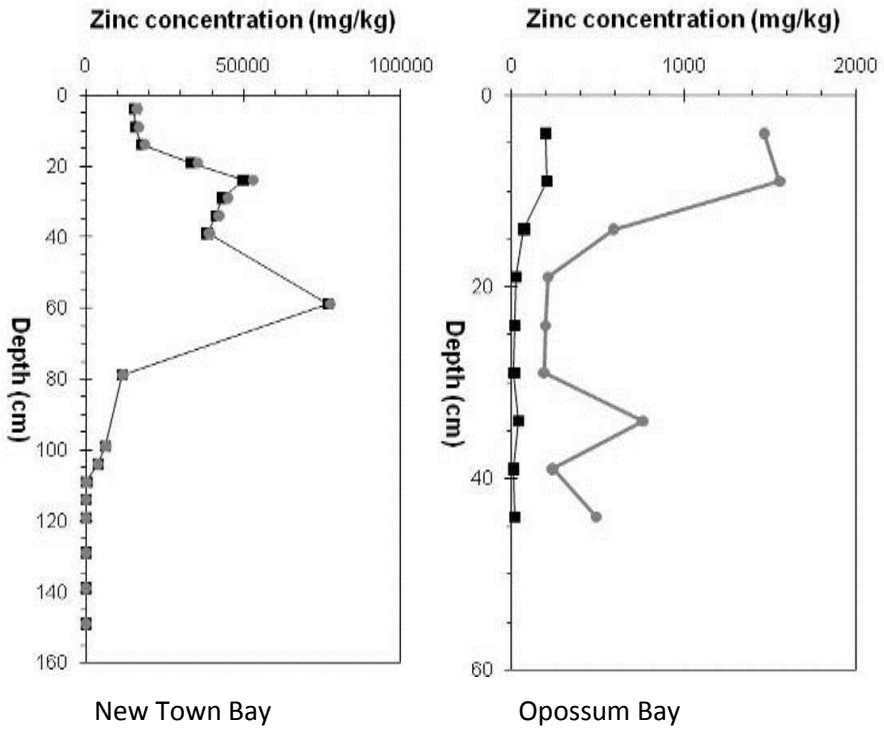


Figure 10 Sediment core data from fine sediments in the middle estuary (left), and sandy sediments in the lower estuary (right). Raw (Black squares) and 63 µm normalised (grey circles) data. (TAFI/DEP data).

For marine based disposal, an assessment of the environment (including sediment quality) needs to be conducted at both the dredge and disposal site. For land based disposal, the total contaminant loads and their leaching characteristics must be defined to determine the appropriate landfill category. More information is provided in PART 6 “Management of Contaminated Material”.

Other sediment quality parameters

Other information that will significantly aid the interpretation of sediment quality data are listed in Table 8.

Parameter	Indicative of
Particle or grain size analysis	Cohesiveness, settling velocities, resuspension potential, accumulation of contaminants
Organic carbon content	Contaminant accumulation potential
Redox status (oxic, sub-oxic, anoxic)	Sediment health, binding of contaminants
Sulphide measurements	Sediment health, binding of contaminants
Density or specific gravity	Consolidation of placed material, volume
Percent moisture	Cohesiveness, settling velocities, resuspension potential

Table 8 Physical and chemical parameters to be considered in sediment quality assessment.

For areas suspected to contain Acid Sulfate Soils, first consult the LIST for maps identifying the predicted distribution of ASS (see Directory of Resources). For detailed information on sampling, control options and planning considerations, consult the Tasmanian Acid Sulfate Soil Management Guidelines.

Assessment using Sediment Quality Guidelines

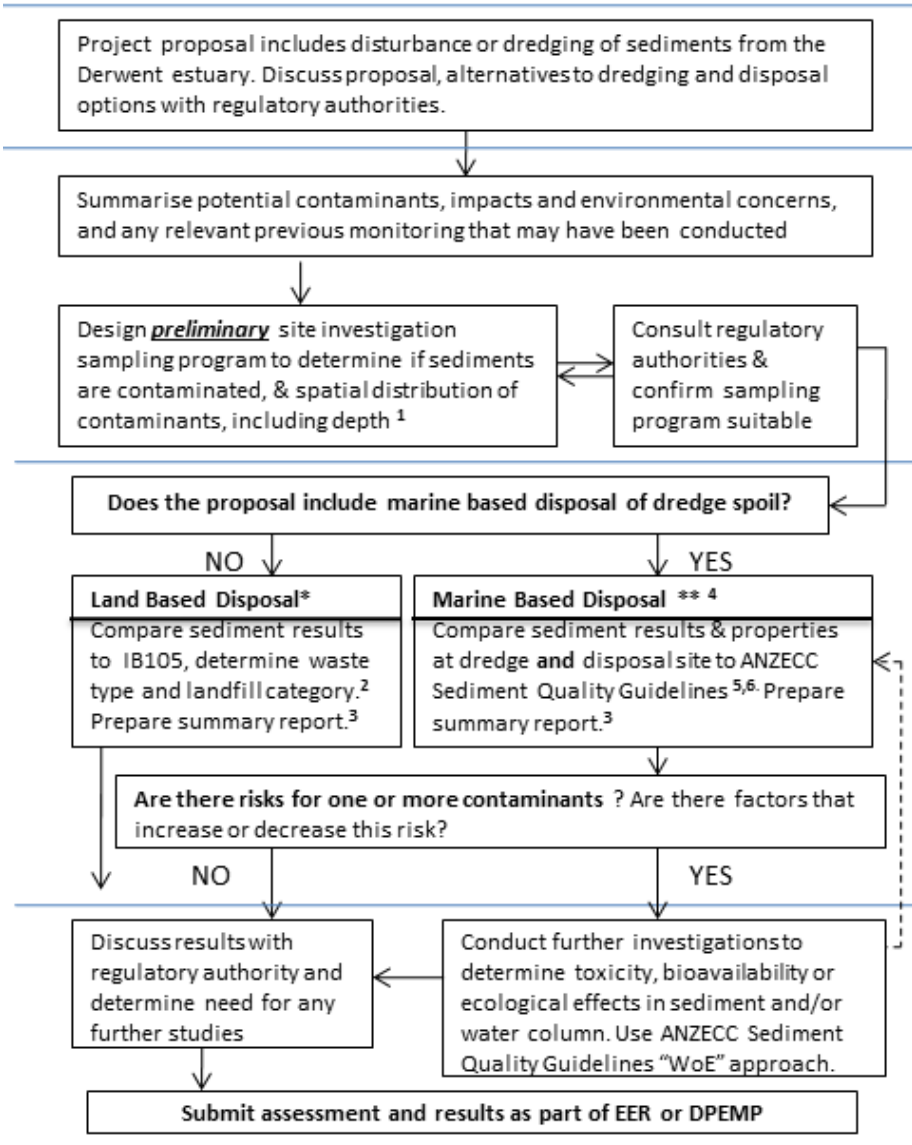
The ANZECC (2000) SQG values for a range of metals, metalloids, organometals and organic sediment contaminants are listed in

Table 9. Data collected during preliminary sediment investigations should be compared to the SQG Trigger and High values. The recommended approach in the first instance is to compare the 95th percentile of the data to the ANZECC trigger values listed and assign a level of risk according to Figure 11, based on the Sediment Chemistry data. Factors identified in the desktop study as increasing or decreasing the risk should be considered at this point. Where the trigger levels are exceeded for one or more contaminants, or there is reason to suggest that site specific factors are important, the decision tree approach outlined in the ANZECC/ARMCANZ SQG should be followed. The approach for metal and organic contaminants is shown in Figure 12.

Other contaminants

Where contaminants are suspected to be present (based on desktop study), and there are no SQG available, it is recommended that the procedures set out in ANZECC/ARMCANZ 2000 are used.

If it is anticipated that sediments will be identified as “Medium Risk” or “High Risk”, based on ANZECC SGQ trigger values (Table 9) it would be prudent to collect sufficient sediments for further detailed investigations of chemical form, bioavailability, and toxicity at an early stage. Samples should be collected, preserved and stored in accordance with the recommendations in the Handbook for Sediment Quality Assessment, until required for testing. This will reduce the cost of additional sampling at later date. Correct storage of samples is critical.



Initial Trigger

Dredging and disposal of marine sediments from the Derwent estuary

"Desk Top" Study & Preliminary Sampling

Include assessment of current & historic surrounding land use, site specific factors, geology etc & compile list of potential contaminants.

Assessment against ANZECC SQG[5]

Low Risk: *Below SQG trigger. Effects negligible.*
Medium Risk: *Between trigger & upper guideline. Effects possible, requires further investigation.*
High Risk*: Above upper guideline. Effects probable, requires further investigation.*
See Table 9 & 10.

Detailed Investigation

Consult regulatory authority about further studies and WoE approach Must address all potential water and sediment quality issues

WoE may include:

- *Sediment Chemistry e.g organic carbon & grain size, acid soluble metals, pore water concentrations, elutriate testing, speciation & complexation capacity*
- *Toxicity testing*
- *Bioaccumulation potential*
- *Community /ecological effects*

1 For land based disposal, design sampling program in accordance with IB105. For marine based disposal use Handbook for Sediment Quality Assessment, ANZECC SQG & elements of NAGD
2 If desktop assessment is not performed, the entire analytical suite outlined in IB105 should be analysed.
3 May form part of NOI where required. Discuss with regulatory authority.
4 Assessed as Level 2 for disposal in waters within the limit of the State. Disposal outside the limits of the State requires Commonwealth assessment & NAGD.
5 If desktop assessment is not performed, the entire analytical suite for which ANZECC Sediment Quality Guidelines exist should be analysed.
6 For the dredge area, or a distinct zones, calculate the 95th percentile, and compare this value to the ANZECC sediment guideline value.

IB105 "Information Bulletin 105 Classification and Management of Contaminated Soil for Disposal" (Environment Division)
NAGD "National Assessment Guidelines for Dredging"
SQG (ANZECC) Sediment Quality Guidelines
WoE Weight of Evidence
* Requires justification, & approval for disposal from Director
** Requires justification.

Figure 11 ***Framework for sediment quality assessment for dredging activities in the Derwent.***

Contaminant	SQG Trigger value	SQG-High value
METALS (mg/kg dry weight)		
Antimony	2	25
Cadmium	1.5	10
Chromium	80	370
Copper	65	270
Lead	50	220
Mercury	0.15	1
Nickel	21	52
Silver	1.0	3.7
Zinc	200	410
METTALOIDS (mg/kg dry weight)		
Arsenic	20	70
ORGANOMETALLICS(µg Sn/kg dry weight, normalised to 1% organic carbon)		
Tributyltin	9	70
ORGANICS (µg/kg dry weight, normalised to 1% organic carbon)		
Total PAH	10,000	50,000
Total DDT	1.6	46
p.p'-DDE	2.2	27
o,p'- + p,p'-DDD	2	6
Chlordane	0.5	6
Dieldrin	280	620
Endrin	10	220
Lindane	0.32	1.0
Total PCBs	23	-
Total petroleum hydrocarbons (TPH)	550	-

Table 9 SQG Trigger levels & SQG-High values for sediment contaminants (Source ANZECC ARMCANZ

Lines of Evidence approach

Recent trends in assessment of sediment quality use multiple Lines of Evidence (LoE) to fully investigate the impacts of contaminant levels in sediments. Sediment chemistry is seen as a single LoE (see Table 10), and gives information about the level of contaminants of concern, possible mitigating or ameliorating characteristics, and some indication of the likelihood of environmental effects. Figure 12 shows sediment chemistry as the first LoE for a decision tree approach to assessing

sediment quality. If sediments are consistently classified as medium or high risk after consecutive investigations including acid extractable metals, comparison to background concentrations, bioavailability estimate assessments (e.g. acid volatile sulphides, porewater concentrations, elutriates or speciation studies) then additional Lines of Evidence should be undertaken to determine the environmental impacts of disturbance to the sediments.

Additional LoE include:

- toxicity testing using locally relevant species
- ecological studies of benthic community structure
- bioaccumulation of contaminants of concern in the food chain.

Further LoE may be developed to meet specific requirements of individual studies if required. The information from each individual LoE is scored (weighted) in accordance with criteria set out in the ANZECC/ARMCANZ SQG, and the results combined to give an overall assessment of the risk level associated with the sediments. This Weight of Evidence (WoE) approach requires design, assessment and interpretation by appropriately qualified persons. In dredging projects, this approach can be used to study both the proposed dredge and (marine) disposal site.

	Lines of Evidence			
Overall Risk Level	**Sediment Chemistry**	**Sediment Toxicity**	**Benthic communities**	**Bioaccumulation**
Low Risk *Effects negligible*	**< SQG Trigger**	**No toxicity to sensitive species observed**	**No impairment to benthic community**	**Bioaccumulative substances not present**
Medium Risk *Effects possible*	**> SQG Trigger**	**Toxicity observed in sensitive species**	**Moderate impairment to benthic community**	**Bioaccumulative substances present**
High Risk *Effects expected*	**>SQG High**	**Toxic to multiple species**	**Highly impacted benthic community**	**Bioaccumulation tissue residue guidelines exceeded**

Table 10 Evaluation of risks associated with contaminated sediments using chemistry, toxicity, ecology, and bioaccumulation Lines of Evidence (Based on USGS and ANZECC/ARMCANZ SQG).

References

ANZECC/ARMCANZ 2000 "Australian and New Zealand Guidelines for Marine and Freshwater Quality"

ANZECC/ARMCANZ 2008 "Revision of the ANZECC/ ARMCANZ Sediment Quality Guidelines" Simpson, S.L., Batley, G.E. and Chariton A.A.

Commonwealth of Australia 2009 "National Assessment Guidelines for Dredging"

DEP 2003 "State of the Derwent Estuary: A review of pollution sources, loads and environmental quality data from 1997 to 2003"

DEP 2007 "Derwent Estuary Water Quality Improvement Plan for Heavy Metals" Department of Tourism, Arts and the Environment

Simpson *et al* 2005 "Handbook for Sediment Quality Assessment" CSIRO, Bangor NSW

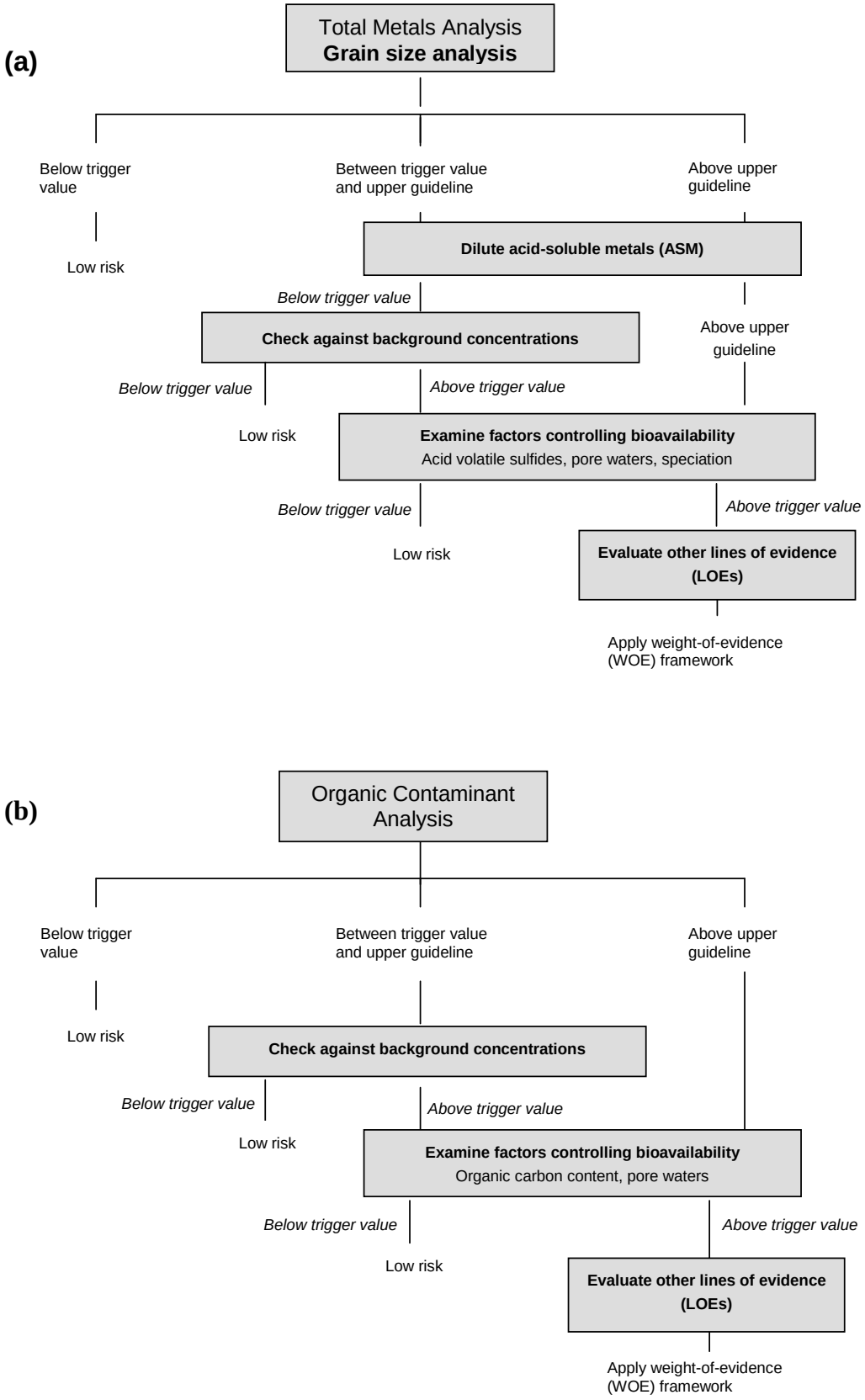
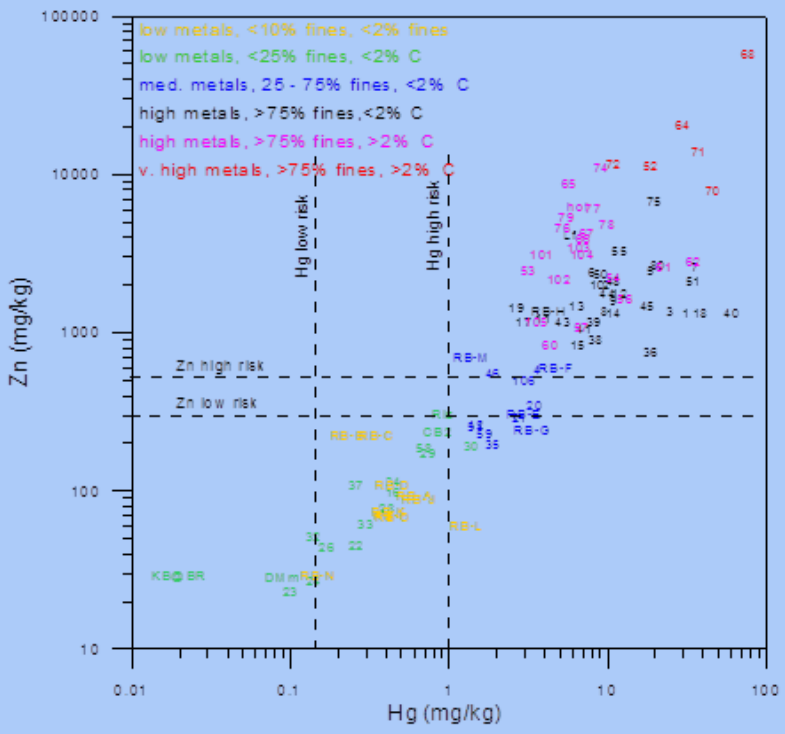


Figure 12 The decision tree approach for the assessment of contaminated sediments for (a) metals and (b) organic contaminants (From ANZECC/ARMCANZ SQG, 2008).

Example of "Weight of Evidence" approach in the Derwent

In 2007 the Derwent Estuary Program completed a study of sediment quality as part of a Coastal Catchment Initiative Water Quality Improvement Plan (WQIP) for Heavy Metals. One element of the WQIP was to use multiple Lines of Evidence to assess sediment quality. The estuary was divided into 6 zones, based on a survey of more than 120 sites between the Bridgewater Bridge and Iron Pot in 2000. A strong correlation between zinc, mercury and organic carbon content was found for estuarine and marine sediments, shown below.

One site from each of the 6 zones was selected for further investigations of a) chemical estimates of bioavailability (pore water, AVS/SEM, acid extractable metals, sulphide, redox, sulphide speciation) b) toxicity testing of the most contaminated sites using three species and c) benthic faunal surveys.



The results showed high levels of metals were released in dilute acid extractions, with significantly lower concentrations extracted in clean seawater. Toxicity tests from 3 of the sites in the middle estuary were acutely toxic, while a site at the mouth of Ralphs Bay was not. Benthic community structure showed abundant but heavily modified faunal communities in areas of high metal concentrations, although physical factors (depth, salinity, sediment type) were a dominant factor.

Additional studies using biogeochemical and hydrodynamic modelling suggested that under low to moderate flows, metals are released from sediments resulting in increased dissolved metal concentrations, whilst high flows results in increased particulate loads. High levels of metals in wild and deployed shellfish, and several species of fish confirmed that despite significant reductions in sources of heavy metals to the estuary from urban and industrial sources, bioavailable forms of contaminants prevent human consumption.

The Weight of Evidence approach employed in the WQIP concluded that organic rich sediments in the middle and upper estuary are high risk, and that disturbance should be avoided. Sandier sediments in the lower estuary presented a lower risk, however mercury bioaccumulation is a concern. Ongoing studies on sediment toxicity and bioaccumulation pathways aim to better define risks and management strategies in the Derwent.

PART 6 Management of Contaminated Materials

Waste Management

Due to the large area of contaminated marine sediments present in the Derwent, it is likely that most applications for dredging will need to address the management of contaminated material. Any activity resulting in the disturbance, movement or removal of contaminated material (including marine sediments) must be assessed under *Environmental Management and Pollution Control (Waste Management) Regulations 2000*. This applies to material that is proposed for re-use, requires treatment, and/or off-site disposal. The Waste Management Regulations cover the disposal of controlled waste to prevent direct or indirect environmental harm, the accumulation of substances in plants, animals, organisms or soil above natural concentrations, and adverse effects on the values of receiving waters for recreational, commercial, domestic, agricultural or industrial processes.

Evaluate disposal options

Based on the information gathered in the desktop study, and discussions with regulatory agencies, an assessment of the disposal options should be made. The assessment should include any potential beneficial uses of the material. For "clean" sediments these may include:

- engineered uses such as capping material and fill
- agricultural use
- habitat creation

For contaminated material, the following options may be considered

- treatment including separation of contaminated fractions
- containment and capping with cleaner material
- containment and stabilisation technology

Disposal options for contaminated materials are limited and expensive. The two principle options for the approved disposal of dredge spoil are:

- land based disposal of contaminated material, or
- disposal of material into the marine environment.

There are separate assessment and approval processes for these options.

Land based disposal

Placement of dredge spoil in landfill may be suitable for small volumes of contaminated material, as long as the material approved for disposal at the landfill facility. Sediments may need to be dewatered as a pre-treatment step before deposition as landfill, as liquid or semi-liquid waste cannot be accepted. EPA Division recommend that where possible, contaminated material be remediated, treated or re-used in preference to disposal at an approved landfill site. This is to reduce the level of waste disposed at landfill, and to avoid or minimise adverse impacts from the management of contaminated waste.

Information Bulletin 105 ("*Classification and Management of Contaminated Soil for Disposal, 2009*") describes classification criteria for soil as Level 1 (Fill Material), Level 2 (Low Level Contaminated Soil), Level 3 (Contaminated Soil), or Level 4 (Contaminated Soil for Remediation) in accordance with the level of prescribed contaminants present. Waste will need to be analysed to determine compliance with levels specified. Applications for use, re-use, remediation, or disposal must be sent to the EPA, in accordance with the information requested in Bulletin 105.

In principle agreement from the landfill disposal facility is required before disposal can be undertaken. The classification of the soil as Level 1, 2, 3 or 4 will determine what category of landfill the waste can be disposed of as, and these are summarised in Table 11. Levels of prescribed contaminants for each of the 4 Categories are included in Appendix 6.

There are limited options available for disposal of Level 2 and Level 3 waste in Tasmania (See Bulletin 105 for approved facilities). There are no facilities that accept Level 4 waste, therefore it must be treated or remediated before reclassification and acceptance as a lesser category.

Approval for use or re-use of fill material is determined on a case by case basis. Disposal of sediments with low levels of contaminants is not devoid of environmental risk, and requires the responsible management of the material to ensure that it does not become a pollutant, through increased turbidity levels, erosion etc. Oxidative release of contaminants should also be considered.

Classification as Level 1 Fill material for land based disposal does not imply material is suitable for use as fill in coastal reclamation projects.

Waste type	Category A	Category B	Category C
	Solid Inert Landfill	Putrescible Landfill	Secure Landfill*
Level 1 ***Fill Material***	✔	✔	✔
Level 2 ***Low Level Contaminated Soil***	✗	✔	✔
Level 3 ***Contaminated Soil***	✗	✗	✔
Level 4 ***Contaminated Soil for Remediation***	✗	✗	✗

Table 11 Summary of waste accepted by Tasmanian Category A, B, or C landfill facilities.* includes hazardous/controlled waste.

Dewatering

Land based disposal can create additional handling requirements for dredged material. The liquid content of waste dredge spoil must be reduced before material can be accepted by a landfill disposal facility, and dewatering sites need to be constructed for large dredge projects.

The Victorian EPA makes the following recommendations for management of dewatering sites for sediments post extraction:

- the dewatering site should be located as close as practicable to the dredge site (within 1 km), or additional booster stations will be required to transfer the sediment via pipelines
- the dewatering site should have little value in its current state, and be rehabilitated post use
- the site should be large enough for containment bunds suitable for dewatering to be constructed
- site security is critical due to the quick-sand like properties of bunded fines
- the site may need to be operational for extended periods if significant drying is required

- evaporative loss should be minimised so that salts are not concentrated in the sediment
- site discharge should be marine rather than freshwater, with compliance limits for discharge attached to the approval
- be accessible to trucks if removal is required for final disposal or site rehabilitation
- be acceptable to the "informed" public, following public consultation

Marine based disposal

The process for assessment of dredge spoil disposal in the marine environment is dependent on the proposed location of the disposal site. The two main categories are:

- disposing of wastes in waters within the limits of the State, or
- disposing of wastes outside the limits of the State

There are separate assessment and approval processes for these options. Both processes require that the proposed activity seek viable alternatives to the disposal of waste in the marine environment, and present justification for this being the preferred option. Where marine disposal is being considered, as far as possible, the dredged material and the sediments in the receiving environment should be similar.

Disposal within the limits of the State

A proposal to dispose of waste (including dredge spoil) in waters within the limits of the State will trigger an assessment as a Level 2 activity, as specified in Section 7(e) of Schedule 2 of the Environmental Management and Pollution Control Act 1994. The environmental assessment and approval process is summarised in Figure 6 and Figure11. Appendix 7 shows the extent of coastal waters inside and outside of the Territorial Sea Baseline.

Disposal outside the limits of the State

A proposal to dispose of waste outside State waters would trigger the *Environment Protection (Sea Dumping) Act 1981*, with assessment required by the Commonwealth. The Act covers both the transportation of dredged material and the actual disposal. The London Convention 1972 (of which Australia is a contracting partner through the implementation of the *Sea Dumping Act* 1981) specifies prohibited substances, including that contaminated with mercury, for which sea dumping is prohibited.

The assessment framework for the *Sea Dumping Act* is set out in the National Assessment Guidelines for Dredging (2009). The assessment process, decision tree approach and compliance limits specified in the NAGD are broadly in line with the protocols recommended in the ANZECC Interim Sediment Quality Guidelines, which are under review. Sediment Quality Assessment criteria (i.e. Trigger Levels) are consistent between the 2 documents.

References

Information Bulletin 105 "Classification and Management of Contaminated Soil for Disposal" EPA September 2009

National Research Council 1997 "Contaminated Sediments in Ports and Waterways". Cleanup Strategies and Technologies" National Academy Press

Page, L and Thorpe, V 2010 "Tasmanian Coastal Works Manual: A Best Practice Management Guide for Changing Coastlines" Department of Primary Industries, Parks, Water and Environment

SKM 1996 "Sea Dumping Review: Issues Paper 2- Waste Minimisation" prepared by Sinclair Knight Mertz for Environment Protection Agency

Conclusions and Recommendations

This guidance document has been prepared to assist the implementation of best practice environmental management in proposed dredging and reclamation projects in the Derwent estuary. It includes a summary of the likely environmental impacts if projects are not carried out with due regard to the natural values and environmental issues in the estuary, and best practice standards for dredging and reclamation. The report also summarises the jurisdictional and institutional complexity of the planning and assessment processes involved in foreshore development. A series of flowcharts and checklists have been prepared to assist planning authorities, consultants and proponents address the major environmental issues associated with dredging and reclamation activities. A framework for sediment quality assessment, based on national guidelines is provided, with examples of sediment quality data and assessment from the Derwent. It also includes a list of resources to help all parties efficiently access an increasingly complex data set of environmental data and information.

During the preparation of this document, a number of areas were identified that require further clarification or focus. The scope of the reclamation component of this review does not include the construction of seawalls, or other hard structures used to protect property and infrastructure. It is highly probable that in the face of predicted sea level rise over the coming decades that seawall construction may become a major factor in protecting urban and industrial properties. The Intergovernmental Panel on Climate Change predicted in 2007 that the extent of sea level rise as a direct result of global warming was between 20 and 80 cm by 2100, with significant impacts on coastal communities in Australia detected by 2050. Measurements since 2007 and improved understanding of the factors that influence sea level rise show that sea level rise of over 1.0 m and as high as 1.5m is possible, and that seas will continue to rise long after 2100.

A projected increase in the severity of storms and frequency of coastal flooding will necessarily result in the use of seawalls and storm surge protection in highly developed coastal areas. Some planning authorities have included inundation schedules in their planning schemes, and this is a first step in addressing likely areas of high risk development. Aspects of managing for sea level rise and techniques to minimise environmental impacts are covered in the recently released Coastal Works Manual (Page and Thorp, 2010). The manual is designed to assist land managers manage coastal environments, but also is valuable resource for anyone planning to do works in the coastal zone. It provides information on the most likely impacts of sea level rise, storms and inundation, and coastal erosion and recession, and best practice techniques for shoreline protection and modification.

Another issue identified is that there are no minimum or discretionary limits for dredging or reclamation activities, and currently all projects must be assessed through the relevant planning authority. It may be beneficial to consider discretionary limits for identified low risk areas, but this concept would require significant discussion between Council and State parties. Assessment process can be complex and time consuming (e.g. where Council and Crown Land approvals are necessary) and any efforts to streamline or clarify assessment processes would be of value.

The lack of resources available to Councils to monitor and follow up on reclamation projects was highlighted during interviews with Council planners and managers. Larger Councils are in a better position to monitor and undertake site visits, but generally there was minimal or no follow up possible once an approval had been granted. Any tools or resources that may enable Councils to fulfil this need will be very beneficial in terms of environmental outcomes.

Each Derwent Council has its own planning scheme, and as a result their approach to assessing and approving reclamation and dredging activities varies. Additionally, the extent of control over foreshore and tidal waters varies between each planning scheme, with jurisdictional boundaries ranging from the high water mark to 200 m from the seaward side of the high water mark. Newer

planning schemes tend to have more detail on permitted and discretionary activities for coastal and foreshore development and use. Older planning schemes currently under review will be drafted in accordance with generic guidelines set down by the TPC, and this should see some streamlining of scope and approaches between Councils, and a greater emphasis on the principles and objectives of the State Coastal Policy.

The fragmented and complex nature of land tenure on the Derwent foreshore gives an additional layer of complexity to the assessment process. Currently 6 planning authorities and 3 state agencies manage foreshore use, with numerous referral agencies. Improved links and coordination between local and state planning mechanisms has previously been identified as an opportunity to provide more streamlined processes. There may be a strong case for a unified regional foreshore overlay for the Derwent to further define appropriate development and use. This could be constructed in terms of level of overall risk for different areas of the estuary, and could draw on the already significant level of detail collected by NRM South, DEP and the Coastal and Marine Branch.

Continued emphasis on management of urban stormwater to control sediment loads will reduce need for maintenance dredging in areas where silt accumulates (e.g. depositional bays).

Sediment and Erosion Control

Sediment and erosion control (or lack of) have been identified as major factors in the accumulation of silt in estuarine and coastal areas, and can directly contribute to the need for ongoing maintenance dredging in depositional areas. Dredging operations are repeatedly proposed in certain shallow embayments in the Derwent estuary in order to meet minimum depth requirements for recreational boat mooring and commercial/industrial needs.

Areas prone to high siltation rates due to stilling effects or high sediment loads from catchment processes, tend to accumulate fine grained sediments. These finer sediments carry the largest fraction of bound contaminants. Improved sediment and erosion control in urban and industrial areas around the estuary is an important aspect of overall catchment management, and may include the installation of Water Sensitive Urban Design features, stormwater traps, sediment basins or settling ponds. Management of sediment and erosion control during construction activities is a key area for prevention of poor water quality and accumulation of sediment in coastal waters. The Derwent Estuary Program has produced a number of Fact Sheets and Guidance documents to assist in management of stormwater, including design and engineering principles (see www.derwentriver.org.au).

Siltation in Lindisfarne Bay associated with storm water (Photo Google Earth).

Silt from catchment loads entering the Derwent (DEP).

Glossary

The following definitions are provided with respect to dredging and reclamation:

acceptable solution quantitative standards that are deemed to satisfy the intent of a design element.

accretion growth through addition or expansion.

agitation dredging process where silt material is deliberately disturbed to create resuspension, allowing natural currents to disperse the material. On a small scale this includes "prop wash" activities undertaken with the intent to move sediment material.

alternative solution subjective matters that need to be assessed for performance against the planning scheme principles.

amenity includes any quality or condition of the area that is conducive to its enjoyment.

ANZECC Australian and New Zealand Environment Conservation Council

ARMCANZ Agriculture & Resource Management Council of Australia and New Zealand

capital dredging dredging for navigation, to enlarge or deepen existing channels and port areas, or to create new ones, or for creation of fill for reclamation**.**

coastal zone State waters and all land to a distance of one kilometre inland from the high water mark.

coastal waters described in Section 3 of the *Coastal Waters (State Powers Act) 1980*, essentially the first 3 nautical miles seaward of the low water mark (also known as State waters). For SE Tas, 3 nautical miles seaward of the Territorial Sea Baseline.

cofferdam temporary watertight enclosure that is pumped dry to expose the bottom of a body of water so that construction, as of piers, may be undertaken.

contamination the condition of land or water where any chemical substance or waste has been added at above background level and represents, or potentially represents, an adverse health or environmental impact.

controlled waste substances with one or more characteristics that may pose a risk of harm to human health and/or the environment.

CSD Cutter Suction Dredge

development the construction, exterior alteration or exterior decoration of a building; the demolition or removal of a building or works; the construction or carrying out of works; the subdivision or consolidation of land, including buildings or airspace; the placing or relocation of a building or works on land.

drag head the intake of a trailer suction hopper dredge.

dredge spoil material removed or recovered by dredging.

dredging an activity undertaken to clean, deepen or widen harbours, waterways or channels for the purpose of navigation, construction, or reclamation. It involves the movement and/or removal of marine sediments.

environmental dredging deliberate removal of contaminated material from the marine environment for human health and environmental protection purposes.

environmental harm **"**any adverse effect on the environment (of whatever degree or duration) and includes an environmental nuisance"; as defined in *Environmental Management and Pollution Control Act 1994.*

elutriate water sample produced by agitating sediments with clean seawater in a defined ration, for a defined period of time. Used to assess sediment quality and contaminant mobility.

foreshore the area between the high and low water mark.

ISQG Interim Sediment Quality Guidelines

internal waters means any waters of the sea on the landward side of the baseline of the territorial sea (TSB); as defined in *Offshore Waters Jurisdiction Act 1976.*

intertidal zone the area that is exposed to the air at low tide and submerged at high tide, for example, the area between tide marks.

jet dredging injection of water into sediments causing the resuspension of material, and subsequent redistribution with natural currents.

land includes buildings and other structures permanently fixed to land; land covered with water; water covering land; and any estate, interest, easement, servitude, privilege or right in or over land.

maintenance dredging works undertaken to ensure channels, berths or construction works are maintained at designed dimensions.

marine structure includes boat sheds, boat launching facilities and marinas.

national environment protection measure a national environment protection measure made and in force under section 14 of the *National Environment Protection Council Act 1994* of the Commonwealth.

overlays an additional planning tool with local planning schemes that operates in addition to the zone. Overlays provide additional controls that respond to specific issues that may affect the land, such as heritage or coastal management.

planning permit any permit, approval or consent required by a planning scheme or special planning order to be issued or given by a Council for a use or development.

performance criteria qualitative statements outlining the means of achieving the intent of a design element.

PEV Protected Environmental Value.

precinct part of a Zone defined and described in the planning scheme.

reclamation **e**xtension or alteration of the foreshore area into intertidal/subtidal areas, involving the filling in or draining of submerged land.

revetment A facing, typically cement or rock, used to support and protect an embankment.

rip rap Large sized stone or boulders, is used extensively to control erosion. Absorbs and deflects wave energy.

State waters State waters are broadly defined as a 3 nautical mile band of marine water measured from the low tide mark. See also Coastal Waters. For SE Tas, 3 nautical miles seaward of the Territorial Sea Baseline.

trigger values a concentration at which action or further assessment is required, based on protection of the environment, species or habitats

TSB Territorial Sea Baseline

TSD Trailer Suction (hopper) Dredge

threatened species threatened flora and fauna nominated under Commonwealth or State legislation, or identified through regional management plans.

use (in relation to land) includes the manner of utilising land but does not include the undertaking of development.

waste producer a person who needs a waste to be disposed of, whether that person has produced the waste, is the occupier of premises which have received the waste from someone else, or has responsibility for waste arising from an historic activity.

waters within the limits of the State equivalent to State waters

watercourse a river, creek or stream in which water flows permanently or intermittently and includes the beds and banks of a river, creek or stream, and elements of a river creek or stream that may confine or contain water.

wetlands depressions in the landscape or areas of poor drainage that hold water derived from ground water and surface water runoff and support plants adapted to partial or full inundation.

zone a particular area delineated on the plans within which a specific set of planning controls apply.

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Directory of Resources

Aboriginal Heritage

Aboriginal Heritage Tasmania

http://www.aboriginalheritage.tas.gov.au/

Information on guidelines and standards for heritage or archaeological assessments, reporting of and access to Tasmanian Aboriginal Site Index information

Burra Charter

http://www.icomos.org/australia/

Information on basic principles and procedures in conservation of Australian Heritage Places

Acid sulfate soils

Atlas of Australian Acid Sulfate Soils

http://www.clw.csiro.au/acidsulfatesoils/atlas.html

Site developed by CSIRO Land and Water, shows potential for acid sulfate soils around Australia

Acid Sulfate Soils Laboratory Methods Guidelines

http://www.nrw.qld.gov.au/land/ass/pdfs/lmg.pdf

Information on techniques for acid sulfate soils analysis

State of the Environment Report

http://soer.justice.tas.gov.au/2003/lan/2/issue/91/ataglance.php

Includes information on ASS as a threatening process and links to other Tasmanian reports

Tasmanian Acid Sulfate Soil Management Guidelines

http://www.dpiw.tas.gov.au/

Includes assessment of projects which may affect Acid Sulfate Soil; Management principles; Management strategies

Coastal Vulnerability

http://www.dpiw.tas.gov.au/inter.nsf/WebPages/PMAS-6B56BV?open

Outlines the vulnerability of the Tasmanian coastline to the impacts of climate change and sea level rise

http://www.derwentestuary.org.au

DEP Climate Change Issues Paper

Legislation

Tasmanian Legislation

http://www.thelaw.tas.gov.au/index.w3p

provides access to Acts and statutory rules for Tasmania

Environmental Management and Pollution Control Act 1994

http://www.thelaw.tas.gov.au/tocview/index.w3p;cond=;doc_id=44%2B%2B1994%2BAT%40EN%2B20050210160000;histon=;prompt=;rec=;term=

Provides access to the EMPCA 1994.

EPBC Act

http://www.environment.gov.au/epbc/index.html

Information on Australias central environmental protection legislation.

Sea Dumping Act

http://www.environment.gov.au/coasts/pollution/dumping/act.html

Information on Australias' international obligations under the London Protocol.

Management & Strategic Plans for the Derwent

Derwent Estuary Environmental Management Plan

http://www.derwentestuary.org.au

Includes discussion of issues, existing conditions, threats and management response to environmental problems.

Natural values

Directory of Important Wetlands

http://www.environment.gov.au/water/publications/environmental/wetlands/directory.html

Provides details of location of listed wetlands in Tasmania.

Estuary Assessment Framework for Non-Pristine Estuaries

www.ozcoasts.gov.au/pdf/nlwra/**estuary**629.pdf

Provides general overview of estuary sediment and water quality , as part of the Estuary Assessment 2000, conducted by the CRC for Coastal Zone, Estuary and Waterway Management.

Threatened Species

http://www.dpiw.tas.gov.au/inter.nsf/themeNodes/RLIG-53kupv?open

Information on Tasmania's threatened plant and animal species including Listing Statements, Notesheets, Recovery Plans and information on listing species.

Natural Values Atlas

http://www.dpiw.tas.gov.au/inter.nsf/WebPages/LJEM-6TV6TV?open#Howtoac...

Online database of Tasmanian plant and animal species, including threatened species. User registration required.

The LIST

http://www.thelist.tas.gov.au

Land Information System Tasmania *is a whole of government integrated land information infrastructure with a web based delivery system.*

Coastal Weeds in the South Eastern Region of Tasmania

http://epa.tas.gov.au/epa/document?docid=65

Information on weed species in SE Tasmania (exclusive of Derwent) with management strategies.

Guidelines for Works in Areas of Little Penguin Habitat

http://epa.tas.gov.au/epa/document?docid=63

Information on appropriate timing and nature of foreshore works for protection of LP habitat.

Register of the National Estate

http://www.environment.gov.au/heritage/ahc/index.html

Lists registered sites of natural, cultural and historical value.

Planning and Development Applications

Infrastructure and Resource Information Service (IRIS)

http://www.iris.tas.gov.au/

Provides information and tools to assist investors, developers, and planners understand the scope and capabilities of Tasmania's infrastructure and resources.

Environment Protection Authority

http://www.epa.tas.gov.au/

Information and guidance on the EPA Board environmental impact assessment process.

Resource Management and Planning Appeals Tribunal

http://www.rmpat.tas.gov.au/

Information on the appeals process.

Planning Schemes within the DEP boundary

Clarence Council

http://www.ccc.tas.gov.au

Clarence Planning Scheme 2007

Hobart City Council

http://www.hobartcity.com.au/Home

City of Hobart Planning Scheme 1982

Glenorchy City Council

http://www.gcc.tas.gov.au

Glenorchy Planning Scheme 1992

Kingborough Council

http://www.kingborough.tas.gov.au

Kingborough Planning Scheme 2000

KIngborough Council Planning Scheme Review: Environmental Management Issues

Derwent Valley

http://www.derwentvalley.tas.gov.au

New Norfolk Council S.46 Planning Scheme 1994

Brighton Council

http://www.brighton.tas.gov.au

Brighton Planning Scheme 2000

Sediment and Water Quality

State of the Derwent Estuary Report

http://www.derwentestuary.org.au

Provides detailed 5 yearly review of sediment and water quality in the Derwent estuary.

Water Quality Improvement Plan for Heavy Metals

http://www.derwentestuary.org.au

Provides detailed assessment of sediment quality in the Derwent estuary.

Sediment and Erosion Control

http://www.derwentestuary.org.au

Provides detailed procedures for effective management of sediment and erosion control on construction sites.

Ecological Status of the Derwent and Huon Estuaries

http://www.tafi.org.au/index.php/site/publications/category/nht_nrm/

Provides comprehensive description of system ecology & distribution of contaminants (heavy metals) in the Derwent.

ANZECC/ARMCANZ Guidelines

http://www.environment.gov.au/water/publications/quality/index.html#nwqmsguidelines

Waste Management

Bulletin 105 "Classification and Management of Contaminated Soil for Disposal, 2006"

http://epa.tas.gov.au/epa/document?docid=55

Defines criteria used by the Environment Division for the classification of contaminated soil that requires treatment and/or off-site disposal.

National Assessment Guidelines for Dredging

http://www.environment.gov.au/coasts/pollution/dumping/publications/guidelines.html

Appendix 1 **Summary of priority and problem coastal weeds in South East Tasmania.**

Species	Common name	Growth form	Comment	Weed type
Achnantherum caudatum	Espartillo	Grass	NRM	Pasture weed
Ammophila arenaria	Marram grass	Grass	1	Dune stabilizer
Arctotheca populifolia	Beach daisy	Herb	ns	Beach weed
Asparagus asparagoides	Bridal creeper*	Climbing shrub	NRM	Ornamental
Asparagus officianalis	Asparagus	Herb	EW	Food crop
Asparagus scandens	Asparagus fern*	Vine	NRM	Ornamental
Billardiera heterophylla	Bluebell creeper	Shrub	EW	Ornamental
Cakile edentula	American sea rocket	Herb	2	Ballast invader
Cakile maritima	European sea rocket	Herb	2	Ballast invader
Carduus nutans	Nodding thistle	Herb	NRM	Pasture weed
Carduus pycnocephalus	Slender thistle	Herb	DW	Pasture weed
Carduus tenuiflorus	Slender thistle	Herb	DW	Pasture weed
Carthamus lanatus	Saffron thistle	Herb	NRM	Pasture weed
Chrysanthemoides monilifera	Boneseed*	Shrub	DW (1)	Ornamental and former dune stabilizer
Cirsium arvense	Californian thistle	Herb	DW (1)	Pasture weed
Cotoneaster spp	Cotoneaster	Tree	2	Ornamental
Coprosma repens	Mirror bush	Small tree	3	Ornamental
Coprosma robusta	Karamu	Shrub	NRM	Ornamental
Cortaderia selloana	Pampas grass	Tall grass	NRM (2)	Ornamental
Crataegus monogyna	Hawthorn	Tree	DW	Ornamental/hedge
Cystisus scoparius	English broom*	Shrub	DW (1)	Ornamental
Delairea odorata	Cape ivy	Climber		Ornamental
Equisetum hyemale	Horsetail	Herb	NRM	Ornamental
Erharta villosa	Pyp grass	Grass	ns	Beach weed
Eragrostis curvula	African lovegrass	Grass	NRM	Pasture/fodder
Erica lusitanica	Spanish heath	Shrub	NRM (1)	Ornamental
Euphorbia paralias	Sea spurge	Herb	1	Ballast invader
Foeniculum vulgare	Fennel	Herb	DW (1)	Ornamental
Genista monspessulana	Canary broom	Shrub	DW (1)	Ornamental
Hedera helix	Ivy	Vine	EW	Ornamental
Hypericum perforatum	St Johns wort	Herb	NRM	Pasture weed
Lepidium draba	White weed	Herb	DW	Pasture weed
Lupinus arboreus	Tree lupin	Shrub	1	Ornamental
Lycium ferocissimum	South african boxthorn	Shrub/Tree	NRM (2)	Pasture weed
Marrubium vulgare	Horehound	Herb	DW (1)	Pasture weed
Nasella neesiana	Chilean needle grass*	Grass	DW(1)	
Nasella trichotoma	Serrated tussock*	Grass	DW,NRM	Pasture weed
Onopordum acanthium	Cotton thistle	Herb	NRM	Pasture weed

Species	Common name	Growth form	Comment	Weed type
Osteospermum fruticosum	Trailing african daisy	Herb	EW	Ornamental
Passiflora mollisima	Banana passionfruit	Vine	EW	Ornamental
Pennisetum macrourum	African feathergrass	Grass	NRM	Pasture/fodder
Pennisetum villosum	Feathertop	Grass	NRM	Ornamental
Pinus radiata	Radiata Pine	Tree	1	Plantation escapee
Pittosporum undulatum	Sweet pittosporum	Tree		Ornamental
Polygala myrtifolia	Myrtle-leaved milkweed	Shrub	3	Ornamental
Psoralea pinnata	Blue Butterfly Bush	Shrub	3	Ornamental
Rosa rubiginosa	Sweet briar	Shrub	EW	Ornamental/food
Rubus fruticosus	Blackberry*	Climbing shrub	DW (1)	Occasional food crop and stabilizer, agricultural weed
Salix sp.	Willow* (not all sp)	Tree	DW, NRM	Ornamental
Senecio jacobaea	Ragwort	Herb	DW (1)	Pasture weed
Spartina anglica	Rice grass	Intertidal grass	DW(1)	Estuarine weed
Thinopyrum junceiforme	Sea Wheat Grass	Grass	ns	Beach weed
Tradescantia albiflora	Wandering jew	Herb	ew	Ornamental
Ulex europaeus	Gorse*	Shrub	DW (1)	Agricultural weed
Vinca major	Blue periwinkle	Vine	EW	Ornamental
Watsonia meriana	Watsonia	Herb	EW	Ornamental

Declared Weeds (DW)
Environmental Weeds (EW)
Level 1 : pose most serious threat to coastal vegetation
Level 2 : serious weeds in a variety of environments
Level 3 : ornamentals yet to become highly problematic
NRM Southern NRM Priority List
*Weed of National Significance

References

DPIWE 2002 "Strategy for the Management of Rice Grass (*Spartina anglica*) in Tasmania, Australia", www.dpiw.tas.gov.au/weeds website.

Page, L and Thorpe, V 2010 "Tasmanian Coastal Works Manual: A Best Practice Management Guide for Changing Coastlines" Department of Primary Industries, Parks, Water and Environment

Reserve Design and Management, 2002 "Coastal Weeds In The South Eastern Region Of Tasmania", Prepared for the Integrated South East Coastal Management Strategy

North Barker Ecosystem Services, 2010 "Weed Assessment and Vegetation Prioritisation Project" prepared for the Derwent Estuary Program *** see this report for more extensive listing

Appendix 2 **Reserves under the Nature Conservation Act 2002, and sites on the Register of the National Estate (not exhaustive), located within the DEP boundary.**

Reserve type	*Site(Ha)*	*Location*	*Comment/ value*
State Reserves	Derwent Cliffs (5)	New Norfolk	
	East Risdon (88)	East Derwent	2 nationally rare eucalypt species
Conservation Areas	Calverts Lagoon (69)	South Arm	Breeding area for waterfowl
	Derwent River (1,568)	South-east	River, marsh
	Goulds Lagoon (6.76)	South-east	Wetland (Council owned)
	Murphys Flat (66)	Granton	Wetland
	Ralphs Bay (7.3) [1]	Clarence	Coastal
	South Arm (784)	South-east	Wetland, migratory waders
Nature Recreation Areas	South Arm (67.5)	Clarence	Coastal, recreation
Marine Reserves	Tinderbox (53)	Tinderbox	Rocky reef & foreshore
Private Sanctuaries	Cape Direction	South Arm	Muttonbird sanctuary
	Kingston Golf Course	Kingston	Wildlife sanctuary
Historic Sites (selected)	Kangaroo Bluff (3.12)	Bellerive	Historic fort
	Risdon Cove Settlement Site (60)	Risdon Cove	Significant indigenous site
	Bridgewater Causeway	Bridgewater	Convict built civil engineering
	Bryn Estyn (122)	New Norfolk	Historic farm including riverflats
	Bowens Landing (3)	Risdon Cove	Historic site of first landing in Tasmania
	Royal Botanical gardens	Hobart	Historic site
	Victoria and Constitution Dock	Hobart	Historic site
	William Collins Bay Whaling Station & Droughty Point Farm	Rokeby	Historic site, middens
Other (Register of the National Estate)	Alum Cliffs Area (100)	Taronga	Spectacular cliff landform
	Ralphs Bay Racecourse Flats Bird Habitat (250)	Lauderdale	Mudflat, saltmarsh and bird habitat
	Blackmans Bay Geological Monument (6)	Blackmans Bay	Geological phenomenon
	Cornelian Bay Boat Houses	Cornelian Bay	Indicative Place
	Humphrey Rivulet	Glenorchy	Indicative Place
	Iron Pot Light	South Arm	Landmark at entrance to Derwent

[1] Ralphs Bay Conservation Area Clarification Bill 2006 defines the area as 173 Ha to include low water mark.

Appendix 3 **Protected Environmental Values for the Derwent Estuary.**

Area	Protected Environmental Values
1. Ralphs Bay	A: Protection of Aquatic Ecosystems (ii) Protection of modified (not pristine) ecosystems from which edible fish, but not shellfish are harvested, and having particular regard to the ecological values identified below. B: Recreational Water Quality & Aesthetics (i) Primary contact water quality (ii) Secondary contact water quality (iii) Aesthetic water quality, and having particular regard to the recreational uses identified below.
Ecological Values Ralphs Bay This area of the Derwent Estuary is characterised by relatively high salinities, shallow water depths and sheltered waters. Important estuarine habitat types include mud and sand flats, saline flats, salt marshes, coastal dunes (e.g. South Arm) and wetlands (e.g. Lauderdale). Seagrass meadows may have been formerly abundant in Ralphs Bay, but seem to have vanished over the past 30-40 years. Major conservation areas include the South Arm State Recreation Area and South Arm Wildlife Sanctuary. Threatened/protected species found in this area include dolphins, small whales ,the salt marsh moths and the spotted handfish. Other species of conservation significance include many types of seabirds, particularly waders and shorebirds. Mortimer Bay has been identified as an important breeding area for pied oyster catchers. Finfish are harvested from Ralphs Bay by recreational fishermen, however shellfish harvesting has been prohibited due to high concentrations of heavy metals. **Recreational Uses Ralphs Bay** Ralphs Bay is used for both primary and secondary recreation. Windsurfing is popular off Lauderdale and the bay is widely used for recreational boating and fishing, with popular anchorages off Shelly Beach.	
2. Lower Derwent Estuary Tasman Bridge to Tinderbox/South Arm	A: Protection of Aquatic Ecosystems (ii) Protection of modified (not pristine) ecosystems from which edible fish, crustaceans and abalone, but not other shellfish, are harvested, and having particular regard to the ecological values identified below B: Recreational Water Quality & Aesthetics (i) Primary contact water quality (ii) Secondary contact water quality (iii) Aesthetic water quality
Ecological Values Lower Derwent Estuary This area is characterised by relatively high salinities, intermediate to deep water depths and is well-mixed by winds and currents. Important estuarine habitat types include rocky cliffs, intertidal and subtidal rocky reefs, macroalgae beds, seagrass beds, sandy beaches and coastal dunes. Major conservation areas within this area include the Cape Direction Muttonbird Sanctuary, Tinderbox Marine Reserve, Kingston Beach Golf Course Wildlife Sanctuary and Alum Cliffs Recreation Reserve. Threatened/protected species found in this area include whales (southern right, humpback, orca), dolphins, seals, wedge tailed eagles, southeastern seastars and the spotted handfish. Other species of conservation significance include giant string kelp, seahorses/sea dragons, threefins and muttonbirds. Finfish are harvested from the lower Derwent by recreational fishermen, however shellfish harvesting has been prohibited due to high concentrations of heavy metals. Abalone, crayfish and sea urchins are also harvested from the area, particularly along the western shoreline, south of Taroona. **Recreational Uses Lower Derwent Estuary** The lower Derwent is used for both primary & secondary recreation. Popular swimming beaches include Howrah Beach, Bellerive Beach, Opossum Bay, Half Moon Bay, Blackmans Bay, Kingston Beach, Taroona & Long Beach/Sandy Bay. The area is widely used for recreational boating & fishing. The Tinderbox Marine Reserve & surrounding areas are popular sites for snorkelling & scuba diving.	

Appendix 3 (cont) Protected Environmental Values for the Derwent Estuary.

Area	Protected Environmental Values
3. Middle Derwent Estuary Tasman Bridge to Bridgewater Causeway	A: Protection of Aquatic Ecosystems (ii) Protection of modified (not pristine) ecosystems from which edible fish, but not shellfish or crustaceans, are harvested, and having particular regard to the ecological values identified below. B: Recreational Water Quality & Aesthetics (i) Primary contact water quality (ii) Secondary contact water quality (iii) Aesthetic water quality, and having particular regard to the recreational uses identified below. E: Industrial Water Supply Pasminco Hobart Smelter (Nystar).

Ecological Values Middle Derwent Estuary

This region of the Derwent Estuary is considerably narrower than downstream areas, and is partially sheltered from prevailing westerlies. The shoreline is relatively convoluted with numerous embayments (the largest of these is Herdsmans Cove, where the Jordan River joins the estuary). Water depths between the Bowen and Tasman bridges are deep to intermediate, permitting the passage of large ships. Above the Bowen Bridge, however, the channel becomes more well-defined and is bordered by extensive subtidal flats. Salinities in this area are intermediate, and the water column ranges from strongly stratified at the Bridgewater Causeway to partially mixed at the Tasman Bridge. Important estuarine habitat types include numerous bays and coves, rocky promontories, silt/pebble beaches, saline and intertidal flats, salt marshes and seagrass beds. Wetlands were formerly present at the heads of many embayments, but have been largely reclaimed with the exception of a few remnants (e.g. Goulds Lagoon, Risdon Cove). Major conservation areas include the East Risdon Nature Reserve, Green Point Nature Reserve and Goulds Lagoon Wildlife Sanctuary. Threatened/protected species found in this area include dolphins, occasional seals, green and gold frog, and southeast seastars. Goulds Lagoon and Risdon Cove also provide important habitat for a range of waterbirds. Finfish are harvested from the lower Derwent by recreational fishermen, however shellfish harvesting has been prohibited due to high concentrations of heavy metals.

Recreational Uses Middle Derwent Estuary

The middle Derwent is primarily used secondary recreation, particularly small boat sailing, rowing and fishing. Some primary contact uses also occur, such as swimming, water skiing and wind -surfing, and the annual Cross-Derwent Swim occurs near the southern boundary of this area.

Industrial Water Supply

The Nystar zinc smelter at Risdon extracts approx 65, 000 kL/day of estuarine water from this are for use in the foreshore gas scrubbers.

Appendix 3 (cont) Protected Environmental Values for the Derwent Estuary.

Area	Protected Environmental Values
4. Upper Derwent Estuary Bridgewater Causeway to New Norfolk Bridge	A: Protection of Aquatic Ecosystems (ii) Protection of modified (not pristine) ecosystems from which edible fish, are harvested, and having particular regard to the ecological values identified below B: Recreational Water Quality & Aesthetics (i) Primary contact water quality (ii) Secondary contact water quality (iii) Aesthetic water quality, and having particular regard to the recreational uses identified below. E: Industrial Water Supply Norske Skog paper mill

Ecological Values Upper Derwent Estuary

The upper Derwent Estuary is characterised by a narrow channel bordered by extensive shallow flats and wetlands. The water column is strongly stratified and salty water persists at depth upstream to the New Norfolk Bridge. Important estuarine habitat types include brackish marshes, intertidal mud flats and subtidal seagrass (e.g. Ruppia) beds (1). Conservation areas include the Derwent River Wildlife Sanctuary and Derwent Cliffs State Reserve. Species of conservation significance include many types of waterfowl, waders and other birds. Thousands of ducks and swans make use of the area, particularly in mid-summer, and harriers and other raptors are frequently seen hunting in the marshes. The mudflats and wetlands also serve as critical habitat for many species of fish, amphibians and invertebrates (2). The Tasmanian whitebait and Tasmanian mudfish (important components of the annual whitebait runs) are both known to spawn in the area. The upper Derwent is an important passage for migratory fish. Sea trout, black bream, yellow eye mullet and eel pass through this area in large numbers, as do 6 smaller fish species collectively known as whitebait (3). Threatened/protected species found in this area include coastal migratory waders, Australian grayling (fish), sea eagles and great crested grebes. (4). Finfish are harvested from the upper Derwent by recreational fishermen, however, shellfish do not colonise this area due to unsuitable salinities.

Recreational Uses Upper Derwent Estuary

The upper Derwent is used for both primary and secondary recreation. The entire area is generally used for rowing, kayaking, canoeing, motorboat racing, water-skiing, and fishing. Swimming is generally restricted to the river around New Norfolk.

Industrial Water Supply Upper Derwent Estuary

The Norske Skog paper mill at Boyer uses approximately 1000 to 2000 kL/day of estuarine water from this area for washing down and other uses on site.

Appendix 4 **Brief summary of key State, Commonwealth and International legislation pertaining to dredging and reclamation activities in estuarine and coastal waters.**

State Legislation	Principle/scope
Aboriginal Relics Act 1975	Protection of the physical remains of Aboriginal occupation in Tasmania
Crown Lands Act 1976	Management and use of Crown reserves.
Environmental Management and Pollution Control Act 1994	Primary environmental protection legislation. Regulation of pollution and emission controls in the marine environment.
Environmental Management and Pollution Control (Waste Management) Regulations 2000	The disposal of controlled waste to prevent direct or indirect environmental harm, for recreational, commercial, domestic, agricultural or industrial processes.
Inland Fisheries Act 1995	Regulates recreational & commercial fishing in inland waters.
Historic Cultural Heritage Act 1995	Protection of heritage with respect to places of archaeological, architectural, cultural, historical, scientific, social and technical significance.
Land Use Planning and Approvals Act 1993	Central Act within RMPS, provides framework for strategic and statutory land use planning and development.
Living Marine Resources Management Act 1995	Regulation and protection of the living marine environment, provision of sustainable fisheries management plans. Listing of noxious species.
Marine Farming Planning Act 1995	Regulation of planning & management for marine farming.
Local Government Act 1993	Provides for the creation of council by-laws in respect of any Act, matter or things for which council has a legislated function or power. Issue of abatement notices for environmental "nuisance".
Marine and Safety Authority Act 1997	Establishes MAST, responsible for ensure safe operations of vessels; provide and manage marine facilities; and manage environmental issues relating to vessels.
National Parks and Reserves Management Act 2002	Management of parks and reserves based on management objectives of each class of reserve, declaration and management of Marine Protected Areas (marine reserves). Administered through Parks and Wildlife.
Nature Conservation Act 2002	Management and protection of some estuarine/marine species & communities.
Resource Planning and Development Commission Act 1997	Establishes RPDC, assessment of planning schemes, *State Policies* and *Projects of State Significance*.
State Coastal Policy 1996	Sustainable use and developments within the coastal zone.
State Policy on Water Quality Management 1997	Protection and enhancement of water quality, including monitoring of water bodies, facilitating integrated catchment management, through the application of the precautionary principle.
Tasmanian Ports Corporation Act 2005	Provide for matters relating to the control of the Tasmanian Ports Corporation Pty. Ltd and its assets.
Threatened Species Protection Act 1995	Classification and listing of threatened flora and fauna, protection of threatened marine species.
Weed Management Act 1999	Management and eradication of significant weeds in Tasmania, including coastal weeds.

Appendix 4(cont) Brief summary of key State, Commonwealth and International legislation pertaining to dredging and reclamation activities in estuarine and coastal waters.

Commonwealth Legislation	Principle/scope
Environment Protection (Sea Dumping Act) 1981.	Protect & preserve the marine environment with respect to pollution related to dumping at sea. Assessment and permitting of proposals to load and dump wastes in accordance with the *National Ocean Disposal Guidelines for Dredged Material 2002.* Covers waters other than waters within the limits of the State
Environment Protection and Biodiversity Conservation Act 1999	Biodiversity conservation, and assessment and management of important protected areas, including matters of National Environmental Significance (NES)[2]
National Environment Protection (Assessment of Site Contamination) Measure 1999	NEPM can be considered similar to state environmental protection policies
National Environment Protection Council Act 1994	Establishment of the National Environment Protection Council for protection from air, water, soil, or noise pollution

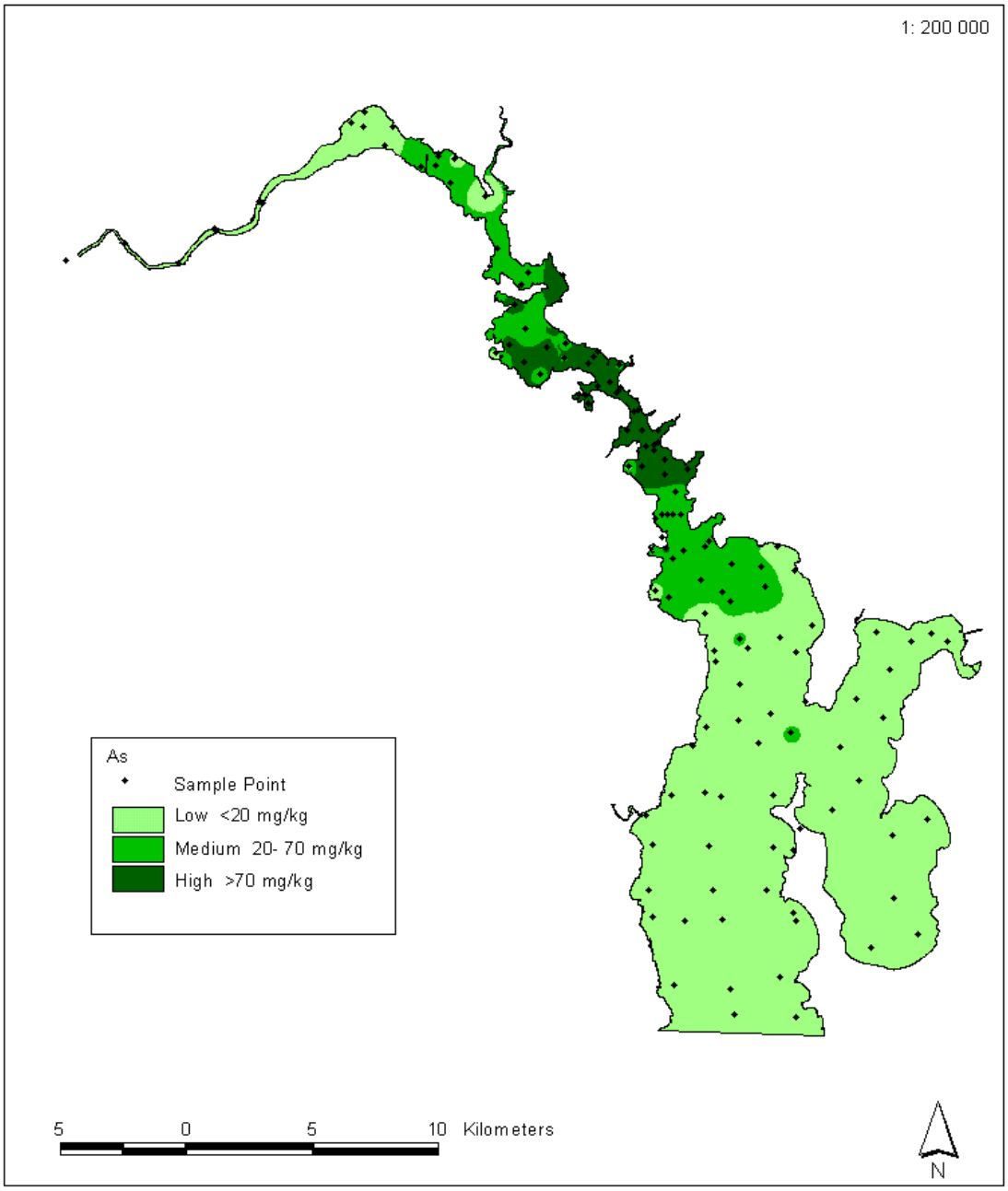
International Legislation	Principle/Scope
Convention on the Prevention of Marine Pollution by Dumping of Wastes or other Matter (London Convention 1972)	Prevent pollution of the sea through the dumping of waste and other matter liable to create hazards to human health, harm living resources and marine life, damage amenities or interfere with other legitimate uses of the sea.

[2] NES matters include World Heritage properties, Ramsar wetlands, listed threatened species and ecological communities, list migratory species, Commonwealth marine areas, National heritage places and nuclear actions.

Appendix 5 **Heavy metal, grain size and organic carbon distribution maps for the Derwent estuary (Green and Coughanowr, 2003).**

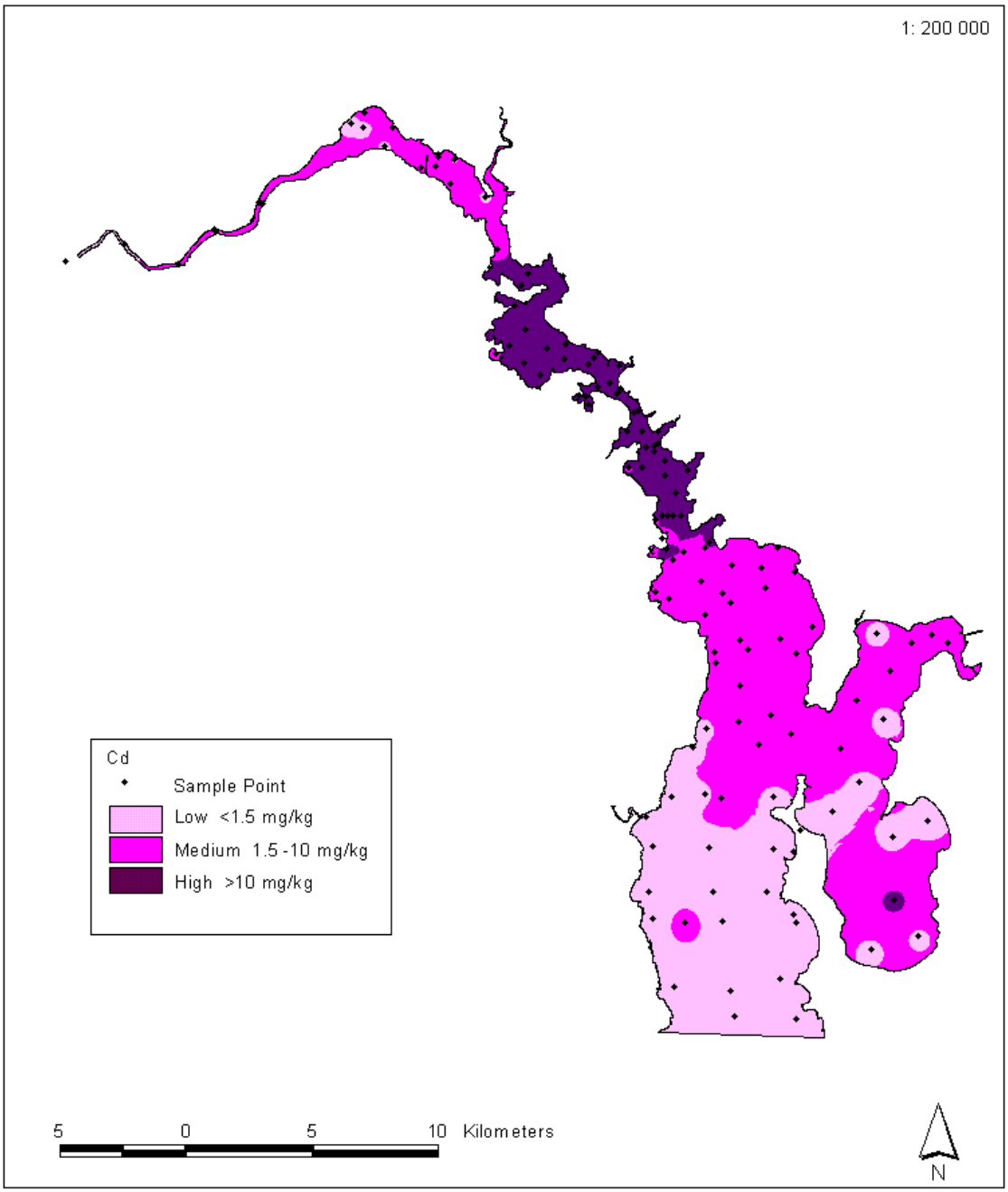
Note: please check the DEP website for more contemporary data collected as part of additional surveys.

Arsenic



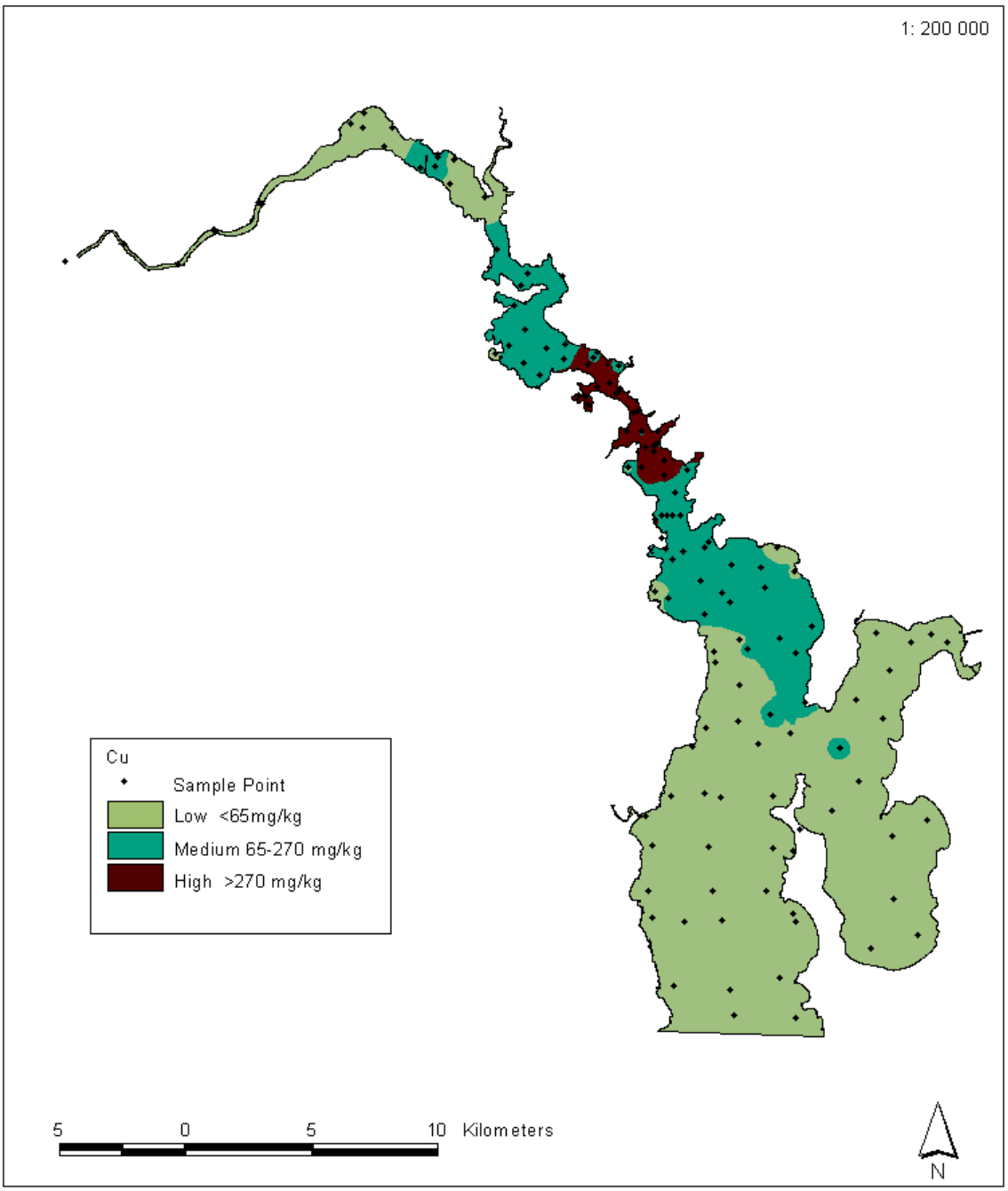
Cadmium

Note: please check the DEP website for more contemporary data collected as part of additional surveys.



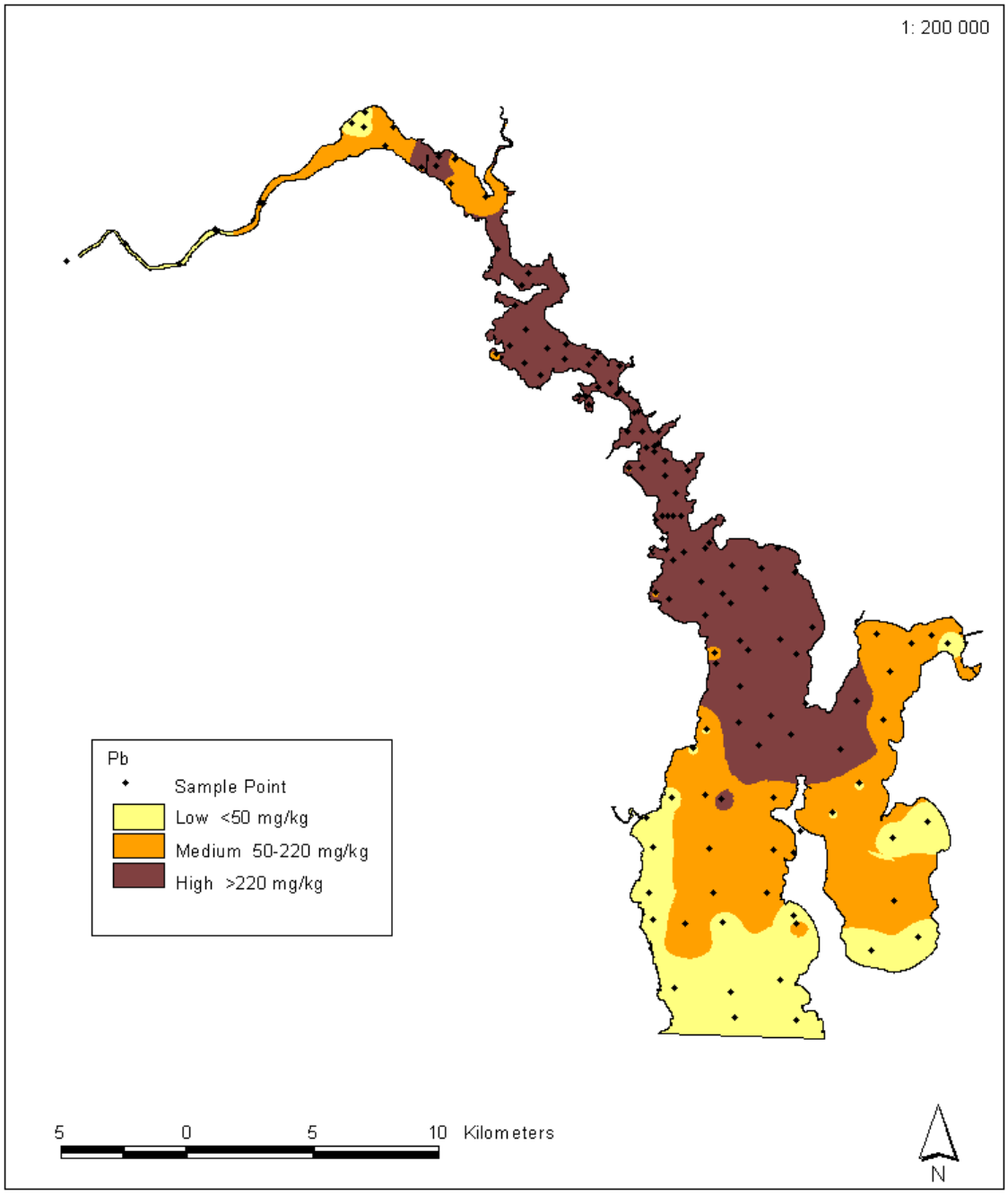
Copper

Note: please check the DEP website for more contemporary data collected as part of additional surveys.



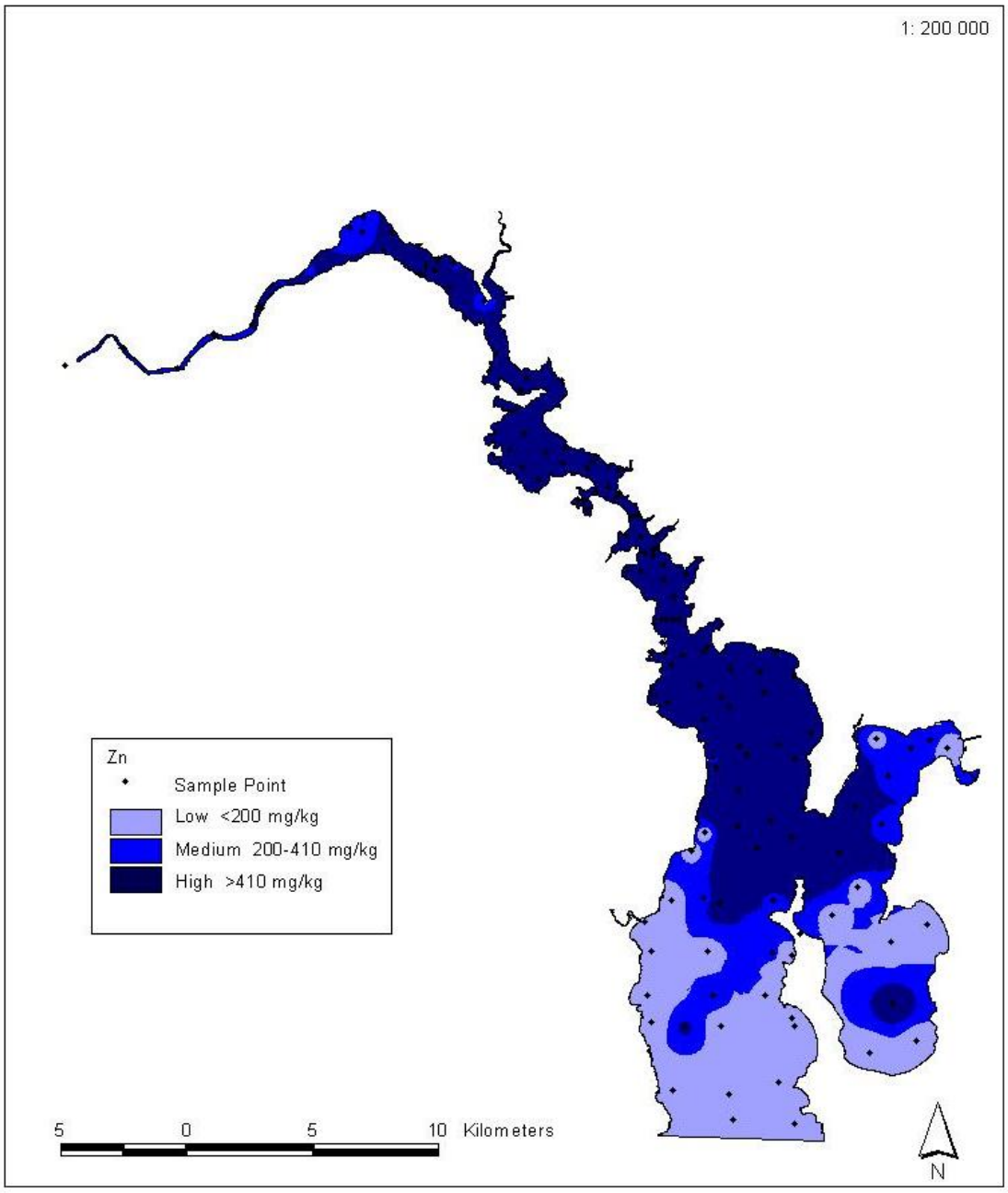
Lead

Note: please check the DEP website for more contemporary data collected as part of additional surveys.



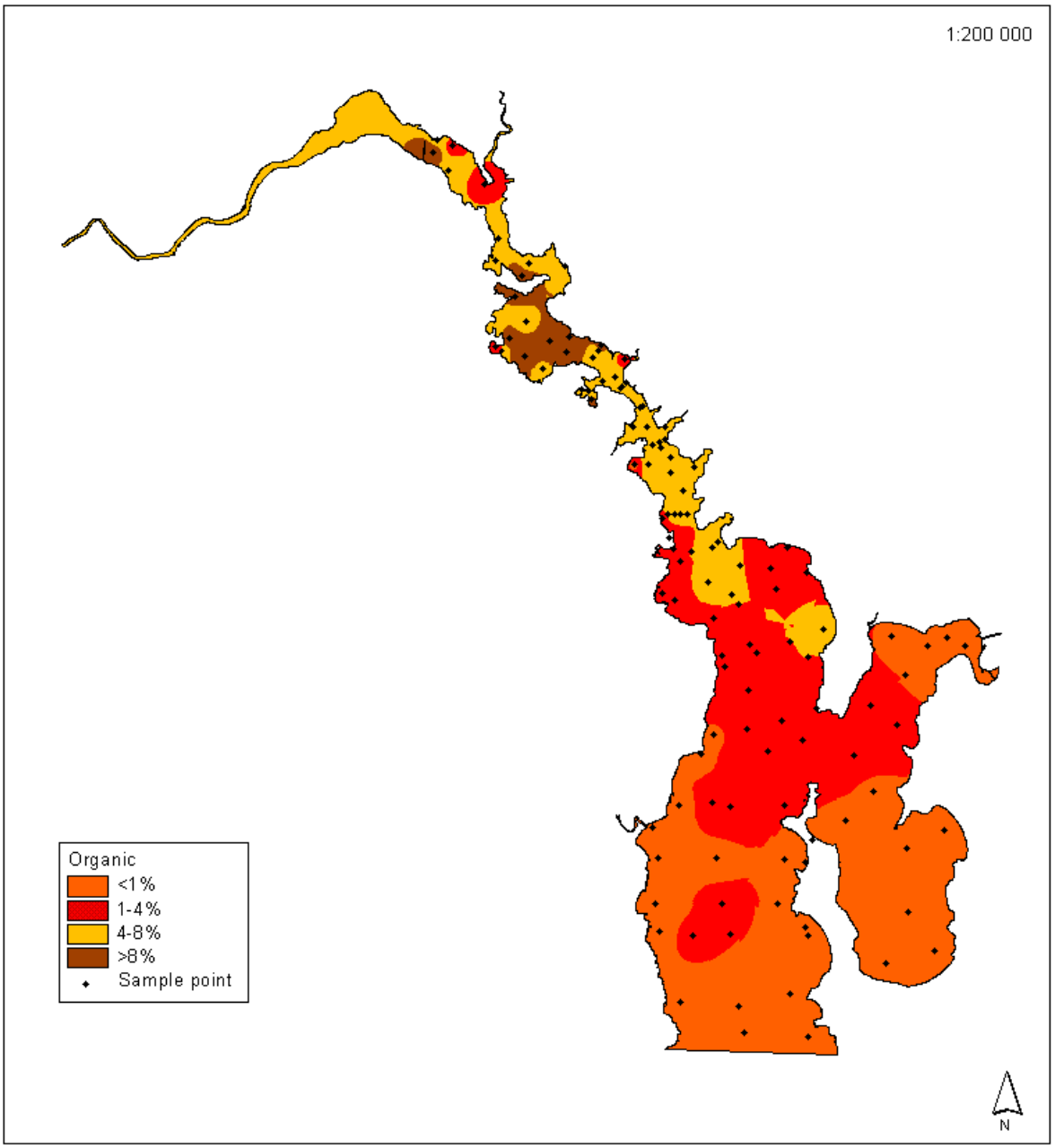
Zinc

Note: please check the DEP website for more contemporary data collected as part of additional surveys.

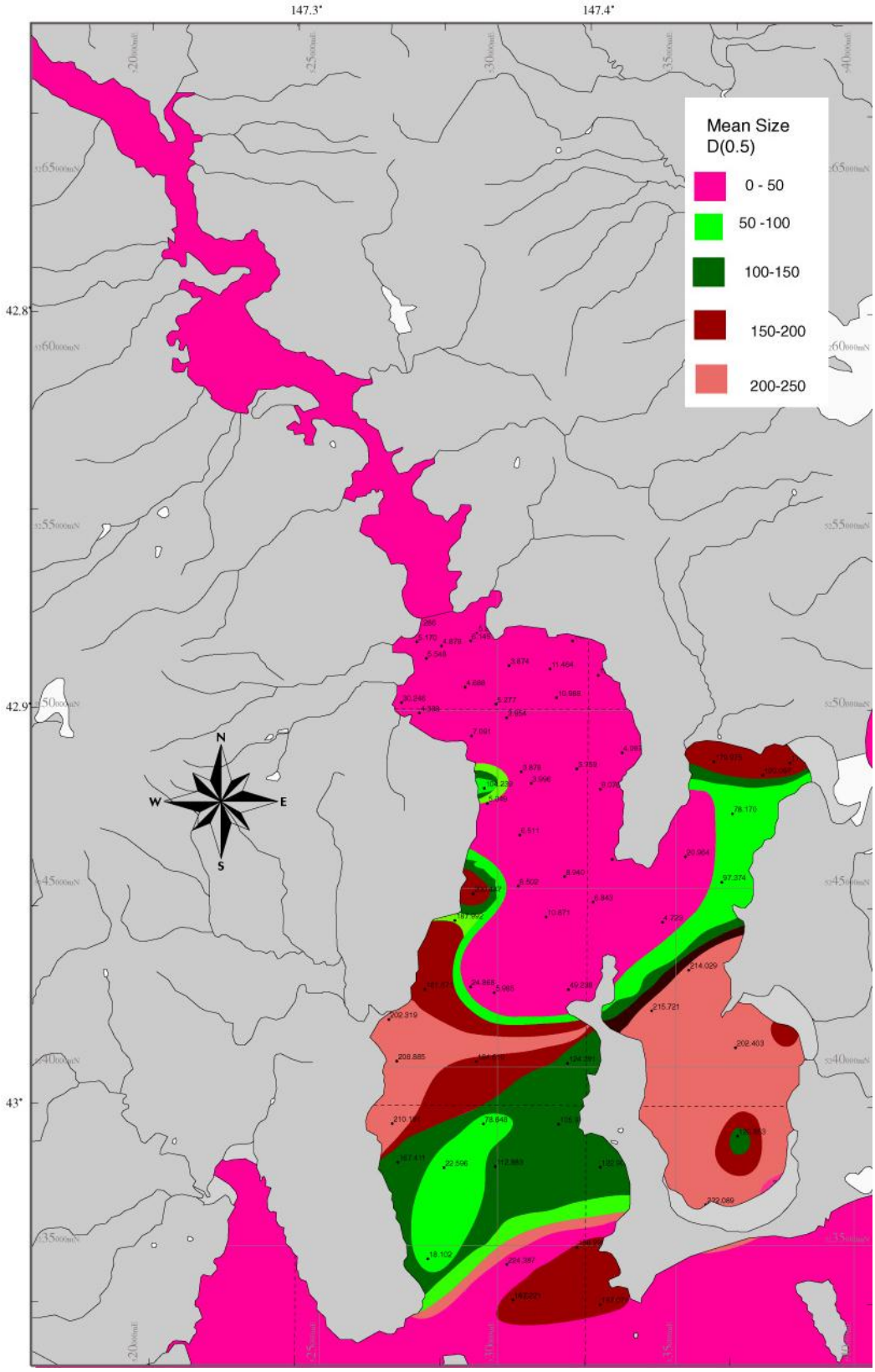


Organic Carbon Content (%)

Note: please check the DEP website for more contemporary data collected as part of additional surveys.



Particle size distribution



Note mapping of 0-50 micron size fraction in waters south of the Derwent estuary is limited by a single data point at the mouth of the estuary. Mudflats and sandflats in Ralphs Bay were not mapped as part of this process. Check DEP website for more contemporary data collected as part of additional surveys.

Appendix 6 *Maximum total concentration and leachable concentration values permitted for waste classification (Information Bulletin No 105)*

CONTAMINANT	*Level 1 FILL MATERIAL*	*Level 2 LOW LEVEL CONTAMINATED SOIL*		*Level 3 CONTAMINATED SOIL*	
	Maximum total mg/kg dry weight	*Maximum total mg/kg dry weight*	*Maximum TCLP leachable mg/L (pH 5.0 extract*	*Maximum total mg/kg dry weight*	*Maximum TCLP leachable mg/L (pH 5.0 extract)*
Arsenic	*20*	*200*	*0.5*	*750*	*5*
Barium	*300*	*3000*	*35*	*30000*	*350*
Beryllium	*2*	*40*	*1*	*400*	*4*
Cadmium	*3*	*40*	*0.1*	*400*	*0.5*
Chromium (total)	*50*	*500*	*0.5*	*5000*	*5*
Chromium (VI)	*1*	*200*	*NA*	*2000*	*NA*
Copper	*100*	*2000*	*10*	*7500*	*100*
Cobalt	*100*	*200*	*NA*	*1000*	*NA*
Lead	*300*	*1200*	*0.5*	*3000*	*5*
Manganese	*500*	*5000*	*25*	*25000*	*250*
Mercury (total)	*1*	*30*	*0.01*	*110*	*0.1*
Molybdenum	*10*	*1000*	*2.5*	*4000*	*20*
Nickel	*60*	*600*	*1*	*3000*	*8*
Selenium	*10*	*50*	*0.1*	*200*	*1*
Silver	*10*	*180*	*0.5*	*720*	*5*
Tin (total)	*50*	*500*	*NA*	*900*	*NA*
Zinc	*200*	*14000*	*25*	*50000*	*250*
Tributyltin (reported as Sn)	*0.005*	*0.07*	*0.05*	*0.7*	*0.5*
Aldrin + Dieldrin	*2*	*20*	*0.003*	*50*	*0.03*
DDT + DDD + DDE	*2*	*200*	*0.2*	*1000*	*2*
Benzo(a)pyrene	*0.08*	*2*	*0.0005*	*20*	*0.005*
Phenols	*25*	*500*	*14*	*2000*	*50*
C_6-C_9 petroleum hydrocarbons	*65*	*650*	*NA*	*1000*	*NA*
C_{10}-C_{36} petroleum hydrocarbons	*1000*	*5000*	*NA*	*10000*	*NA*
Polycyclic aromatic hydrocarbons -total	*20*	*40*	*NA*	*200*	*NA*
Polychlorinated biphenyls (PCBs)	*2*	*20*	*0.001*	*50*	*0.002*
Benzene	*1*	*5*	*0.05*	*50*	*0.5*
Toluene	*1*	*100*	*1.4*	*1000*	*14*
Ethylbenzene	*3*	*100*	*3*	*1080*	*30*
Xylene (total)	*14*	*180*	*5*	*1800*	*50*
Cyanide (total)	*32*	*1000*	*1*	*2500*	*10*
Fluoride	*300*	*3000*	*15*	*10000*	*150*

Appendix 7 ***Tasmanian State Coastal Waters (prepared by Richard Mount, RPDC 2001).***