# The economics of ocean outfalls and wastewater in Australia: Some empirical evidence on a dog's breakfast.

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**Abstract**

Much has been achieved in Australia since the release of the Hilmer (Hilmer *et al.* 1993) report in 1993, especially in the recent decade with water reform. Prices are beginning to reflect full costs of supply. Water entitlements are now tradeable instruments across the country. The same engagement of the reform agenda can not be said for urban waste water and ocean outfalls. Much of urban water conservation relies on prohibition or regulation.

This paper presents a theoretical framework for analysing the re-use and disposal of waste water in urban communities in Australia. Many of these communities, especially all the state capitals, rely on ocean outfalls to dispose of their waste water. The framework takes a broad view of the value of recycling water and helps to analyse why the market for recycling fails. The reasons are classic. Prices for water use do not reflect their full cost. Externalities are not internalised. Services are monopolised where natural monopoly theory is questionable.

The paper also presents survey evidence as to whether we may change our preferences for how we manage our waste water if we visit an outfall or treatment plant. Responses do change as a result of visiting these sites and this might be part of finding an improved understanding of, and solutions to, our water problems.

**Key Words**

Ocean outfalls, water re-use, urban water reform, recycled water, waste water

**JEL Codes**

Q25, Q53, Q57, I18, D42

## Introduction

Water supplies, use and waste discharge are issues that have historically driven many political arrangements at local, regional and international scales. Water supplies in Australia are becoming scarce and waste water use is likely to become more viable if the full economic costs of water use are taken into consideration. Similarly, the use of ocean outfalls for waste water discharge is a contentious issue at all levels, with numerous examples of decisions concerning placement, use and changing use patterns being driven by political interests rather than broad social, economic, biological and environmental understanding.

Wastewater ocean outfalls have considerable impacts on the marine and coastal environment, especially for humans (health, psychological and ethical). How these impacts translate into economic and monetary values is a key question asked by this paper. Given the current drought and changing climate, waste water re-use is a pressing national and international issue.

The Clean Ocean Foundation (COF 2008), through its National Outfall Database (NOD), estimates that 1,335 GL (1,325,000 ML) of waste water are annually dissipated along Australia's coast. The dissipation rates, for some of the following urban sites, are:

- The Gunnamatta outfall on the Mornington Peninsula, Victoria, 358ML/day (358,000,000 l/day) (COF 2008);
- The Long Bay outfall in Sydney, 456ML/day (COF 2008); and
- Luggage Point in Brisbane, 180 ML/day (COF, 2007)

By considering the wider social issues of :

- lost beach recreation;
- lost human health (ear infections, sickness etc.);
- lost marine and coastal habitats;
- psychological and ethical guilt aspects; and
- water re-use options,

within a social-economic framework, it may be sufficient to 'tip the scales' and warrant an outfall's closure. The research which develops from this paper is expected to provide strategic knowledge with substantial public policy implications for ocean outfalls, desalinisation plants, water re-use and coastal management in Australia and overseas.

**Brief Literature Review**

There is a paucity of specific literature in the field of lost beach and coastal foreshore values from outfalls. There is literature on the value of beach recreation in the United States (Bell and Leeworthy 1986) and from water quality improvements (Strand *et al.* 1985, Smith and Desvouges 1986, Bosckstael *et al.* 1989) and more recently in Australia in the estuary environment (Rolfe and Windle 2005). Blackwell (2007) makes a contribution to values for beach recreation in Australia.

The social cost benefit framework along with its limitations is well documented in the literature (Mishan 1972, 1998; Hanley and Spash 1993; Sinden and Thampapillai 1995; Department of Finance and Administration 2006).

Much of the indirect economic literature on waste water outfalls is provided as policy documents via various levels of government. For example, various states jurisdictions have undertaken work on the external costs (and benefits) associated with water use (NWC 2006a) but this overlooks the externalities created for coastal communities from waste water disposal.

**Waste Water Outfalls and Re-use: Benefits and Costs**

The intention of the research to flow from this paper is that it may fill a knowledge gap in terms of identifying and estimating non-pecuniary negative externalities[1] caused from releasing waste water to coastal waters. Direct external costs may be borne by:

- recreational beach or coastal foreshore users (through smell and discolouration of the water and potential adverse health impacts) including lost tourism values (marine and coastal dependent businesses);
- ecosystems through ecological and biophysical impacts at the site of the outfall;
- society in general through social and cultural impacts (including the psychological impacts of breaching common ethical considerations from dumping waste into coastal waters); and
- property owners in the nearby vicinity of the outfall.

These direct external costs represent the forgone benefits from treating, re-using or recycling the waste water. Similarly, a number of indirect external costs from releasing waste water into coastal waters exist and these may be viewed as forgone benefits of re-using the water. Such indirect benefits include:

[1] A non-pecuniary external diseconomy or negative externality exists where a cost caused by one party is borne on a bystander and that cost is not taken into account in the first party's decision making.

- extra water being available for the environment or other commercial, rural, residential and industrial uses through less take being required from regulated[2] or unregulated systems;
- postponement of further infrastructure development and associated environmental costs; and
- possibilities of addressing saltwater intrusion issues and depleted coastal aquifer systems with recycled and treated waste water.

This paper proposes for future research to estimate the likely direct and indirect benefits from using or recycling the water at designated sites. Often these benefits are not readily quantified given their public good characteristics. Public goods typically exhibit non-rivalry, indivisibility and or non-excludability which means that the standard market forces such as correct pricing are not available to convey needed information to market participants. This means the market fails in providing the socially optimal level of output at the socially optimal price.

Demand for recycled water may exist at particular test sites for:

- human consumption;
- industry, agricultural and business use (e.g. some businesses already use water from the South Eastern pipeline and the Werribee Treatment Plant near Melbourne in Victoria);
- dealing with salt water intrusion and aquifer depletion;
- reducing water quality impacts for recreation, tourism, views, smells and possibly land values;
- ameliorating ecological impacts;
- reducing human health impacts;
- addressing psychological impacts for people whom create waste knowing that their waste water is adversely impacting on a coastal community or environment. Ethically many people may think this is wrong; and
- reducing waste and inefficiency of water use.

Of course recycling water comes at a substantial cost. However, a key question arising from this paper is: '*Do the public (and private) benefits from recycling surpass the costs*.' The research to be developed from this paper will attempt to quantify the externalities from changes in the quality and quantity of waste water outfall and the ability to use pricing as a mechanism to internalize these externalities in decisions over water use, waste water creation, disposal and reuse. In fact, the final report of the Productivity Commission (2006c) indicates:

> Using administrative arrangements to allocate water for environmental purposes conceals the opportunity cost of meeting environmental targets. Market mechanisms are usually a more efficient means of re-allocating resources.

As Quiggin (2006) and the Productivity Commission (2006c) have identified, using a consistent policy stance across jurisdictions and being careful to account for location and scale is likely to result in better outcomes for water use and the environment.

**Significance and Innovation**

Given the current drought and changing climate, waste water re-use is a pressing national and international issue. Winners and losers have much at stake in a decision over an outfall, water reuse or alternative sources of supply. Every state and territory except the ACT has ocean waste water outfalls. The outfall of waste water into the ocean and coastal environment does not fit within the current scope of state water regulation. For example in Queensland the Department of Natural Resources and Waters' jurisdiction under the Water Act 2000 ends at the tidal limit. In the case of ocean outfalls, the nexus between water use and waste water creation is broken at the tidal limit and picked up by the

[2] Some jurisdictions such as Queensland refer to regulated systems as *supplemented*: meaning that the flows are supplemented through the use of water infrastructure such as dams, barrages and weirs as apposed to the flow of the water body being regulated through the use of such structures.

Environmental Protection Agency. To bridge this nexus, state legislation needs to connect externalities with their original source. Outfalls and their legislative disconnect are currently missing from the purview of water reform policy.

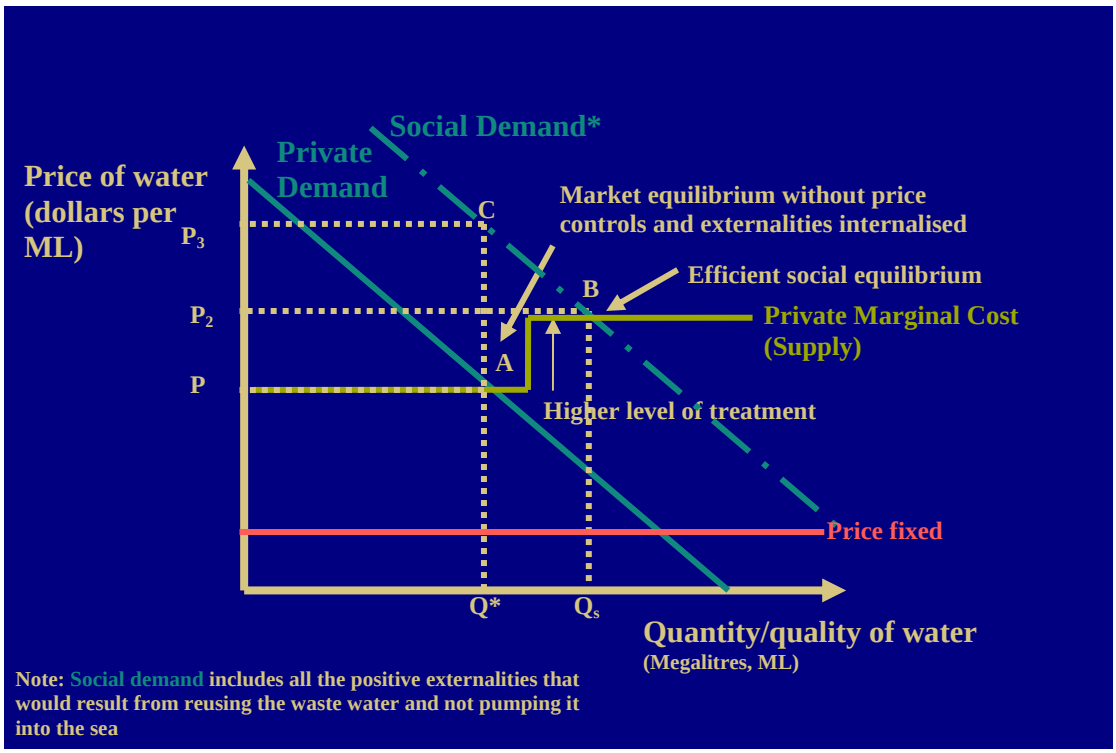
The research flowing from this paper is intended to deliver strategic economic information on the public benefits of reducing ocean outfall for re-use helping to advance change and better practice in Australian water management. Choice modelling, contingent valuation, travel cost, and hedonic pricing methods could be used to assess these public benefits. In addition, the ability to transfer estimates obtained from these methods at one site to another could be undertaken where conditions are suitable because value transfer represents an innovative way to reduce the cost of the valuation exercise.

Market based instruments may be an avenue for capturing the public benefits of reduced ocean outfall. In the absence of a flexible pricing regime, the price elasticity of demand for water and waste water re-use is likely to be relatively low given prices for urban and rural water do not reflect scarcity. Thus, a tradable certificates arrangement may be better placed than using price to correct for these lost public benefits. For example, Hoffmann et al. (2004) found that the price elasticity of demand for urban water in Brisbane over the long and short term was relatively inelastic. While the price elasticity in Brisbane was found to be inelastic it was more elastic than the empirical evidence from others state capitals.

## Conceptual Framework

The conceptual framework for this paper involves the use of a social economic framework taking account of the social costs and benefits of ocean outfalls and desalinisation plants. Figure 1 helps to analyse some of the alarming issues associated with the economics of ocean wastewater outfalls. The figure depicts the demand and supply for recycled water.

**Figure 1: Demand and Supply for Recycled Water**




In Figure 1 the private marginal cost or supply curve is given by the yellow kinked line. The kink in the line indicates that a higher level of treatment is required of current waste water for it to be recycled and reused. This higher level of treatment comes at a cost with additional plant and infrastructure and

hence the kink in the curve. There is a change in total costs in order to provide additional recycled water but beyond this point there is capacity within the new plant to produce more water with minimal change in marginal costs. This is similar to bringing on additional power plants which run at a higher marginal cost as overall demand for power rises. The higher level of treatment allows a higher level of social demand to be achieved with an efficient social equilibrium at point B versus the current 'market' equilibrium at A. The amount of water recycled increases from Q* to Qs and the socially desirable price is $P_2$ which is higher than the current 'market' price of P or a government imposed essential service price as depicted by the pink line. The diagram also indicates that current levels of recycling are valued at $P_3$ in a social sense, higher than current values revealed in the 'market' by P. The difference from $P_3$ to P represents the external benefits from water recycling at the quantity of output Q*.

*Why doesn't demand reflect the preferences of society?*
Non-pecuniary external costs or diseconomies[3] of pumping water out to sea are dispersed and shared by many.

- It is difficult to link sickness in individuals to taking a beach visit and being contaminated by the ocean outfall.
- It is difficult for all those affected in society to get together to take action. The existence of a non government organizations such as the Clean Ocean Foundation and its struggle for survival provides evidence of this.
- While each of us, through the state, share the coastal waters and its ecology and resources, we don't necessarily see it as directly impacting on our hip pocket and we personally are not directly responsible.
- Nor is the damage that is done to the environment immediately obvious because the damage is below or in the water, at sites with restricted access.
- The members of the society impacted by the outfall don't charge (one that is commensurate with the externalities created) the service provider for dumping the waste water in their local sea (because the service provider has a permit to do so) and water users (the creators of waste water) are not then on-charged for the external costs of disposal at sea.
- The damage done to tourism, beach recreation and property values is not obvious nor has it been assessed. Assessment entails 'what if', which has a degree of uncertainty. A key research aim is to help assess the likely damages.
- The benefits from reusing the water are also dispersed. For example, treated water may be used to address salt water intrusion resulting from depleted coastal aquifers. As stated by NWC (2006, p. 8), there is need to better understand and manage Australia's groundwater systems and their 'connectivity' with surface water systems. While one user may see the aquifer as providing ample supply another may see their supply depleted substantially. Free access to a common property resource is likely to result in 'Tragedy of the Commons' (Hardin 1968) and because many coastal aquifers are accessible free of charge, use is not metered and is not reflective of the full costs. Further, aquifers can be replenished over time but at a relatively slow rate. Replenishment of aquifer may help in the long run in addressing salt water intrusion of coastal lands. In addition, typically ground water systems are managed by different agencies to the agencies that manage ocean outfall and waste water treatment. Therefore, agencies may not benefit financially from attempting to take account of external benefits from changing their business because of the non-excludable nature of these benefits.

*Why doesn't supply respond to demand?*
The waste water service provider is typically a government owned or authorised monopoly (GOM) (the only provider) and is not exposed to market forces to respond to industry, agriculture and society's willingness to pay for recycled water (nor the associated external benefits).

[3] The general treatment of externalities is drawn from Tietenberg (2006) but the application is from the author's own experience and knowledge.

- The GOM has no competitors.
- Prices for waste water treatment are typically set by government, usually reflecting cost of supply (but not demand conditions).
- Also, the GOM's accounts do not reflect any lost positive externalities from the ocean outfalls because these are external to their business.
- GOM's are established based on natural monopoly theory but this may be flawed in practice. For example, Saal and Parker (2000) found that the amalgamated Water and Sewerage Companies (WASC) of England and Wales was not displaying economics of scope between water and sewerage services. The Office of Water Services (OFWAT, 2004) discusses the implementation of competitive delivery of water services in England where competing companies share networks similar to that provided in the telephone communication sector in Australia.

**Design and Methods**

Non-market valuation methods can be used to ascertain:

- lost values for beach recreation;
- health affects for humans;
- property value impacts using hedonic pricing from market values; and
- psychological and associated guilt impacts by attempting to transfer these concerns to monetary values.

The psychological impacts from knowing one contributes to an environmental or social wrong, as far as the author is aware, has not yet been translated into monetary economic values. The role of non-market valuation in revealing psychological impacts including ethical wrongs involved in economic tradeoffs is an area requiring future research. Estimates of lost values for the population of users and non-users of outfall sites are also wanting.

**Initial empirics: People's views on waste water outfalls and treatment plants**

In order to assess the impact that visiting a site may have on one's ethical stance of waste water outfalls and treatment plants students at the Australian Maritime College visited a number of sites as depicted in Table 1.

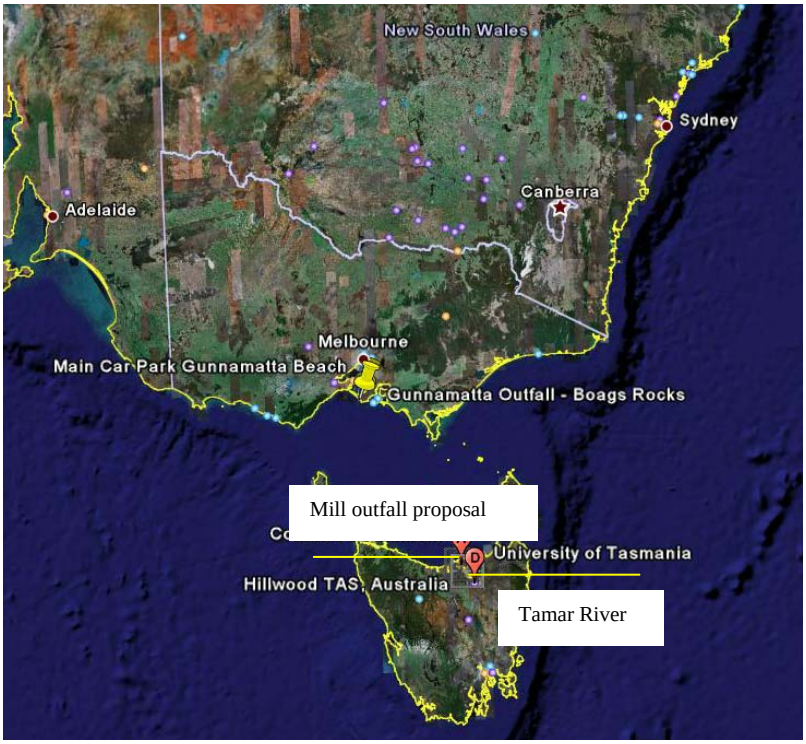
**Table 1: Field trip locations, dates and sample sizes**

| Site | Location | Date | Sample size |
|---|---|---|---|
| Gunnamatta Beach ocean outfall, | Boags Rocks, Bass Straight, Victoria | Friday, 17 August 2007 | 10 |
| Bell Bay pulp mill site | Tamar River, Tasmania **a** | Monday, 24 September 2007 | 12 |
| Ti Tree Bend secondary waste water treatment plant | Tamar River, Tasmania **b** | Monday, 21 July 2008 | 23 |

Notes: **a**. The outfall location is to be at Five Mile Bluff, north east of Launceston on the Bass Straight coast. **b**. Outfall is into the Tamar River from the treatment plant at Invermay, Launceston. Future plans are to move this outfall closer to the sea.

Locations of the various sites are depicted in Figure 2. Students were required to fill a work sheet which contained a number of personal preference questions with ranked responses: 1 = 'very much'; 4 = 'neutral'; 7 = 'not at all'. Students were required to complete these questions both before and again after visiting the site in order to test if their preferences changed as a result of their experience on site. Students were given a lecture and hand-out on the ethical criterion of ecologically sustainable development (ESD) because a number of questions required them to judge current management practices against this criterion. Examples of the worksheet questions are given in Figure 8, Figure 9, and Figure 10 at the rear of the paper.

**Figure 2: Map of field trip locations in Victoria and Tasmania, Australia (Google Earth 2007)**




The modal responses of students are provided in Table 2. As can be seen from the tables, students did on average, change their preferences as a result of visiting the given site.

**Table 2: Modal responses by field trip**

| Site | Question<br><br>Visit | Substantial issue for coastal conservation in Australia? | Does issue represent ESD of our coasts and seas? | Does issue represent ESD of our water or natural resources? **b** | Closure would change the integrity of the coastal and marine environment impacted? **c** | Economics can help analyze and solve some of the tradeoffs we face from waste water outfalls in the coastal zone? |
|---|---|---|---|---|---|---|
| Gunnamatta | Before | 2 | 6 | 7 | 1 | 2 |
| | After | 1 | 7 | 7 | 2 | 1 |
| Pulp mill | Before | 2 | **a** | 6 | 1 | 4 |
| | After | 1 | **a** | 7 | 1 | 2 |
| Ti Tree Bend | Before | 3 | 5 | 5 | 3 | 2 |
| | After | 1 | 3 | 4 | 1 | 1 |

Notes: ESD = ecologically sustainable development. Scaled responses were from: 1 = very much; 4 = neutral; 7 = not at all. **a**. For the pulp mill there was a replacement question asking if the mill were a substantial issue for marine and coastal conservation in Tasmania and the modal responses were 1 for both before and after. **b**. The term 'natural resources' was used for Bell Bay Pulp Mill because timber resources were also included along with 'water' (and energy). **c**. Because at the time of the field visit the mill had not yet been built the question asked was whether allowance of the mill would change the integrity of the marine and coastal environment. This still represented a marginal assessment consistent with the questioning of closure of the outfalls.

Table 3 shows the change in scaled responses from ‘before’ to (less) ‘after’ their site visit. All but in one question, the modal student response changed across all field trip questions. A positive change in scale means a movement towards ‘very much’ and a negative change represents a movement towards ‘not at all’ on the 7 numeral scale.

**Table 3: Changes[a] in assessment**

| Question<br><br>Site | Substantial issue for coastal conservation in Australia? | Does issue represent ESD of our coasts and seas? | Does issue represent ESD of our water or natural resources? **c** | Closure would change the integrity of the coastal and marine environment impacted? **d** | Economics can help analyse and solve some of the tradeoffs we face from waste water outfalls in the coastal zone? |
|---|---|---|---|---|---|
| Gunnamatta | 1 | -1 | 0 | -1 | 1 |
| Pulp mill | 1 | **b** | -1 | 0 | 2 |
| Ti Tree Bend | 2 | 2 | 1 | 2 | 1 |

Notes: ESD = ecologically sustainable development. Scaled responses were from: 1 = very much; 4 = neutral; 7 = not at all. **a**. Change is before less after : If + = moved toward 'very much', if - = moved toward 'not at all'. **b**. For the pulp mill there was a replacement question asking if the mill were a substantial issue for marine and coastal conservation in Tasmania and the modal responses were 1 for both before and after. **c**. The term 'natural resources' was used for Bell Bay Pulp Mill because timber resources were also included along with 'water' (and energy). **d**. Because at the time of the field visit the mill had not yet been built the question asked was whether allowance of the mill would change the integrity of the marine and coastal environment. This still represented a marginal assessment consistent with the questioning of closure of the outfalls.

Most changes in responses met *a priori* expectations. As a result of visiting sites student assessments of:

- the substance of outfalls, pulp mills and treatment plants as Australian issues typically increased by an order of 1-2 out of 7;
- economics helping to analyse and solve some of the tradeoffs we face from waste water outfalls in the coastal zone increased by an order of 1 to 2 out of 7;
- whether the closure of the Ti Tree Bend treatment plant would raise the integrity of the marine and coastal environment rose by an order of 2 out of 7.

Inconsistent with *a priori* expectations are those highlighted in the table. Students changed their assessments as a result of visiting sites:

- by a rise of 2 out of 7 for whether Ti Tree Bend plant met the ESD of our coasts and seas;
- by a rise of 1 out of 7 for whether Ti Tree Bend met the ESD criterion for our water resources;
- by a fall of 1 for whether the closure of Gunnamatta would improve the integrity of marine ecosystems. This may be explained by a small sample size.

The first two anomalies may be explained by the author's *a priori* expectations being wrong. Maybe students viewed waste water treatment plants as an attempt to improve environmental outcomes, which is a valid argument or preference.

Part of the reason for our water resource use being a mess is because, while water conservation consciousness has risen in the last decade, the same is not true for an appreciation of the full impact of our water use and its lifecycle. The broader lifecycle includes our creation of waste water, water reuse, recycling and disposal. Anecdotal evidence of our poor appreciation of the lifecycle of our water use may be the rejection of water recycling projects in a number of regions around Australia including for example Toowoomba. However, reclamation projects are on the increase with examples such as the Western Corridor Water Recycling Project forming part of a Water Grid in South East Queensland as depicted in Figure 3. The demand for these projects is more likely to come from scarcity and uncertainty of supply rather than an appreciation of the impacts of our waste water creation on marine and coastal environments and communities. In August 2008, the Victorian Civil and Administrative Tribunal conducted a hearing on the controversial development of a biosolids facility at Black Rocks, between Barwon Heads and Torquay (see Figure 4 and Figure 7). While the facility attempts to re-use in pelletised form some of the solid waste that results from waste water creation, this may trigger a number of negative externalities for the coastal communities and people in general (Blackwell 2008) including reduced landscape scenery (see Figure 4 and Figure 6), human health impacts, losses to marine recreation (see Figure 5) and ecosystem integrity, and increased costs for future water recycling. Similarly Wonthaggi on the Victorian coast has a proposal for a desalination plant which is opposed on social, economic and ecological grounds by the local community, beach users, and various social institutions (Allison 2008).

**Figure 3: South East Queensland's 'Water Grid' (Queensland Government 2006)**

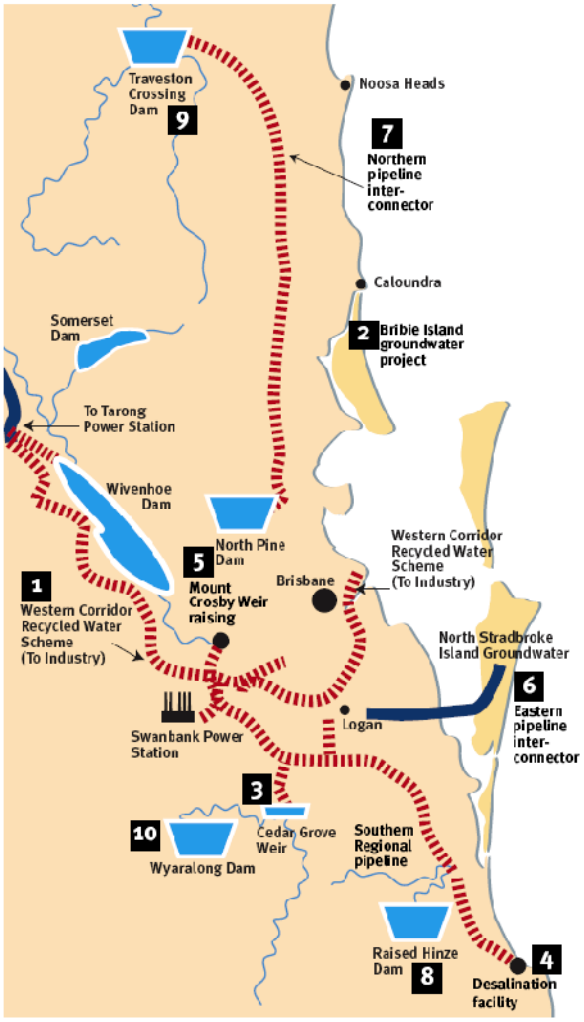
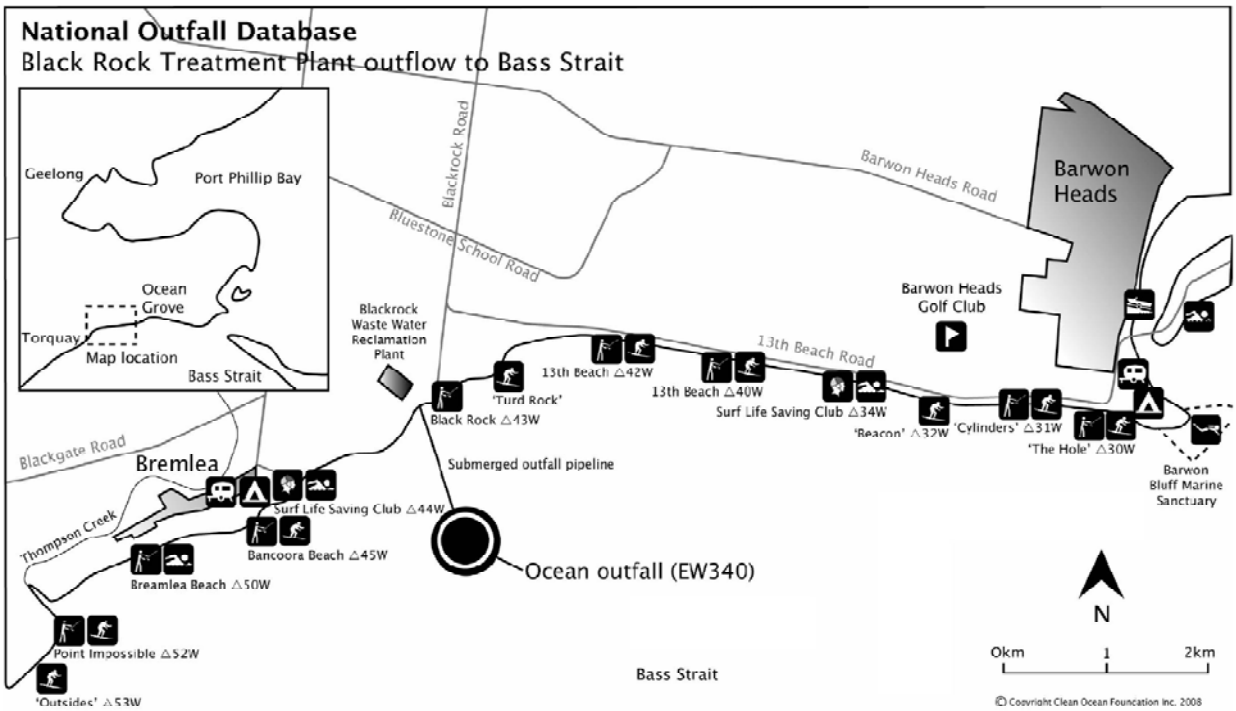



**Figure 4: Biosolids facility at Black Rocks, Victoria (Plenary Projects Aug 2008)**

**Figure 5: Point Impossible, a surf break at risk from our waste water disposal (COF, Aug 2008)**

**Figure 6: 13th Beach at risk from biosolids facility (COF, Aug 2008)**

**Figure 7: Map of location of proposed biosolids facility, Black Rock, Victorian coast (COF, Aug 2008)**




## Conclusion

Ocean waste water outfalls provide local state and Commonwealth agencies with a key opportunity to reduce a significant social ill and at the same time create social and private goods. Water supplies in all Australian capital cities are scarce. By taking account of the benefits to society, including those to the market from reducing waste water outfalls, decisions over the amount and location of outfalls may be changed for the better. The social benefits of doing so in terms of improved health of community members and raised psychological and ethical wellbeing may be substantial. The ecological benefits may also be large. Improvements in the biophysical environment are likely to have spill-overs into our recreation and tourism sectors. All Australians have much to gain from thinking smartly, from a broad social economic framework, about how we use our water, create waste water and dispose of it. Visiting disposal and treatment sites and becoming aware of the issues will also aid in improved appreciation of the opportunities forgone from our present water practices and guide solutions in the future.

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**Figure 8: Gunnamatta outfall worksheet**

Field Trip to Gunnamatta Outfall, IMCC, Name……Student no……..

**Before we head out...**

*Do you think that waste water outfalls are a substantial issue for for marine and coastal conservation in Australia?*

Very much Neutral Not at all
1 2 3 4 5 6 7

*Do you think waste water outfalls represent the ecological sustainable development (or use) of our coasts and seas?*

Very much Neutral Not at all
1 2 3 4 5 6 7

*Do you think that waste water outfalls represent the ecologically sustainable development (or use) of our water resources?*

Very much Neutral Not at all
1 2 3 4 5 6 7

What is the magnitude of the issue?

*How much water are we sending off our coasts in Australia?*.....ML/yr ……..$/ML
Total value……?

*How much water are we sending into our waterways via waste water outfalls in the central Victoria region*
(Melbourne)?.....ML/yr……$/ML
Total value……?

*What's the quality level or grade for most of this water?*.....

*How does this compare to our urban and industrial water use in*
(a) Australia?.....ML/yr ……ave grade
(b) Melbourne? .....ML/yr……ave grade

*How much more would it cost to raise the grade of our waste water so it can be used:*
(a) For gardens, parks, golf courses, playing fields etc?
Grade……Cost ……$/ML
(b) For human consumption?
Grade……Cost ……$/ML

*If this was done would there be much change in the integrity of the coastal and marine environment impacted by the outfall?*

Yes a lot Neutral No, none at all
1 2 3 4 5 6 7

*Can we use economics to help analyse and solve some of the conflicts or trade-offs we face from waste water outfalls in the coastal zone?*

Yes a lot Neutral No, none at all
1 2 3 4 5 6 7

**While on site…**

*What are the proportions of contribution to the waste water at Gunnamatta:*
*(a) urban use……..%*
*(b) industrial use…….% and*
*(c) other, please specify……..and ……..%.*

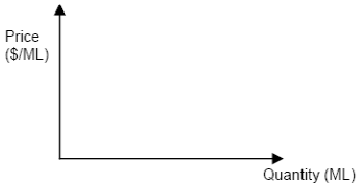
*(a) People from the Peninsula……%*
*(b) People away from the Peninsula (eg. Melbourne)……..%*

*What is included in the **social economic cost** of the outfall?*
*Social impacts*

*Biological impacts*

*Economic impacts*

*Draw a diagram which reflects the social cost of the outfall in a market for the demand and supply of recycled water.*




*How might we estimate this social cost? What are some of the economic valuation methods we can use?*

*Give an example of a type of question you would ask visitors to a beach to get a monetary value for the social cost of the outfall on their recreation?*

*List some of the economic instruments that could be used to deal with the social cost (externalities) of the outfall? Relate these to your diagram?*

**After the field trip and lecture…**

*Do you think that waste water outfalls are a substantial issue for concern in Australia for marine and coastal conservation?*

Very much Neutral Not at all
1 2 3 4 5 6 7

*Do you think waste water outfalls represent the ecological sustainable development (or use) of our coasts and seas?*

Very much Neutral Not at all
1 2 3 4 5 6 7

*Do you think that waste water outfalls represent the ecologically sustainable development (or use) of our water resources?*

Very much Neutral Not at all
1 2 3 4 5 6 7

*If the outfall was closed would there be much change in the integrity of the coastal and marine environment at the site of the outfall?*

Yes a lot Neutral No, none at all
1 2 3 4 5 6 7

*Can we use economics to help analyse and solve some of the conflicts or trade-offs we face from waste water outfalls in the coastal zone?*

Yes a lot Neutral No, none at all
1 2 3 4 5 6 7

*Any other comments or concerns?*

**Figure 9: Pulp mill worksheet**

Field Trip: Economic Aspects of the Bell Bay Pulp Mill, East Tamar, IMCC, Name……Student no……..

**Before we head out...**

*Do you think that the Bell Bay pulp mill is a substantial issue for marine, estuarine and coastal conservation in Tasmania?*

| Very much | | | Neutral | | | Not at all | Unsure |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

*Do you think that the Bell Bay pulp mill is a substantial issue for marine, estuarine and coastal conservation in Australia?*

| Very much | | | Neutral | | | Not at all | Unsure |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

*Do you think that the Bell Bay pulp mill represents the ecologically sustainable development (or use) of Tasmania's natural resources?*

| Very much | | | Neutral | | | Not at all | Unsure |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

*If this mill is allowed will there be a fall in the integrity of the coastal, estuarine and marine environments?*

| Yes a lot | | | Neutral | | | No, none at all |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

*Can we use economics to help analyse and solve some of the conflicts or trade-offs we face from mill developments?*

| Yes a lot | | | Neutral | | | No, none at all |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

What is the magnitude of the issue? (Refer to the materials on WebCT and do your own searches and provide sources.)

*How much will be gained in market values from the mill to Tasmania? Direct*.....jobs/yr ……income/yr
Indirect.....jobs/yr ……..income/yr
Total.....jobs/yr ……income/yr

*How much will be gained in market values from the mill to the Northern region? Direct*.....jobs/yr
……income/yr
Indirect.....jobs/yr ……..income/yr
Total.....jobs/yr ……income/yr

*What will be the exports earned from the mill?*
……*Value $/yr*……..*volume/yr*

*How do these exports compare to exports from:*
*the wine industry?*
……*Value $/yr*……..*volume/yr*
*the scallop industry?*
……*Value $/yr*……..*volume/yr*

*What is likely to be lost (what is the opportunity cost) as a result of the mill going ahead? (Refer to the 2 impacts handouts on WebCT.)*

*Social impacts*

*Biological and physical impacts*

*Economic impacts*

*Have any of these costs been quantified? If so write their costs along side each.*

*If not, have any of these been included in the reports required as part of the mill development? If so write a y (for yes) along side each.*

*Circle those impacts which you think are substantial and have been overlooked by the economic and social reports?*

**While on site...**

*Draw a diagram which reflects any external costs borne by the scallop and wine industries from the mill in a market for the demand and supply of timber/chips. (As an example you may consider the negative impact of increased truck traffic for wineries – refer to Whish-Wilson 2006 on WebCT).*


*How may we estimate some of the costs which have been overlooked – what methods can we use? Tick to the left of appropriate ones from the following and write the relevant impacts alongside. (Refer to Campbell and Brown 2003, Chp 12 from WebCT)*

*Production based methods:*
- *Dose response*
- *Opportunity cost*
- *Preventative cost*
- *Replacement cost*

*Utility based methods*
- *Travel cost method (revealed preference)*
- *Hedonic pricing*
- *Contingent valuation*
- *Discrete Choice modelling*

*Give an example of a question you would ask respondents to estimate people's willingness to pay to prevent the mill development or move it to Hampshire?*

*Tick the appropriate economic instruments that could be used to deal with the social cost (externalities) of the mill? Relate these to your diagram?*
- *Taxes (Pigou)*
- *Subsidies*
- *Quotas*
- *Tradeable permits (Coase Theorem)*

**After the field trip…**

*Do you think that the Bell Bay pulp mill is a substantial issue for marine, estuarine and coastal conservation in Tasmania?*

| Very much | | | Neutral | | | Not at all | Unsure |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

*Do you think that the Bell Bay pulp mill is a substantial issue for marine, estuarine and coastal conservation in Australia?*

| Very much | | | Neutral | | | Not at all | Unsure |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

*Do you think that the Bell Bay pulp mill represents the ecologically sustainable development (or use) of Tasmania's natural resources?*

| Very much | | | Neutral | | | Not at all | Unsure |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

*If this mill is allowed will there be a fall in the integrity of the coastal, estuarine and marine environments?*

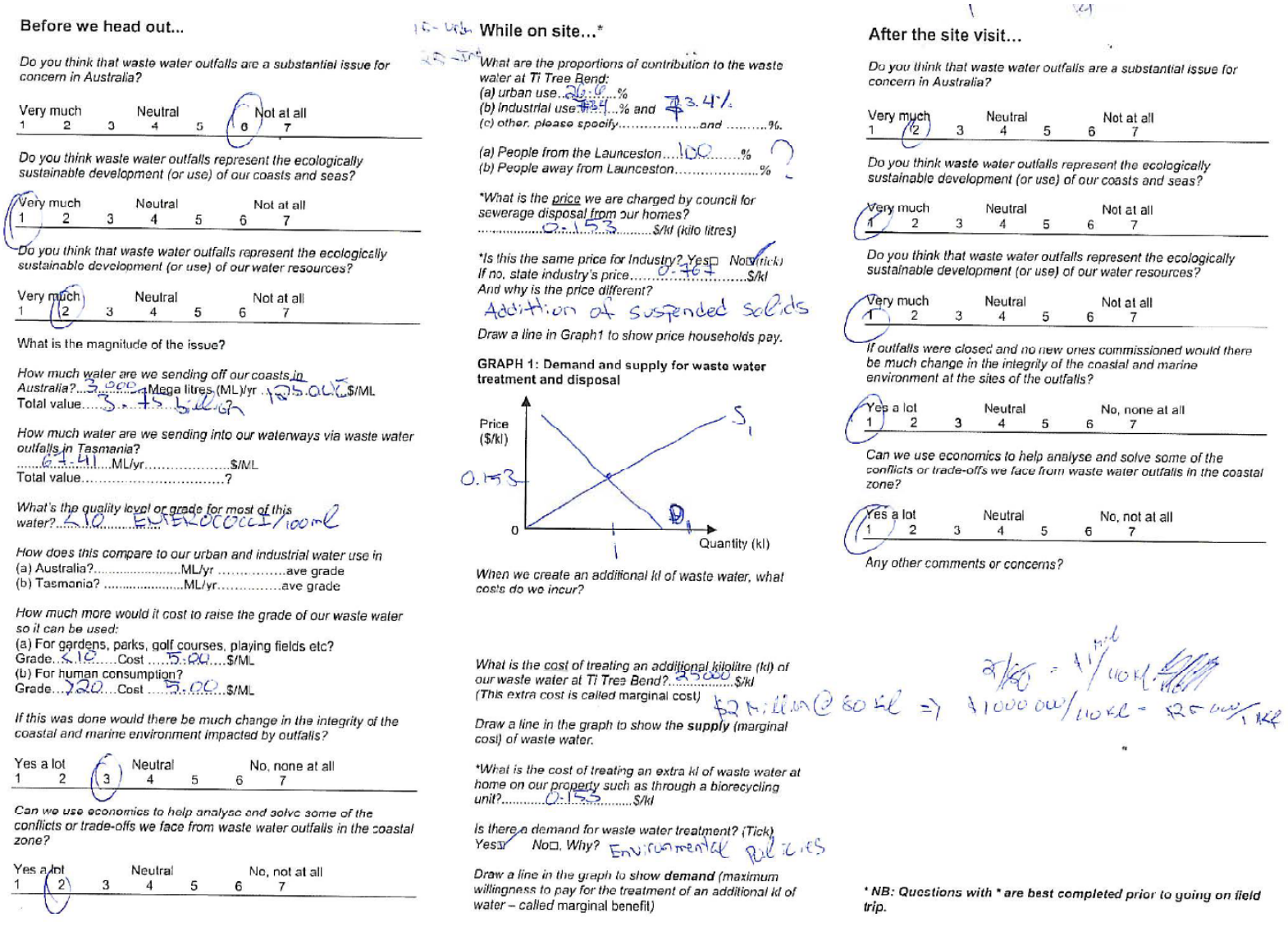
| Yes a lot | | | Neutral | | | No, none at all |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

*Can we use economics to help analyse and solve some of the conflicts or trade-offs we face from mill developments?*

| Yes a lot | | | Neutral | | | No, none at all |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

*Any other comments or concerns?*

**Figure 10: Work sheet for Titrea Bend Treatment Plant , completed example**



**Before we head out...**

*Do you think that waste water outfalls are a substantial issue for concern in Australia?*

Very much 1 2 3 4 5 6 Not at all 7

*Do you think waste water outfalls represent the ecologically sustainable development (or use) of our coasts and seas?*

Very much 1 2 3 4 5 6 7 Not at all

*Do you think that waste water outfalls represent the ecologically sustainable development (or use) of our water resources?*

Very much 1 2 3 4 5 6 7 Not at all

What is the magnitude of the issue?

*How much water are we sending off our coasts in Australia?* 3,000 Mega litres (ML)/yr 125.000 $/ML
Total value 375 billion?

*How much water are we sending into our waterways via waste water outfalls in Tasmania?*
67.41 ML/yr ..... $/ML
Total value ..... ?

*What's the quality level or grade for most of this water?* 210 ENTEROCOCCI/100ml

*How does this compare to our urban and industrial water use in*
(a) Australia? ..... ML/yr ..... ave grade
(b) Tasmania? ..... ML/yr ..... ave grade

*How much more would it cost to raise the grade of our waste water so it can be used:*
(a) For gardens, parks, golf courses, playing fields etc?
Grade 210 Cost 15.00 $/ML
(b) For human consumption?
Grade 220 Cost 5.00 $/ML

*If this was done would there be much change in the integrity of the coastal and marine environment impacted by outfalls?*

Yes a lot 1 2 3 Neutral 4 5 6 No, none at all 7

*Can we use economics to help analyse and solve some of the conflicts or trade-offs we face from waste water outfalls in the coastal zone?*

Yes a lot 1 2 3 Neutral 4 5 6 7 No, not at all

**While on site...***

*What are the proportions of contribution to the waste water at Ti Tree Bend:*
*(a) urban use* 26.6 %
*(b) Industrial use* 73.4 % and
*(c) other, please specify* ..... and ..... %.

*(a) People from the Launceston* 100 %
*(b) People away from Launceston* ..... %

**What is the price we are charged by council for sewerage disposal from our homes?*
0.153 $/kl (kilo litres)

**Is this the same price for Industry? Yes* No (tick)
*If no, state industry's price* 0.764 $/kl
*And why is the price different?*
Addition of suspended solids

*Draw a line in Graph1 to show price households pay.*

**GRAPH 1: Demand and supply for waste water treatment and disposal**




*When we create an additional kl of waste water, what costs do we incur?*

*What is the cost of treating an additional kilolitre (kl) of our waste water at Ti Tree Bend?* 25000 $/kl
*(This extra cost is called marginal cost)*
$2 Million @ 80 kl => $1000 000 / 40 kl = $25 000 / 1 kl

*Draw a line in the graph to show the **supply** (marginal cost) of waste water.*

**What is the cost of treating an extra kl of waste water at home on our property such as through a biorecycling unit?* 0.153 $/kl

*Is there a demand for waste water treatment? (Tick)*
Yes ✓ No ☐. Why? Environmental policies

*Draw a line in the graph to show **demand** (maximum willingness to pay for the treatment of an additional kl of water – called marginal benefit)*

**After the site visit...**

*Do you think that waste water outfalls are a substantial issue for concern in Australia?*

Very much 1 2 3 Neutral 4 5 6 Not at all 7

*Do you think waste water outfalls represent the ecologically sustainable development (or use) of our coasts and seas?*

Very much 1 2 3 Neutral 4 5 6 7 Not at all

*Do you think that waste water outfalls represent the ecologically sustainable development (or use) of our water resources?*

Very much 1 2 3 Neutral 4 5 6 7 Not at all

*If outfalls were closed and no new ones commissioned would there be much change in the integrity of the coastal and marine environment at the sites of the outfalls?*

Yes a lot 1 2 3 Neutral 4 5 6 7 No, none at all

*Can we use economics to help analyse and solve some of the conflicts or trade-offs we face from waste water outfalls in the coastal zone?*

Yes a lot 1 2 3 Neutral 4 5 6 7 No, not at all

*Any other comments or concerns?*

***NB: Questions with * are best completed prior to going on field trip.***