Economic and social value of improved water quality at Sydney’s coastal beaches

Sydney Water

2016
Coastal beaches are an iconic part of Sydney’s identity, a defining feature of the Sydney lifestyle. With around 36 million visits to Sydney’s beaches each year, they provide plentiful opportunities for recreation for people from all walks of life, and cater to varying interests. Beaches are a place to swim, surf, play, relax, spend time with friends and family or simply enjoy the view.

People value beaches as a place to go, and also place value on their existence. There are a number of factors affecting why people like going to the beach; including the sun and the sand, the beach atmosphere, and, undeniably, the water quality at the beach. If water quality at the beach is poor, swimmers may become ill, biodiversity may suffer, and the beach experience would be less enjoyable overall.
As such, beaches contribute to the ‘liveability’ of a city. Increasingly, there is a desire for the large cities around the world to better support quality of life. The Australian Government has a renewed focus on cities, and the NSW Government is seeking to improve Sydney’s liveability through initiatives such as the establishment of the Greater Sydney Commission.

Infrastructure investments play an important role in facilitating liveability; in the case of beaches, the old cliff-face outfalls at North Head, Bondi and Malabar were decommissioned and replaced with the Deepwater Ocean Outfall program 25 years ago to contribute to cleaner water at Sydney’s coastal beaches. Alongside other changes to wastewater treatment, beneficial re-use and trade waste policies, this program has improved water quality at beaches, resulting in a range of benefits and contributions. Sydney Water has commissioned Deloitte Access Economics to consider these wider impacts. This study is not a cost-benefit analysis or assessment of the Deepwater Ocean Outfall program or other wastewater management initiatives, but rather focuses on the economic and social value generated from improvements in water quality.

These impacts are challenging to measure; the benefits and contribution of beaches to the economy and society are not fully reflected in annual reports of businesses, or in the National Accounts. Indeed, many of these impacts, such as the value of a trip to the beach for an individual, or the reduced likelihood of getting sick at the beach, are partially intangible.

A range of economic modelling and other estimation techniques are used in this study to get a sense of the quantum of benefits associated with beaches, and with cleaner water at beaches. It is important to recognise that these are not precise estimates, but point to the existence of major benefits of infrastructure investments such as deepwater ocean outfalls and other wastewater management initiatives.

This study considered five potential benefits and contributions of beaches, and cleaner water, to society. Three of these are quantified: tourism contributions are estimated by the expenditure of people who are drawn to visit Sydney, health benefits are estimated through reduced costs of absenteeism, and the value for Sydney residents is quantified through a new survey conducted by Deloitte Access Economics to understand people’s attitudes to the beach.

This study also considers the benefits to biodiversity and the contribution to Sydney’s iconic brand, however, these benefits could not be quantified.

The five benefits considered are presented in Figure i, and are discussed below.

Figure i: Benefits explored in this study

<table>
<thead>
<tr>
<th>Economic and social value of improved water quality at Sydney’s beaches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value for Sydney residents</td>
</tr>
<tr>
<td>Tourism and business contribution</td>
</tr>
<tr>
<td>Health benefits</td>
</tr>
<tr>
<td>Biodiversity benefits</td>
</tr>
<tr>
<td>Contributions to Sydney’s iconic brand</td>
</tr>
</tbody>
</table>

Source: Deloitte Access Economics
Sydney's coastal beaches are valued by Sydney residents, with clean water at Sydney's coastal beaches valued in many ways. People value their direct use of beaches as well as having the option to go, even if they do not attend frequently. There are also non-use values associated with the maintenance of the beach water quality, in terms of retaining beach amenity for future generations, or in terms of the value from knowing that clean water at beaches exists.

In this analysis, total value of beach access for Sydney residents is estimated at around $1.2 billion per annum, based on estimates of an individual's value of time, with $94 million of this attributable to beach water quality. It was also found that beaches were valuable even for people who did not visit the beach. Indeed, Deloitte Access Economics' survey found that 9 out of 10 people that have not visited a coastal beach in Sydney over the last 12 months, still value them, for reasons such as their contribution to Sydney's lifestyle and their iconic value to the city. Based on respondents' reported values, it is estimated that the total non-use value of coastal beaches in Sydney is around $123 million per year, with $43 million of this attributable to beach water quality.

Overall, the total value of Sydney's coastal beaches for Sydney residents is estimated at around $1.3 billion per year. Using a 7% discount rate, this equates to a lifetime value for Sydney's coastal beaches of almost $19 billion.

Beaches are also one of Sydney's key attractions for domestic and international tourists. Consistently clean water is critical for beaches to remain open and to retain their amenity values. In turn, this supports continued visitation and thriving coastal businesses and economies. Modelling of these tourism activities reveals that the net value added associated with beach water quality is worth around $332 million per year to the NSW economy through tourism, with around 80% of this value coming from international visitation. Over 3,500 full time equivalent (FTE) jobs are associated with this tourism, including direct employment of approximately 2,900 FTE jobs within tourism sectors and 600 indirect FTE jobs in supporting industries.

Cleaner water at the beach also has health benefits for the population, with a reduction in sewage pollutants associated with a decreased incidence of gastrointestinal, respiratory, eye and ear conditions. With around 31 million visits to Sydney's coastal beaches each year, cleaner water may contribute to the avoidance of illness for around 180,000 people annually. One of the ways of measuring the cost of illness to the economy is the lost productivity associated with absenteeism. It is estimated that the avoided costs of absenteeism could be around $140 million per year.

The potential impacts of cleaner water for biodiversity were also considered as part of this study. The decommissioning of the old cliff-face outfalls and subsequent replacement with the Deepwater Ocean Outfall program has significantly improved water quality in and around Sydney's shoreline and has not had any identifiable impact on the marine environment around the new offshore discharge.

Finally, Sydney's coastal beaches are a key part of Sydney's iconic, or brand, value. Sydney's brand is important in influencing the perceptions of the city by those internationally and interstate and can shape business and economic interactions. A Deloitte Access Economics survey found that beaches ranked in the top three when visitors think of Sydney – alongside Sydney Harbour and the Sydney Opera House. Clean water is largely synonymous with the beach experience, and hence is an important contributor to Sydney's brand value.

Overall, this research suggests that significant economic and social value is attributable to the improved water quality at Sydney's coastal beaches as a result of wastewater management activities, including the Deepwater Ocean Outfall program.

Deloitte Access Economics
Introduction

Sydney's coastal beaches are an iconic part of the city’s identity and a defining feature of the Sydney lifestyle. From North Palm Beach on the northern peninsula to Bulgo Beach at the southern end of the Royal National Park, around 36 million visits are made to Sydney's 64 coastal beaches each year by both domestic and international visitors.

As some of the most popular outdoor public spaces for residents and tourists alike, coastal beaches contribute to the liveability of Sydney. Coastal beaches provide plentiful opportunities for recreation for people from all walks of life and cater to varying interests.

Coastal water quality is central to the enjoyment of the beach experience. In a survey conducted by Deloitte Access Economics, around half of respondents who are Sydney residents that have visited one or more of Sydney's coastal beaches in the last 12 months rated the cleanliness of the water as either the first or second most important feature for them when they visit. In addition, around half of respondents who are beach users in Sydney participated in water-based activities at beaches from the water's edge to swimming in the surf.

Over the last 25 years, a number of water and wastewater management initiatives have contributed to a significant improvement in the water quality at Sydney's beaches. Most notably, the decommissioning of the cliff-face outfalls at North Head, Bondi and Malabar and replacement with deep ocean outfalls two to four kilometres offshore, along with increases in wastewater treatment, beneficial re-use and enhanced trade waste policies have led to improvements in health, and generated economic and social value from the significant pollution reduction at beaches.

While there is a wealth of information and research on the costs and benefits of specific environmental management strategies and infrastructure, there is a gap in the understanding of these wider economic and social implications.

To coincide with the 25th anniversary of the Deepwater Ocean Outfall program, Sydney Water has commissioned Deloitte Access Economics to estimate the economic and social value of improved water quality at Sydney's coastal beaches.

This research is both timely and relevant and highlights the broader benefits and contributions of environmental management initiatives and wastewater infrastructure in generating value for individuals, supporting business, attracting tourists and migrants and maintaining the iconic value of Sydney's beaches.

1.1 Wastewater management and coastal beach water quality

Infrastructure investments play an important role in facilitating the liveability of a city; in the case of cleaner water at beaches, Sydney Water has been responsible for a number of initiatives.

Sydney Water operates 30 wastewater treatment and water recycling plants that treat over 1.5 billion litres of wastewater every day from homes and businesses across Sydney, Illawarra and the Blue Mountains. Around 70% of Sydney's wastewater undergoes primary treatment at the plants located at North Head, Bondi and Malabar before being discharged to the ocean. Around 1200ML of effluent is currently discharged from these three plants each day.

Prior to 1991, effluent from the treatment plants was discharged to shallow water very close to the shore through cliff-face outfalls. This practice had a significant effect on water quality and beach amenity, with impacts including grease deposits on the sand, unsafe water for swimming, contaminants in seafood, detrimental impacts on the marine environment and reduced visual amenity (Sydney Water, 2012). Unsurprisingly, there was substantial public dissatisfaction with the state of the beaches (see next page).

In response, a decision was made in the early 1980s to decommission the cliff-face outfalls and replace them with deepwater ocean outfalls so that effluent was instead released between two to four kilometres offshore (see Figure 1.1).
The Sydney Coastal Councils Group (SCCG) was established in 1989 to advocate for a better solution to wastewater discharge at North Head, Bondi and Malabar, relative to the existing cliff-face outfalls. The efforts of the SCCG – encompassing public education and engagement, research and community representation – instigated the NSW State Government to take action to address these coastal water quality and beach amenity concerns. This led to the decommissioning of the cliff-face outfalls and establishment of the Deepwater Ocean Outfall program.

Over the last 25 years, the SCCG has grown to represent the interests of 15 member councils in matters related to sustainable management of Sydney’s coastal and estuarine environment. The main activities of the SCCG – collaboration, capacity building, advocacy and research – seek to address a wide range of coastal management issues, including shoreline recession, coastal erosion, environmental monitoring and stormwater management.

In 2013, the SCCG partnered with the University of New South Wales to carry out the Sydney Beaches Valuation Project. This project is discussed later in this analysis.

Figure 1.1: Design of the Malabar deepwater ocean outfall

Source: Sydney Water
After an extensive planning, design and approvals phase, involving a number of studies and monitoring exercises to examine the impact of the change on the offshore marine environment, the Deepwater Ocean Outfall program was commissioned at a total capital cost of $310 million (in 1991 prices). The Malabar outfall commenced operation in September 1990, with North Head and Bondi following in December 1990 and August 1991 respectively. The outfalls are between 2 and 3.8km offshore. The location of each outfall is shown in Figure 1.2.

Since this time, effluent from the North Head, Bondi and Malabar wastewater treatment plants have been released offshore, up to 85m below the water surface. Sydney Water reports that the wastewater rises to surface less than 10% of the time, as the plumes are more quickly dispersed and diluted amongst the ocean water.

A number of other initiatives have also contributed to the stark improvement in water quality levels at coastal beaches over this period. Increases in wastewater treatment, beneficial re-use and enhanced trade waste policies are other key management changes which have further promoted improvements in water quality. Collectively, these initiatives have substantially improved the beach experience at North Head, Bondi and Malabar, as well as other coastal beaches.

That said, it should be noted that the initiatives noted above are by no means the only contributors to beach water quality. Beach water quality is also affected by stormwater runoff, the quality of stormwater infrastructure and other programs and investments.
Beaches are a unique public space for recreation

Beaches support marine and coastal ecosystems

Beaches make Sydney an attractive place for tourists and migrants

Source: Deloitte Access Economics

Source: Sydney Water

Opening of deepwater ocean outfalls

Figure 1.3: Faecal coliforms at Bondi Beach during swimming season, 1990 – 2007

Figure 1.4: Beaches as an environmental, cultural and economic asset
At the most fundamental level, beaches support marine and coastal ecosystems. Numerous species of fish, molluscs, marine worms, crustaceans, sea sponges, starfish, sea urchins, seabirds, oysters, grasses, shrubs and trees, among other flora and fauna, rely on the beach environment as a place for growth and development.

Beaches also provide a unique public space for people to participate in a range of recreational activities and contribute to the liveability of a city. Particularly during the peak summer period, many Sydney residents and tourists will go to the beach to wade in the shallows, swim, surf, kayak, paddleboard, play sport, follow a coastal walking, running or cycling trail, sit on the sand, read a book, meet with friends, eat and drink, skateboard, fish, or shop. Beaches can be enjoyed by people of all ages, both as individuals and in groups.

In turn, as a defining feature of the Sydney lifestyle, coastal beaches also generate tangible economic benefits, by making Sydney an attractive place to visit and live for others intrastate, interstate or overseas. Beaches increase Sydney’s international competitiveness in the market for tourists and migrants, which lead to increases in economic output.

While there are many features of beaches that contribute to these benefits, this report focuses on understanding the economic and social value that can be attributed to coastal beach water quality, relative to other factors (see Figure 1.5). The scope of this report encompasses all coastal beaches in Sydney – from North Palm Beach to Bulgo Beach, but excludes non-coastal beaches that open onto Sydney Harbour or inland rivers.

In this regard, Deloitte Access Economics explored five different components in developing this report, as shown in Figure 1.6. Some of these benefits can be measured in terms of their contribution to Gross Domestic Product (GDP), such as economic activities associated with tourism and business. Others, such as the value of a beach trip for an individual, are partially intangible, and are not fully reflected in market activity. However, these broader welfare benefits can also be measured in monetary terms to understand their relative magnitude. Each benefit is discussed in turn below.

Figure 1.5: Elements of the beach experience

Source: Deloitte Access Economics
Firstly, improved water quality at Sydney's coastal beaches delivers **health benefits**, in the form of avoided costs due to reductions in the prevalence of illnesses for swimmers. During the operation of the cliff-face outfalls, swimmers at Manly, Bondi and Malabar were, on average, more likely to contract gastrointestinal, respiratory, eye and ear conditions than non-swimmers (Corbett et al. 1993). Reducing sewage contamination in coastal beach water has therefore helped to improve health outcomes, reduce the burden on Sydney's health system, and also improve productivity in the economy as employees have fewer days off work due to these illnesses.

Increases in water quality also generates **value for Sydney residents**. This includes both **use and non-use** value, that is, not only value gained by those that visit the beaches, but also for others that do not attend, but instead place a value on simply knowing that beaches have improved water quality, and/or the preservation of beach water quality for future generations. While this value is not captured in measures of economic activity, it is important that they are recognised when evaluating initiatives to maintain and improve water quality levels.

Another key contribution of improved water quality at coastal beaches is **tourism expenditure associated with beach water quality**. Research undertaken by Tourism Australia has identified that our urban coastlines are a significant driver of destination selection by international tourists, among aquatic, marine and coastal experiences more broadly. Australia is also recognised internationally in the tourism market for its clean and pristine environment. Maintaining water quality at coastal beaches is therefore likely to play a significant role in attracting tourists to Sydney, contributing to the broader economy.

Overlapping these various perspectives is the contribution of water quality at Sydney's beaches to the **iconic Sydney brand**. The perceptions of Sydney in the international community influence our population, trade, tourism, business investment decisions, employment prospects and culture. Beaches are an important component of this brand value. As an anecdotal example, North Palm Beach has doubled as the site of the Summer Bay Surf Club on the Australian drama *Home and Away* since 1988. In practice, there is strong evidence which demonstrates that the contribution of water quality at Sydney's coastal beaches to Sydney's brand value is very significant.

Finally, this analysis considers the potential for improved water quality to deliver **biodiversity benefits** for plant and animal species located in coastal habitats. The discharge of wastewater from the old cliff face outfalls before 1991 impacted on the near shore marine environment and also led to contaminants in seafood. The decommissioning of the old outfalls is therefore likely to have generated biodiversity benefits for the shoreline marine environment. Furthermore, research programs have indicated that the discharge of wastewater further off the coastline has had no discernible negative impact on the marine communities.

**Figure 1.6: Benefits explored in this study**

![Diagram showing the benefits of improved water quality at Sydney's beaches](diagram.png)

Source: Deloitte Access Economics
1.3 Approach
A four stage approach was used to develop the evidence base for this report:

- Data and literature review: existing data and research on the importance of Sydney's beaches, and the impact of changes to water quality since the Deepwater Ocean Outfall program and other initiatives were reviewed to inform this project. Key sources of information included the Environmental Monitoring Program which preceded the installation of the deepwater ocean outfalls, water quality data from the Beachwatch monitoring program, as well as additional data and research provided by NSW Health, Tourism Australia, Surf Life Saving NSW and the Sydney Coastal Councils Group as part of the consultation phase.

- Survey: a survey of Australians and visitors to Australia was undertaken to provide additional, up-to-date primary data for the project. The survey, detailed in Appendix A, sought to understand the importance of beaches to individuals, and more specifically, the importance of water quality for beach experience, beach existence, and the contribution of beaches and water quality to Sydney's brand. In total, 845 responses were received, with respondents separated into five cohorts.

- Consultations: seven interviews were held with key stakeholders to provide specific insights on wastewater management activities, including the Deepwater Ocean Outfall program or the importance of water quality at Sydney's coastal beaches more generally. This included technical experts (both currently and formerly employed at Sydney Water) involved with the monitoring of the Deepwater Ocean Outfall program, as well as representatives from NSW Health, Surf Life Saving NSW, the Sydney Coastal Councils Group and Tourism Australia.

- Economic analysis: a number of economic analysis techniques were employed to quantify the economic and social value associated with improved water quality at Sydney's coastal beaches. This included high level analysis of the health benefits and value for Sydney residents, analysis of the economic contribution of tourism associated with coastal beach water quality and quantification of use and non-use values attributable to coastal water quality at Sydney's coastal beaches.

1.4 Outline of this report
The structure of this report is as follows:

- Chapter 2 presents estimates of the value of improved water quality at Sydney's coastal beaches for Sydney residents.
- Chapter 3 quantifies the economic contribution of international and interstate tourism attributable to water quality at Sydney's coastal beaches.
- Chapter 4 estimates the health benefits that can be attributed to the improvement of water quality associated with wastewater management initiatives.
- Chapter 5 considers the potential for biodiversity benefits due to improved water quality at coastal beaches.
- Chapter 6 discusses the importance of water quality at coastal beaches for Sydney's iconic brand.

Supporting information is also provided in the following Appendices:

- Appendix A provides background information on the survey.
- Appendix B outlines further information on economic contribution studies.
- Appendix C provides additional information on the high-level property price analysis.
Value for Sydney residents

Individuals value clean water at Sydney’s coastal beaches in many ways. People value their direct use of beaches as well as having the option to go, even if they do not attend frequently. Some people are willing to pay more to live near the beach; a high-level hedonic price analysis suggest that property prices may be around $350,000 in suburbs with coastal beaches relative to other Sydney suburbs. There are also non-use values associated with the maintenance of the beach water quality, in terms of retaining beach amenity for future generations, or in terms of value from knowing that clean water at beaches exist. These elements are illustrated in Figure 2.1.

As individuals are not required to make direct payments for use, access or for the existence of beaches, the value that they prescribe to beaches is not immediately observable from market transactions. Instead, non-market valuation techniques can be used to quantify the value of clean water at Sydney’s coastal beaches for Sydney residents in monetary terms.

Drawing from the existing literature and new survey data, this chapter provides evidence of the value of water quality at coastal beaches for both users and non-users living in Sydney.

2.1 Use value

The sheer number of people that visit coastal beaches in Sydney, particularly in the peak of summer, demonstrates that attending beaches is valued by individuals. Indeed, this report finds that beach users in Sydney spend a substantial amount of time at the beach – almost three hours on average per visit, with an average of eight visits per year.

Beach users participate in a broad range of activities when they visit, as shown in Chart 2.1. Unsurprisingly, some of the most popular activities include purchasing food and/or drinks, lying on the sand, exercising alongside the shore, and wading and swimming in the surf.

Figure 2.1: Components of values for individuals from clean water at beaches

<table>
<thead>
<tr>
<th>Use values</th>
<th>Non-use values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct use values</td>
<td>Value derived from direct use, e.g. • Swimming • Surfing • Fishing • Walking along coastline</td>
</tr>
<tr>
<td>Indirect use values</td>
<td>Value derived from the functional benefits of the beach, e.g. • Providing a habitat for fish, plants and infauna</td>
</tr>
<tr>
<td>Option values</td>
<td>Value derived from having the option to use the beach, e.g. the option to visit more often if one chooses</td>
</tr>
<tr>
<td>Existence values</td>
<td>Value derived from the knowledge that beaches have good water quality levels, e.g. ethical or spiritual value</td>
</tr>
<tr>
<td>Altruist values</td>
<td>Value derived from the knowledge that other people have access to good water quality at beaches</td>
</tr>
<tr>
<td>Bequest values</td>
<td>Value derived from maintaining water quality levels so that they can be enjoyed by future generations</td>
</tr>
</tbody>
</table>

Source: Deloitte Access Economics, adapted from Kumar (2010)

Details of this high-level analysis are presented in Appendix C.
Chart 2.1: Reported participation in beach activities by those that attended a coastal beach in the last 12 months

Source: Deloitte Access Economics survey

Visited a cafe, restaurant or bar - 68%
Lying on the sand - 57%
Walking, running or cycling along the coastline - 55%
Wading in the water, without submerging head - 53%
Water-based activities with full body submerged - 49%
Visited a shop - 37%
Supervising family members in the surf - 20%
Fishing (from the coastline) - 13%
Volunteering as a surf lifesaver - 4%
Other - 4%

Case Study: Surf Life Saving NSW

Surf Life Saving NSW (SLSNSW) understands the value of coastal beaches for individuals perhaps better than any other organisation. Across the 36 Surf Life Saving Clubs within the Northern Beaches and Sydney branches, active members volunteered 295,550 patrol hours at major surf beaches in 2014-15 so that people could enjoy them safely.

In addition, these clubs organised and ran over 45 special events at coastal beaches in 2015, including surf carnivals, ocean swims, fun runs, water safety events and triathlons. This does not include the weekly Nippers sessions for junior SLS members held by most clubs, and regular Sunday club swims.

In relation to coastal beach water quality, Shaun Hudson, SLSNSW Lifesaving Compliance Coordinator notes that, ‘the coastal lifestyle is important to the people of Sydney and having clean water plays a key role in that. It’s been great to see that beach closures due to pollution have been steadily decreasing in recent seasons as it highlights that the significant investment made over the last 25 years is making a difference.’

Given the risks that are associated with surf conditions, it is important that beachgoers take appropriate precautions to ensure that they have positive beach experiences. In 2014-15, clubs in Sydney collectively made 2,659 rescues, administered first aid to 5,033 people and called 255 ambulances. Unfortunately, there were also nine drownings at Sydney’s coastal beaches during this period. SLSNSW recommends that people swim between the flags and follow lifeguard and lifesaver instructions, to ensure their safety and enjoyment when at the beach.

According to Mr Hudson, ‘all of our members have a fundamental respect for the ocean environment and want to see it protected so that everyone can enjoy it both now and into the future. As our population continues to increase, recreating at beaches will continue to remain a popular pastime for all demographics and the job of the lifesavers will be made easier if they’re confident in their environment.’
Value of leisure time

According to the Australian Bureau of Statistics (ABS), the average Australian weekly earnings for an adult working full time in Australia in May 2015 were $1,541.50. Earnings after tax are $1,180.50. To estimate a net wage, $100 worth of expenses is deducted as costs of getting to work. This implies that the average Australian earns an average of $1,080.50 per week net of taxes and expenses.

Assuming a 38 hour working week, and that the average person takes an additional 6.75 hours commuting to and from work each week (see Milthorpe (2007), average hourly earnings can be estimated at $24.15.

Larson & Shaikh (2004) find that one hour of leisure is worth 45% of the value of an hour of employment to the individual. On this basis, the hourly leisure rate is likely to be around $10.87, for Australians, on average.

For this report, this estimate has been adjusted downwards to account for the lower leisure time value of those outside the working age population. Specifically, a report produced by Transport for NSW suggests that the value of concession travel time is around 40% of the value of non-concession travellers (2015). Given that around 32% of the Greater Sydney population (excluding the Central Coast) is outside the working age population, a weighted average leisure time value of $8.75 per hour has been produced for the calculations in this report.

It is noted that this value could potentially underestimate the value of beach visits to individuals, to the extent that coastal beaches are of greater value to individuals than alternative leisure activities.
Coastal beach visitation – a data gap

Surf Life Saving clubs in NSW make estimates of beach visitation on weekends and public holidays, at the start and end of patrol hours, from September to April each year. Using this methodology, it was estimated that almost 3.9 million people (locals and tourists alike) visited coastal beaches in Sydney in 2014-15.

However, it is acknowledged that this is an underestimate of total coastal beach visitation, as it does not capture visits to the beach during weekdays in this peak summer period (particularly during summer school holidays), outside patrol hours, or during winter. This estimate is also low relative to other one-off estimates of beach attendance from other sources. For example, Waverley Council estimates that Bondi Beach alone hosts approximately 5 million visitors each year.

In 2013, the Sydney Coastal Councils Group and the University of New South Wales released the findings of the Sydney Beaches Valuation Project. This study made a high-level estimate that around 28 million beach visits are made by Sydney residents each year. The key conclusion of the study was that while ‘the economic values associated with beaches are extremely high … these values stem from behaviour and visitation that is poorly understood.’

More recently, Surf Life Saving Australia commissioned research in 2014 and 2015 which suggests that around 81% of the Australian population aged between 16 and 69 years visits the coastline at least once per year.

For the purpose of this report, we have applied this beach-usage proportion (81%) to the population of Greater Sydney (excluding the Central Coast) to estimate a beach user cohort of around 3.6 million people. Based on survey responses, it is assumed that each individual in this cohort attends coastal beaches in Sydney an average of eight times per year. This produces a total annual coastal beach visitation estimate for Sydney residents of 31 million visits per year.
The following section focuses specifically on quantifying the share of total value of beaches for users that is attributable to current water quality levels.

2.1.1 Use value attributable to coastal beach water quality

Water quality is clearly an important feature for beach users, with 49% of those who attended one or more of Sydney’s coastal beaches in the last 12 months reporting that they participate in water-based activities when at the beach, with their full body submerged (see Chart 2.1).

Furthermore, around half of surveyed Sydney residents that have visited one or more of Sydney’s coastal beaches in the last 12 months rated the cleanliness of the water as either the first or second most important feature for them when they visit.

To estimate the share of total use value attributable to current water quality levels at Sydney’s coastal beaches, Sydney beach users were asked to report how often they would visit the beaches, on average, if there was a reduction in water quality, back to previous levels. In making this comparison, respondents were shown two images of the shoreline at Malabar, before and after the key changes to wastewater management, including the establishment of the deepwater ocean outfalls (as shown in Figure 2.2).

Almost two-thirds of respondents indicated that if water quality levels at all of Sydney’s coastal beaches were to fall in line with previous levels, they would reduce their visitation. Based on the survey data and current attendance levels of respondents, this reduction could be in the order of 25% of total visits.

This reported change in visitation has been adjusted downwards to 16%, to account for the fact that the water quality impacts associated with the Deepwater Ocean Outfall program and other wastewater management initiatives are primarily concentrated at North Head, Bondi and Malabar. That is, in the absence of the new deepwater ocean outfalls and other key initiatives, not all of Sydney’s coastal beaches would experience water quality levels similar to those shown to the right in Figure 2.2.

This adjustment has drawn on data from Surf Life Saving NSW on the relative share of beach visits attributable to these beaches (around 25%), and assumed that only half the reported drop in visitation would be realised for other coastal beaches in Sydney.

Overall, this implies that visits to Sydney’s coastal beaches would reduce by almost 4.9 million visits per year, if there was a decline in water quality levels, similar to those before the introduction of the Deepwater Ocean Outfall program and other wastewater management activities.

When quantifying the reduction in individual value associated with this change in behaviour, it is important to recognise that people would still value the alternative activities that they shift their time towards. For example, rather than visit a coastal beach with reduced water quality, a person might decide to visit a harbour beach, or go to a park, or stay at home with family and friends. For this purpose, we estimate that individuals would value their ‘next best’ activity at 50% of the value they would have otherwise obtained from their beach visit (i.e. around $19 per person per visit).

Overall, this suggests that the use value of beaches that is attributable to coastal beach water quality by Sydney beach users is in the order of $94 million per year.
2.2 Non-use value
People also place altruistic value on coastal beaches, which are not associated with the value obtained from visiting. There are a range of reasons why this is the case.

As shown in Chart 2.2, common reasons why non-users (defined as those who have not visited one of Sydney’s coastal beaches in the last 12 months) place a value on beaches include:
- As beaches contribute to Sydney’s lifestyle and are iconic to the city (60% of respondents)
- As non-users like having the option to go to the beach (53% of respondents)
- The existence of the coastal environment (45% of respondents)
- As other people are able to go to the beach (30% of respondents).

The survey undertaken for this report found that only 55% of surveyed Sydney residents that visited a coastal beach in the last 12 months reported always applying sunscreen or using other sun protection measures when at the beach. This indicates that there is room for improvement in the uptake of appropriate sun protection measures.

While there clearly is significant value associated with using the beach, it is important to be mindful of the potential costs as well.

Overall, the survey suggests that 9 out of 10 people that have not visited a coastal beach in Sydney over the last 12 months, still value them. When asked how much value they place on the existence of coastal beaches, respondents reported an average value of $27 per person per year.

As shown in Chart 2.3, there are varying preferences for coastal beaches within the non-user cohort. For example, while 30% of respondents reported that the existence of beaches is worth $50 or more a year to them, the second most popular response for non-users (16% of respondents) was that they place no value on the existence of coastal beaches at all.

The average estimate of $27 per year is considered to be conservative, given that it has been calculated by applying a value of $50 a year for the large share of respondents that selected the open-ended upper bound option of ‘$50 or more’ (see Chart 2.4). Increasing the upper bound value to $75 a year has the effect of raising the point average to $35 per annum.
Overall, we estimate that the total value of Sydney's coastal beaches for Sydney residents is around $1.3 billion per year. This consists of the aggregate use value of $1.2 billion per annum, and the non-use value of $123 million per year. Using a 7% discount rate, this equates to a lifetime value for Sydney's coastal beaches of almost $19 billion.

In total, the value attributable to improved water quality for Sydney residents associated with key wastewater management initiatives including the Deepwater Ocean Outfall program is estimated to be worth around $137 million per year. This includes the annual value of current coastal beach water quality for users of around $94 million, and an additional $43 million per year associated with altruistic, non-use value.
2.3 Water quality and willingness to pay

Another way to estimate the value of water quality at Sydney’s coastal beaches is to ask individuals about their willingness to pay for the maintenance of current water quality levels, per year, through government taxes.

Across the Sydney beach user and non-user cohorts in the survey, an average willingness to pay of around $7.40 per year was reported. On one hand, this should be interpreted as a lower bound estimate, given that almost one-third of respondents in each group selected the open-ended upper bound option of ‘$10 or more’ (see Chart 2.4). A conservative estimate of $20 per year was applied to this group in order to calculate the average value.

That said, for the purpose of this analysis, it is appropriate to scale this average estimate downwards, using the assumptions described in Section 2.1, to account for the extent of the impact of the Deepwater Ocean Outfall program and other wastewater management initiatives across all of Sydney’s coastal beaches. This produces an adjusted willingness to pay estimate of $4.63 per year.

Given that population of Sydney is around 4.5 million people (ABS, 2014), this suggests a total annual willingness to pay of around $21 million.

However, it is hard to interpret this result, as willingness to pay through taxes may not be the best indicator of the value prescribed to current water quality by individuals. That is, the amount that individuals consider is fair for them to pay for a service can be different to the intangible personal value that they place on receiving that service.

Chart 2.4: Annual willingness to pay through taxes to maintain water quality at Sydney’s coastal beaches

Source: Deloitte Access Economics survey

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This increases to an adjusted willingness to pay of $8.33 per year, if a higher value of $40 per year is assumed for the open-ended upper bound option of ‘$10 or more’.
Tourism and business

3.1 Tourism demand associated with beach water quality

Water quality is critical for beaches to remain open and to retain their amenity values. In turn, this supports continued visitation and thriving coastal businesses and economies.

Almost 3.1 million international visitors to Australia made a stopover in Sydney during 2014-15 (TRA, 2015a). Over two thirds (69%) of these visitors reported going to the beach at some point while they were in Australia. As shown in Chart 3.1, the propensity for international visitors to go to a beach in Australia varies by the main reason for their trip, with the highest likelihood of attending a beach associated with those who visit Australia for a holiday (79%), for education (79%) or for employment (75%).

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Table 3.1: Visitors to Sydney and likelihood of going to a beach during trip – holiday

<table>
<thead>
<tr>
<th></th>
<th>Total number of visitors</th>
<th>Number of visitors who went to a beach</th>
<th>Share of visitors who went to a beach</th>
</tr>
</thead>
<tbody>
<tr>
<td>International</td>
<td>3,096,204</td>
<td>2,150,513</td>
<td>69%</td>
</tr>
<tr>
<td>Domestic overnight</td>
<td>9,020,120</td>
<td>1,225,339</td>
<td>14%</td>
</tr>
<tr>
<td>Domestic day trip</td>
<td>18,389,288</td>
<td>1,556,805</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30,505,611</strong></td>
<td><strong>4,932,657</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: TRA (2015a, 2015b)

---

Chart 3.1: Beach visitation by international visitors to Sydney, by main reason for trip, 2014-15

<table>
<thead>
<tr>
<th>Share of visitor that went to a beach while in Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
</tr>
<tr>
<td>Holiday</td>
</tr>
<tr>
<td>79%</td>
</tr>
</tbody>
</table>

Source: TRA (2015a)

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TRA’s International Visitor Survey does not identify which location an international visitor went to a beach while in Australia. Accordingly, some international visitors listed above may have visited a beach in another location, despite visiting Sydney during their trip.
Sydney beaches and tourism

There is a strong evidence base to support the general recognition that beaches are important for tourism in Australia. Consumer research commissioned by Tourism Australia found that, across Australia’s key tourism source markets, world class coastlines, beaches and marine wildlife rank within the top three emotive factors when choosing a destination (Consumer Demand Project, Tourism Australia, 2015).

Adele Labine-Romain, Executive General Manager, Strategy and Research notes, ‘we know that beaches are an important driver and competitive advantage for Australia as a travel destination, a critical point of differentiation in a highly competitive global tourism market.’

We also know that approximately 70 per cent of international visitors participate in aquatic and coastal experiences as part of their trip to Australia (International Visitor Survey, Tourism Research Australia, 2015). These figures are supported by Tourism Australia’s consumer research (2015) which shows that beaches top the list of the most appealing attractions in Australia.’

‘Indeed Australia is ranked first by international travellers, not only for our remote coastal, beach and aquatic locations, but also for beaches right near cities’, explains Ms Labine-Romain.
Visiting beaches is also a popular activity for interstate day trip and overnight visitors to Sydney. While the proportion of total domestic visitors who go to the beach during trips to Sydney is lower than international rates, the total number of visitors is substantial, reaching almost 5 million visitors attending beaches in Sydney overall (see Table 3.1). To the extent that visitors make multiple trips to the beach during a single stay, total beach visitation rates associated with tourism are likely to be even larger.

The economic contribution by tourism in Sydney can be estimated by collecting average visitor expenditure data from Tourism Research Australia, and estimating the expenditure that can be attributed to Sydney's beach water quality. The contribution of this to total economic activity and employment can be quantified using Input-Output (IO) modelling.

To estimate the contribution of coastal beach water quality, Deloitte Access Economics, via Stancombe Research and Planning, conducted a survey of Sydney visitors. Among other questions, respondents were asked about the change in their tendency to visit one of Sydney's coastal beaches if there was a reduction in water quality. The question was accompanied by real photos of the Malabar Coast before and after the development of Deepwater Ocean Outfalls and introduction of other key wastewater management initiatives such as increased treatment, beneficial re-use and enhanced trade waste policies.

As noted in Table 3.1, it is estimated that in 2014, 4.9 million of the 30.5 million visitors to Sydney enjoyed some activity at one of Sydney’s beaches. Of those 4.9 million people, over 500,000 visitors can be attributed to beach water quality.\(^7\) Taking into account the differences in expenditure behaviours between domestic overnight, domestic day trip and international visitors, it is estimated that these tourism demand contributed about $512 million in tourism expenditure for the greater Sydney area.

IO modelling of these tourism impacts reveals that the net value added by beach water quality is worth around $332 million per year to the NSW economy. This includes approximately $266 million value added by international tourism, $53 million value added by domestic overnight tourism, and $12 million value added by domestic day trip tourism activities. Over 3,500 full time equivalent (FTE) jobs are associated with these economic activities, including direct employment of approximately 2,900 FTE jobs within tourism sectors and 600 indirect FTE jobs in supporting industries.

\(^7\)Approximately 6% visitors said they would definitely not come if water quality and beach cleanliness deteriorate. An additional 5% of visitors said they will be less likely to come to Sydney. For the latter group a conservative propensity assumption is made for each group (5% for international tourists, 15% for domestic overnight tourists and 25% for domestic day trip tourists).
IO modelling
The basis for estimating an economic contribution is the direct value added and employment contributed by Sydney coastal beaches in the form of additional tourism demand.

Value added is the most appropriate measure of the economic contribution to GDP. It is the sum of the returns to the primary factors of production – labour and capital – and can be calculated by adding the gross operating surplus and wages paid to workers in the tourism sector.

This is then combined with a selection of the Australian Bureau of Statistics’ input-output table to determine the indirect or flow-on contribution to the economy. The indirect contribution is a measure of the demand for goods and services produced in other sectors of the economy as a result of the direct economic activity generated by the additional tourism demand associated with Sydney’s coastal beaches. The size of the flow-on activity is determined by the extent of the linkages with other sectors of the economy.

It is important to note the limitations of IO modelling; the modelling implicitly assumes that prices are fixed, which can overstate the impact of the effects of additional economic activity. While taking into account flow-on effects through intermediate goods linkages, the approach ignores the possible crowding out effects of changes in economic activity. For example, greater consumption of certain intermediate inputs by one industry potentially reduces overall production in other industries as substitutions are made away from goods that have increased in price (due to increased demand).

3.2 The beach-side business sector
The beach-side business sector also receives revenue from local Sydney residents that attend beaches. The survey undertaken for this project found that 86% of surveyed beach users spent money on their most recent visit to one of Sydney’s beaches, even though beach attendance itself is free. Specifically, it was reported that beach users spend $13 on average per person per visit, including expenditure on food, drinks, shopping, recreational activities and parking.

When scaled up for the estimated total number of coastal beach visits by Sydney residents each year (around 31 million), we estimate that Sydney residents spend around $414 million per year when visiting Sydney’s coastal beaches.

This should not be interpreted as an additional benefit for the Sydney economy, as it is likely that much of this spending would simply be transferred to places elsewhere in Sydney if local beach visitation declined. Nevertheless, it demonstrates the substantial revenue currently gained by businesses and councils in coastal areas.
Positive migration benefits

Along with providing benefits to residents and attracting tourists, it is postulated that the quality of Sydney’s coastal beaches, in particular the clean water at these beaches, could be one factor influencing migrants’ decisions to settle in Sydney as opposed to other Australian or overseas cities. The Committee for Sydney has also identified a number of factors which attract migration, including: work opportunities; a convenient journey to work; access to childcare options and a safe and secure city which is open after hours.

Factors which influence individual decisions to relocate include economic, social, political and environmental reasons. In particular, environment and climate are often used as key measures in international liveability rankings of cities and urban centres.

In this study, Deloitte Access Economics conducted a survey of adult migrants who moved to Sydney after 1991, asking respondents to rate the importance of Sydney’s coastal beaches as an influence on their choices, compared to other well-established considerations such as employment and education opportunities, proximity to family and friends, safety and cost of living.

Our result shows that around 11% of adult migrants\(^8\) in Sydney ranked the ability to access one of Sydney’s coastal beaches as a key consideration in their decision to move to the city. This is perhaps not surprising, as ABS data shows that some coastal locations have a higher than average share of migrant residents, relative to NSW more broadly. For example, migrants account for 35% to 43% of the population in the Manly, Randwick and Waverley Local Government Areas (LGAs), compared to 36% for Greater Sydney, 33% for Greater Melbourne, and 27% for NSW as a whole (ABS 2011).

Putting this in context, in 2012, there were some 56,000 migrants who came to Sydney.\(^9\) Using the findings from our survey, this would indicate that around 6,000 of these migrants came to Sydney partially because of the coastal beaches. These figures imply that there are significant economic dividends associated with Sydney’s coastal beaches in the form of attracting migrants.

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\(^8\) Those older than 18 years old when they moved to Sydney.
\(^9\) Includes the following VISA groups: Vocational Education and Training sector, Higher education sector, Student other, Temporary work skilled (subclass 457), Visitor, Working Holiday, Family, Skill, Special Eligibility and humanitarian.
Health

Swimming and surfing at the beach are very popular recreational activities in Sydney, for locals and tourists alike, particularly during summer.

Sydney Water’s initiatives, including the decommissioning of the old cliff-face outfalls at North Head, Bondi and Malabar and subsequent replacement with deepwater ocean outfalls, and increases in wastewater treatment, have improved water quality at beaches, leading to improved health outcomes for swimmers.

Swimming in water contaminated with sewage, in particular with high concentrations of enterococci and faecal coliform, has been linked to a greater likelihood of gastrointestinal, respiratory, eye and ear conditions (Corbett et al 1993). The NSW Office of Environment & Heritage (2015) notes gastroenteritis and diarrhoea as key swimming-related illnesses in waters polluted by stormwater or sewage.

A valuation framework can be used to estimate the avoided health costs from improvements in water quality that have led to reductions in the probability of these types of illnesses. The steps involved in this process include:

- Estimating the change in the probability of illness associated with different water quality levels, based on appropriate pollutant measures.
- Applying this to the number of people that swim at relevant beaches.
- Estimating the costs to society from absenteeism associated with illness.
- An alternative approach could involve identifying the burden of each illness – the average number of days it takes a person to recover to normal health, and quantifying the avoided health costs using an estimate of disability adjusted life years (DALYs) and the value of a statistical life year (VSLY).

It should be noted that there are a number of limitations to this analysis. Firstly, the incidence of illness cannot be solely linked to the impact of deep ocean outfalls; illness can also arise from contaminated stormwater runoff or may have been contracted elsewhere during the day, confounding the causal relationship. Bather loading (number of people swimming) may also have an impact on the incidence of illness. There are also arguments about the relevance of the DALY approach, however, this is a recognised approach for estimating the impact of illness. Deloitte Access Economics’ consultations with NSW and other technical experts highlight some of the limitations associated with estimating health impacts.

Sydney Water monitoring data suggests that faecal coliform levels at Malabar, North Head and Bondi significantly decreased after the commissioning of the deep ocean outfalls at these locations. Levels of faecal coliform (measured as cfu/100mL) were between 81 times and 123 times lower than before the deep ocean outfalls were commissioned. Similarly, Beachwatch data shows that enterococci levels have declined from an average across all recorded samples of 49.7 cfu/100mL in 1993 to 23.5 cfu/100mL in 2015. This suggests significant improvement in beach water quality, in terms of contaminants affecting human health, over time.

4.1 Benefits to the economy from reduced absenteeism due to illness

Shuval (2003) estimated the global burden of diseases caused by wastewater pollution of the marine environment. It was estimated that globally, 2 billion person-days were spent annually at coastal recreational resorts, with many persons exposed to coastal water polluted by wastewater.

The study used risk assessments from the World Health Organization (WHO) and other research sources to estimate that annually, there were in excess of 120 million cases of gastrointestinal disease, and in excess of 50 million cases of more severe respiratory diseases caused by swimming and bathing in wastewater polluted coastal waters worldwide.

This study suggests that around 6% of people swimming in wastewater-polluted water develop gastrointestinal disease, and a further 2.5% of people develop more serious respiratory diseases.

The improvement in water quality associated with the Deepwater Ocean Outfall program has been associated with a decline in the incidence of illness. The Water Board (1994) Surf Health Research Project, conducted between 1991 and 1993, was an epidemiological study assessing the health of Sydney beachgoers during the commissioning of the deep ocean outfalls. The study found that, at Bondi, reported illness dropped from 138 per 1,000 swims in 1991 (pre-outfall) to 87 per 1,000 swims in 1993. Across all beaches, and compared to a previous Beach Users Study, it was estimated that illness declined from 276 per 1,000 swims in 1990 to 120 illnesses per 1,000 swims in 1993, noting differences in cohorts and swimming frequency.

These results suggest that the improvement of water quality has led to a decrease in reported illness by swimmers of between 36% and 57%. For the purposes of this analysis, we assume that through improving water quality at Sydney’s beaches, deep ocean outfalls have reduced the incidence of illness by half.

As detailed in Chapter 2, it is estimated that there are around 31 million visits to coastal beaches each year by domestic beachgoers, and it is assumed that ¼ of these visits are at the three beaches benefiting from deepwater ocean outfalls, and the remaining visits at other coastal beaches which are assumed to receive half the benefits from cleaner water:16
However, not all people at the beach spend their time in the water; a report by the Sydney Coastal Councils Group (2013) suggests that 22% of people spend the majority of their time in the water at Manly Ocean Beach. Assuming a similar proportion of swimmers at all coastal beaches, and noting the reduction in the incidence of illness post-outfall as estimated by the former Water Board, this suggests that the subsequent improvement to beach water quality from the deepwater ocean outfall program and other wastewater management initiatives, may contribute to the avoidance of illness for around 180,000 beach users each year.

The health benefits to the economy are the avoided costs of absenteeism associated with these avoided episodes of illness. The cost of absenteeism is the lost days of work resulting from a period of illness – in this case, gastroenteritis or respiratory illness.

The most recent National Gastroenteritis Survey II, conducted in 2008-09, estimated the incidence and public health impact of gastroenteritis in Australia. It found that gastroenteritis had a considerable impact on work, with 65% reporting a median impact of 1 day lost work associated with having the illness.

Respiratory illnesses such as coughs, colds and flu are also commonly reported illnesses after swimming (Hess 2007). An extensive literature review on the impact of influenza on working days lost in North America, Western Europe, Asia and Australia (Keech and Beadworth 2008) found that working days lost ranged from less than 1 day to 5.9 days per episode. For the purposes of this analysis, we conservatively assume that 1 day of work is lost per episode of influenza.

Estimating average daily earnings of $227.38 in May 2015 (ABS 2015) and based on the avoided cases of illness for beach users, the avoided cost of absenteeism associated with cleaner water at Sydney’s coastal beaches is approximately $140 million per year.

It should be noted that these are conservative estimates as they ignore the costs to society of presenteeism, where employees continue to attend work while ill. Presenteeism is also associated with reduced labour productivity as well as the possibility of spreading illness to other people, and thereby reducing productivity even further.

Economic and social value of improved water quality | Health

Wellbeing impact of avoided illness at the beach

Another way to consider the benefits of cleaner beach water is through the wellbeing impacts for the persons who avoid illness. The wellbeing costs of illness can be estimated using the disability adjusted life years (DALYs) framework. The Global Burden of Disease Study 2010 (Lancet 2012) DALYs for diarrhoea and respiratory disease are used to measure the burden of these illnesses. These illnesses are estimated to last for 3 and 7 days respectively (Victorian Department of Health and Human Services 2010 and 2015).

Deloitte Access Economics’ revealed preference approach to estimating the value of a statistical life year (VSLY) suggests a VSLY of $182,000 in 2015. This suggests that an avoided case of mild diarrhoea is worth around $54 to an individual, and an avoided case of moderate respiratory disease is worth around $98 to an individual. This suggests that the overall wellbeing value for persons avoiding illness from swimming at Sydney’s coastal beaches is around $12 million per year, noting the limitations discussed in this chapter.

It should be noted that these benefits are intangible, and these welfare benefits are estimated in dollar terms to present an order of magnitude, rather than representing real dollars in the economy. These wellbeing benefits are not additional to the absenteeism benefits estimated in this chapter as the VSLY framework implicitly factors in the potential cost of lost income for the individual if illness is sustained.
Biodiversity

Biodiversity, or the variety of life forms, is vital to the preservation of biological ecosystems. Damage to biodiversity can cause severe disruptions to the food chain, the natural environment, and ultimately the long-term sustainability of life forms. Sydney's coastal waters are rich in marine life forms, collectively hosting over 200 marine species (Reef Life Survey, 2015). The preservation of this marine biodiversity is not only crucial for Sydney's broader ecosystem; it also delivers socio-economic benefits to residents and visitors to the city.

Marine organisms can be extremely sensitive to the toxicity of the coastal environment. For example, bivalve shellfish species such as clams, oysters, scallops and muscles feed by filtering microscopic organisms from the coastal waters. Potentially harmful bacteria, viruses, and organic toxins from their surrounding environment not only have adverse effects on these marine organisms, toxins can also build up in their tissues and negatively impact other organisms, including people, that consume them.

These types of impacts were observed in the shoreline marine environment during the operation of the old cliff-face outfalls. For instance, the State Pollution Control Commission reported in 1989 that fish species near Sydney's coastal wastewater discharge contained above normal levels of organic toxins, such as organochlorines. As one specific example, red morwongs caught in and around the Malabar wastewater discharge had average levels of benzene hexachloride 120 times and Chlordane 12 times over the maximum residue limit for consumption (NH&MRC standard) (SPCC, 1989). These organic toxins are commonly used as insecticides on land and can potentially have lethal impacts on marine species that are even briefly exposed.

Meanwhile, the Deepwater Ocean Outfall program has not had any identifiable impact on the marine environment around the new offshore discharge. The environmental monitoring program undertaken by Sydney Water and the NSW Environment Protection Authority (NSW EPA) examined many aspects associated with the biodiversity of the offshore marine communities, including organic toxins, metals and bacteria, using a range of approaches including community of abundance and diversity studies. This comprehensive program found no empirical evidence of distinguishable deteriorating environmental conditions near the new offshore discharge locations.

Overall, this suggests that changes in wastewater management including the establishment of the Deepwater Ocean Outfall program has had a net positive impact on the biodiversity of marine communities along Sydney's coastline. However, the exact magnitude of these benefits is difficult to quantify, as the impact of improved shoreline water quality on marine species populations is uncertain.

To inform a qualitative assessment of the biodiversity benefits of improved water quality at Sydney's coastal beaches, Deloitte Access Economics consulted technical experts to further understand the biodiversity implications associated with the Deepwater Ocean Outfall program, with a summary presented in the box on the next page.

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2U.S. Environmental Protection Agency (1977) – Chlordane concentration between 1 to 100 μg/l is considered to be lethal to many fish species.
3Chlordane concentration is measured at less than 0.00008 μg/l, less than 2% of the 0.004 μg/l maximum guideline limit set by the ANECC. Other measurable organic toxins are all below 5% of the guideline limits.
Dr Tony Miskiewicz

- impacts of deepwater ocean outfalls on biodiversity

A key component of the Deepwater Ocean Outfall environmental monitoring program undertaken by Sydney Water and the NSW Environment Protection Authority (NSW EPA) involved research on the impact of the new outfalls on marine species further offshore. This involved a range of studies examining the impact of deep sea disposal of wastewater on marine animal and plant species, including fish larvae, demersal fish, benthic invertebrates such as worms, shrimps, sponges and cunjevoi, among others.

According to Dr Tony Miskiewicz, formerly employed at Sydney Water, the program found that the ‘offshore impact of the Deepwater Ocean Outfall program on biodiversity cannot be readily distinguished from other changes associated with natural spatial and seasonal variability’. Natural variability in marine ecosystem health occurs for a range of reasons, including the mobility of fish species and changes in currents or weather conditions that affect the dilution process. The monitoring program also recognised that the impacts of the Deepwater Ocean Outfalls also vary in different stages of the lifecycle – fish larvae will be affected differently from exposure to wastewater than adult fish, which are able to regulate metals.

Overall, while some studies observed that the Deepwater Ocean Outfall program caused some elevations of metals and organochlorines in fish, these were not exceedingly higher. The species where elevations were observed were also not species that are fished for human consumption.

Nevertheless, there is anecdotal evidence that the removal of shoreline outfalls in other locations has been associated with changes in marine environments. Dr Miskiewicz notes that, ‘After the decommissioning of the shoreline outfalls at Bellambi and Port Kembla, Wollongong, the green algae disappeared and the barnacles and cunjevoi came back.’
Literature on improved water quality and biodiversity

Biodiversity plays a fundamental role in the preservation of the environment and ecosystems, and is also valued socially, through its contribution to aesthetic, recreation and cultural values.

Like many environmental and social outcomes, the task of estimating the value of biodiversity is challenging because the preservation of the natural environment is not exchanged through markets. In the absence of market price and demand information, non-market valuation techniques can be used to estimate the preferences and the value individuals place on biodiversity.

There is a large body of literature examining the non-market value of various biodiversity outcomes through either revealed preference or stated preference techniques. This section summarises the most relevant results of these studies and their implied benefits with reference to improved water quality at Sydney’s coastal beaches.

Van Bueren & Bennett (2000) estimated that, on average, Australian households are willing to pay $1 per year for 20 years to protect a single species at the national level.\(^{14}\) At the regional level, willingness to pay could be as high as $2 per household in the region per year for 20 years for each species protected. It should also be noted that initiatives like the Deepwater Ocean Outfall program and other improvements to wastewater management can be expected to have positive impacts for many species, rather than just one. Given that there are around 1.8 million households in the Greater Sydney area, the consumer surplus generated from protecting species around Sydney’s wastewater outfalls could be significant.

Furthermore, household willingness to pay for biodiversity conservation is particularly pronounced for highly visible and endangered species. For example, the Victorian Department of the Environment and Heritage (2005) found that Victorian residents are willing to pay over $38 per household per year on average for the conservation of Leedbeater’s Possum.\(^{15}\) In the context of Sydney’s beach water quality, contributions to the long term protection of endangered species near the outfalls, such as the Little Penguin (Eudyptula minor) population at North Head, could be valued at a premium.

In addition to the benefits for local residents, conservation of marine biodiversity can also have a significant impact on the welfare of visitors to Sydney. Ressureicao, et al., (2012) studied visitors’ willingness to pay on three European islands, finding that visitors on average are willing to sacrifice between 1.2% to 2.7% of their monthly income to prevent the loss of fish species, and 0.9% to 2.1% for algae conservation. With around 5 million visits to Sydney’s coastal beaches by international and domestic tourists each year, improved water quality at the shoreline and the subsequent benefits for biodiversity in the locale could deliver substantial consumer surplus to these visitors.

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\(^{14}\) Original estimate is $0.68 per species protected, converted to 2015 dollars using Australia’s national CPI.

\(^{15}\) Original estimate is $29 per household, converted to 2015 dollars using Australia’s national CPI.
Sydney’s brand, as a city, is central to its economic and social prosperity. The perceptions of Sydney in the international community influence our population, trade, tourism, business investment decisions, employment prospects and culture.

There are many facets of the Sydney brand, one of those being sites and landmarks, which help define what is iconic about the city and what influences its ‘liveability’. One of the things that Sydney is best known for, domestically and internationally, is its natural environment: its surrounding national parks, harbour and beaches. The number and quality of its world class beaches, both inside Sydney Harbour and along its oceanic coast both north and south of the harbour’s entrance, are almost unique globally for the leisure possibilities they afford.

Deloitte Access Economics’ survey asked respondents about what they think of, when they think of Sydney. The options were presented in random order, to minimise order bias, with the available options including: beaches, Sydney Harbour, outdoors experience, weather, food, sport, lifestyle, shopping, cultural diversity, place where Australia was first settled, Sydney Opera House, traffic/congestion or other.

Overall, 8% of respondents said the most important thing they thought of was ‘beaches’, with this going up to 15% for international tourists. This increased when considering the ‘Top 3’, with 35% of respondents ranking beaches in their Top 3 when thinking of Sydney, with this going up to 44% for international tourists.

The most common ranking for beaches was 3rd, with the two most popular choices being Sydney Harbour and the Sydney Opera House. For beaches to be ranked among these two Sydney icons suggests that beaches are a significant contributor to Sydney’s brand. This finding is supported by other sources, for example, the Bondi to Coogee Beach Coastal Walk is currently rated in the top three of TripAdvisor’s list of things to do in Sydney, alongside Sydney Harbour and the Sydney Opera House (2016).

The contribution of beaches to the Sydney lifestyle and the Sydney brand stems from the word of mouth of locals and tourists that have experienced the beaches, as well as media and marketing. For instance, since 1988 North Palm Beach Surf Life Saving Club has doubled as the ‘Summer Bay Surf Club’ on the Australian television program Home and Away, which has aired in over 80 countries (North Palm Beach SLSC, n.d.). Highlighting Sydney’s beaches is also a key part of how Tourism Australia and Destination NSW market Sydney to the world (see next page).

There is also evidence that water quality is one of the most important features of beaches for locals and tourists. Survey respondents were asked what they thought of when they thought of Sydney’s coastal beaches. The top response, cited by 41% of respondents, was ‘clean water’, thus demonstrating how clean water is largely synonymous with the beach experience. Indeed, clean water was the top response in the survey sub-categories, namely for beach users, non-users and international tourists as well.

This suggests that the trustworthiness of Sydney’s coastal beach water is integral to the city’s brand for international and domestic visitors. When high water quality is combined with the differentiation that Sydney’s beaches offer to other major capital cities around the world – a variety of accessible, free, well patrolled and beautiful environments within minutes from the city centre and residential suburbs – the resulting brand is extremely powerful, distinctive and relevant to a wide variety of potential users. You don’t need to be a swimmer, surfer, paddle boarder, sailor or water sports enthusiast to enjoy Sydney’s clean beaches; indeed, a growing market of beach walkers and a beach café culture continues to grow and flourish, in part due to the pristine natural surroundings. These benefits can accordingly be linked to Sydney Water’s wastewater management initiatives, including the Deepwater Ocean Outfall program.

The primary economic benefits that accrue from this contribution to brand value are closely linked with others considered in this study – that is, the attraction of international tourists and migrants to Sydney. Accordingly, the importance of water quality at coastal beaches for Sydney’s brand value has not been separately quantified in this study.
Beach water quality and the Sydney brand

World class beauty and natural environments constitute one of Australia’s key competitive strengths in the international tourism market (Consumer Demand Project, Tourism Australia, 2015). Adele Labine-Romain, Executive General Manager, Strategy and Research notes that, ‘Beaches are a critical component of what Australia has to offer. They are one of the fundamentals of the Australian tourism experience’.

In the context of worldwide environmental challenges, maintaining water quality at beaches is particularly critical to upholding Sydney’s reputation. As Ms Labine-Romain explains, ‘Australia’s brand is built on having a very clean and pristine environment. The value placed on these resources, and Australia’s reputation, have both increased as others face challenges in this area’.

Indeed, the latest chapter of Tourism Australia’s global marketing campaign There’s nothing like Australia highlights the country’s varied aquatic and coastal experiences. By promoting Australia’s beaches and high quality coastal environment, the $40 million campaign builds on a core strength, and aims to remind international visitors of Australia’s impressive coastlines, beaches and marine wildlife, contributing to growth in international visitor expenditure and improving Australia’s association with aquatic and coastal experiences.
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Appendix A: Survey development

To provide an evidence base for this project, Deloitte Access Economics conducted a survey of Australians and visitors to Australia. The aim of the survey was to understand the importance of beaches to individuals, and more specifically, the importance of water quality for beach experience, beach existence, and the contribution of beaches and water quality to Sydney’s brand.

In total, 845 individuals completed the survey. Respondents were separated into five different cohorts:

- **Sydney beach users** – individuals living in Greater Sydney that have visited one or more of Sydney’s coastal beaches during the last 12 months (n=224)
- **Sydney beach non-users** – individuals living in Greater Sydney that have not visited one or more of Sydney’s coastal beaches during the last 12 months (n=178)
- **International tourists** – individuals ordinarily living in either New Zealand, UK, USA or China, that have visited one or more of Sydney’s coastal beaches during the last 12 months (n=217)
- **Interstate tourists** – individuals ordinarily living outside of NSW that have visited one or more of Sydney’s coastal beaches during the last 12 months (n=113)
- **Intrastrate tourists** – individuals ordinarily living in NSW (but outside Greater Sydney) that have visited one or more of Sydney’s coastal beaches during the last 12 months (n=113).

An additional sub-cohort of migrants was also identified within the Sydney beach user and non-user cohorts. This group was defined to include individuals living in Greater Sydney that were born overseas, and moved to Sydney to live in 1991, and were over 18 years old when they moved.

**Data collection**

The survey utilised an online data collection approach, via a research panel to draw sample and administer the questionnaire. The panel comprises individuals who have opted in to participate in surveys and has over 200,000 active members. The online nature of this component allows a broad sample to be reached – both in terms of demography and geography. A random sample of panel members were invited by email to take part in the survey, and were first screened to identify people who matched the sample specifications. Upon completion of the survey, a small monetary reward is credited to panellists’ accounts, which they can later redeem as a gift voucher. To meet a minimum quota, additional responses were sampled from other sources for the international migrant cohort.

**Quality control**

Standard quality control measures were used to clean the data, including removal of ‘speeders’ (respondents who completed the survey too quickly to have given due attention and thought to answers), ‘flat liners’ (respondents who consistently showed no variation in answers at grid questions) and inconsistent answers at ‘trap questions’ (similar questions at different points of the questionnaire to which similar answers would be expected).
Appendix B: Economic contribution studies

Economic contribution studies are intended to quantify measures such as value added, exports, imports and employment associated with a given industry or firm, in a historical reference year. The economic contribution is a measure of the value of production by a firm or industry.

Value added
The measures of economic activity provided by this contribution study are consistent with those provided by the Australian Bureau of Statistics. For example, value added is the contribution the sector makes to total factor income and gross domestic product (GDP) and gross territory product.

There are a number of ways to measure GDP, including:

- Expenditure approach – measures expenditure: of households, on investment, government and net exports
- Income approach – measures the income in an economy by measuring the payments of wages and profits to workers and owners.

Below is a discussion measuring the value added by an industry using the income approach.

Measuring the economic contribution – income approach
There are several commonly used measures of economic activity, each of which describes a different aspect of an industry’s economic contribution:

- Value added measures the value of output (i.e. goods and services) generated by the entity’s factors of production (i.e. labour and capital) as measured in the income to those factors of production. The sum of value added across all entities in the economy equals gross domestic product. Given the relationship to GDP, the value added measure can be thought of as the increased contribution to welfare.

Value added is the sum of:

- Gross operating surplus (GOS) represents the value of income generated by the entity’s capital inputs, generally measured as the earnings before interest, tax, depreciation and amortisation (EBITDA).

- Tax on production less subsidy provided for production. Note: given the manner in which returns to capital before tax are calculated, company tax is not included or this would double-count that tax. In addition it excludes goods and services tax, which is a tax on consumption (i.e. levied on households).

- Labour income is a subcomponent of value added. It represents the value of output generated by the entity’s direct labour inputs, as measured by the income to labour.

Figure B.1 shows the accounting framework used to evaluate economic activity, along with the components that make up output. Output is the sum of value added and the value of intermediate inputs used by the firm.

The value of intermediate inputs can also be calculated directly by summing up expenses related to non-primary factor inputs.

Figure B.1: Economic activity accounting framework

Source: Deloitte Access Economics.
Contribution studies generally outline employment generated by a sector. Employment is a fundamentally different measure of activity to those above. It measures the number of workers that are employed by the entity, rather than the value of the workers’ output.

Direct and indirect contributions
The direct economic contribution is a representation of the flow from labour and capital in the company.

The indirect contribution is a measure of the demand for goods and services produced in other sectors as a result of demand generated by visiting the beach. Estimation of the indirect economic contribution is undertaken in an input-output (IO) framework using Australian Bureau of Statistics IO tables which report the inputs and outputs of specific sectors of the economy (ABS 2013).

The total economic contribution to the economy is the sum of the direct and indirect economic contributions.

Other measures, such as total revenue or total exports are useful measures of economic activity, but these measures alone cannot account for the contribution made to GDP. Such measures overstate the contribution to value added because they include activity by external firms supplying inputs. In addition, they do not discount the inputs supplied from outside Australia.

Limitations of economic contribution studies
While describing the geographic origin of production inputs may be a guide to a firm’s linkages with the local economy, it should be recognised that these are the type of normal industry linkages that characterise all economic activities.

Unless there is significant unused capacity in the economy (such as unemployed labour) there is only a weak relationship between a firm’s economic contribution as measured by value added (or other static aggregates) and the welfare or living standard of the community. Indeed, the use of labour and capital by demand created from the industry comes at an opportunity cost as it may reduce the amount of resources available to spend on other economic activities.

This is not to say that the economic contribution, including employment, is not important. As stated by the Productivity Commission in the context of Australia’s gambling industries:17

Value added trade and job creation arguments need to be considered in the context of the economy as a whole … income from trade uses real resources, which could have been employed to generate benefits elsewhere. These arguments do not mean that jobs, trade and activity are unimportant in an economy. To the contrary they are critical to people’s well-being. However, any particular industry’s contribution to these benefits is much smaller than might at first be thought, because substitute industries could produce similar, though not equal gains.

In a fundamental sense, economic contribution studies are simply historical accounting exercises. No ‘what-if’, or counterfactual inferences – such as what would happen to living standards if the firm disappeared? – should be drawn from them.

The analysis – as discussed in the report – relies on a national IO table modelling framework and there are some limitations to this modelling framework. The analysis assumes that goods and services provided to the sector are produced by factors of production that are located completely within the state or region defined and that income flows do not leak to other states.

The IO framework and the derivation of the multipliers also assume that the relevant economic activity takes place within an unconstrained environment. That is, an increase in economic activity in one area of the economy does not increase prices and subsequently crowd out economic activity in another area of the economy. As a result, the modelled total and indirect contribution can be regarded as an upper-bound estimate of the contribution made by the supply of intermediate inputs.

Similarly the IO framework does not account for further flow-on benefits as captured in a more dynamic modelling environment like a Computerised General Equilibrium model.

Input-output analysis
Input-output tables are required to account for the intermediate flows between sectors. These tables measure the direct economic activity of every sector in the economy at the national level. Importantly, these tables allow intermediate inputs to be further broken down by source. These detailed intermediate flows can be used to derive the total change in economic activity associated with a given direct change in activity for a given sector.

A widely used measure of the spill-over of activity from one sector to another is captured by the ratio of the total to direct change in economic activity. The resulting estimate is typically referred to as the ‘multiplier’. A multiplier greater than one implies some indirect activity, with higher multipliers indicating relatively larger indirect and total activity flowing from a given level of direct activity.

The IO matrix used for Australia is derived from the ABS 2009-10 IO tables (2013). The industry classification used for IO tables is based on the Australian and New Zealand Standard Industrial Classification (ANZSIC), with 114 sectors in the modelling framework.

Similarly, the IO matrix used for New Zealand is derived from Statistics New Zealand’s (SNZ) 2007 IO table. While the industry classification is also based on Australian and New Zealand Standard Industrial Classification (ANZSIC), the tables are broken down into 106 industries, as opposed to the 114 used by the ABS in compiling the Australian IO tables.

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Coastal water quality and beach cleanliness have significant social value including aesthetic, recreational and cultural value. While majority of these social values are not exchanged through the markets and therefore cannot be priced easily, they are partially reflected through the value consumers place on coastal properties. In particular, properties in Sydney that are close to river banks, waterfronts or wetlands often demand a premium, partly due to the aesthetic and cultural appeal of these properties, including waterfront views, and proximity to beachside activities.

To estimate the value consumers place on Sydney's beaches, a high-level hedonic price analysis was conducted on Sydney's property sales data (2014-2015). Hedonic pricing models have been used extensively in the economics literature to measure the value households place on locating properties close to a given resource, such as a beach, river, or lake. The model implicitly assumes that a property's price is reflective of the value of the marginal utility that consumers derive from its individual characteristics, such as number of bedrooms, bathroom and land area.

The variables used in hedonic modelling for measuring the valuation for characteristics of properties are well established and, subject to constraint of availability, are common across most studies in the literature. In this research, we identified suburbs associated with one of Sydney’s coastal beaches. This beachside characteristic is analysed alongside common deterministic variables such number of bedrooms, bathrooms, carparks and land area. It is important to note that the intention of this exercise is not to produce a robust modelling framework for Sydney property prices, rather, the modelling seeks to discover an indicative estimate for the value consumer place on Sydney beaches.

Based on the hedonic price analysis, our result shows that, on average, properties in suburbs with coastal beaches are valued at around $350,000 more than properties in non-beachside suburbs, implying that Sydney residents derive a significant amount of value (or utility) from proximity to coastal beaches.

This value estimate is reflective of consumers’ willingness to pay at a particular point in time, it is also a function of prevailing economic factors influencing the consumer's purchasing power and overall property prices. It is possible that this value will vary from time to time, and shift according to changes in consumer preference and economic conditions.

Model specification

Data on property sales in 2015 was used in this analysis, with information on sale price, property area, number of bedrooms, bathrooms, car parks and type of property (house/unit). A hedonic pricing model was developed, where the value of an underlying asset is the composite of the market price of its constituent parts.

A linear OLS regression was carried out to analyse the market price of being in a beach front suburb, with quadratic terms of key property characteristics included to reflect diminishing rates of return:

\[
\text{sale price} = \alpha + \beta_1 \text{No. Bedrooms} + \beta_2 \text{No. Bedrooms}^2 + \beta_3 \text{No. Bathrooms} + \beta_4 \text{No. Bathrooms}^2 + \beta_5 \text{No. Carparks} + \beta_6 \text{No. Carparks}^2 + \beta_7 \text{land area} + \beta_8 \text{land area}^2 + \beta_9 \text{beach} + \epsilon
\]
Limitation of our work

General use restriction
This report is prepared solely for the use of Sydney Water. This report is not intended to and should not be used or relied upon by anyone else and we accept no duty of care to any other person or entity. The report has been prepared for the purpose of conducting economic research which will be used by Sydney Water in its marketing activities – both in recognition of the 25th Anniversary of the Deep Ocean Outfall Program as well as at other events. You should not refer to or use our name or the advice for any other purpose.