Australia’s beaches are a key component of its cultural identity, but this symbol is not as clean as could be. Beach pollution is—or should be—an issue of great concern to the beach-going public. There are many reasons why beaches become polluted. Oil spills, industrial discharge of toxic waste, trash, and even unsafe levels of treated sewage are well-known and obvious sources of pollution. However, according to the Environmental Protection Agency (EPA), the most common cause of beach pollution is contaminated stormwater.

 The environmental movement’s concern about beach pollution has shifted from sewerage to stormwater. This change in focus is in large part due to increased water quality testing, which has revealed stormwater as the major culprit. In response, in 1997 the state government created the Waterways Package, a plan to improve the quality of the state’s waterways. The state mandated that every council have a stormwater management plan aimed at achieving clean, healthy waterways, and allocated $60 million as part of a stormwater trust fund to improve water quality.

 Stormwater causes beach pollution because it becomes contaminated with pollutants as it travels through the stormwater system. These pollutants can include dog droppings, automobile fluids, cigarette butts, litter, runoff from streets, and anything that is washed into the stormwater system. Stormwater is then piped into catchments (areas of land that drain to a common point) that empty unfiltered into the sea. This problem is exacerbated by land development, which alters natural catchments, introduces unnatural pollutants, and results in the environment being unable to filter water as it previously could.

 Stormwater beach pollution has dramatically affected North Weston Beach (also known as North Beach), primarily through the overflow of stormwater from the Fairy Creek Lagoon. During heavy rain the lagoon discharges at the northern end of North Beach through Chatwin Park to the Tasman Sea. The Fairy Creek Lagoon has three major contributing waterways: the Fairy Creek, the Durras Arm, and the Cabbage Tree Creek. According to the Weston Coastal Stormwater Management Plan (WCSMP), the total area of these catchments is 3,416.3 hectares. This chapter will focus on the Fairy Creek Catchment or sub catchment 3 as defined by the WCSMP.

 The Fairy Creek Catchment has been under heavy stress from development for over 150 years, with the majority of roads and developed land established more than 50 years ago. Little was known about flooding at the time, and development was allowed to expand into natural floodplains, creating hard surfaces that increased unchecked stormwater runoff. The problems are further compounded by the physical constraints of the area. The steep escarpment to the west, bounded by the Tasman Sea to the east, leaves little room for Weston to expand, putting extra development pressure on already over-developed land.

 This chapter looks at the problem of stormwater pollution in the Fairy Creek Catchment and addresses the following questions: What causes stormwater to become polluted and eventually contaminate North Beach? What are the possible health effects to surfers, swimmers, and the wider community? And what is being done to manage this problem?

**Causes of stormwater pollution at North Weston Beach**

 In order to understand why stormwater becomes polluted and eventually ends up polluting North Beach, it is necessary to study the Fairy Creek Catchment. What enters the catchment will most likely end up at the ocean discharge point when enough rain is washed through. This is as simple as water running downhill and finding the most direct path to the lowest point, in this case, the ocean.

 The physical characteristics of the Fairy Creek Catchment are a large contributor to the problem of stormwater pollution at North Beach. The Fairy Creek Catchment is characterized by a steep escarpment to the west, with heavy rainfalls averaging 1,100–1,600mm per year. This leads to many high-velocity streams that have extremely limited discharge capacity and often cause severe flooding. The catchment rivers generally run west to east, while major roads and the railway run north to south, creating unnatural obstructions to the flow and exacerbating problem flooding. Overdevelopment and an increase in non-porous surfaces, such as asphalt, further compound the drainage problem.

 The following list details some of the sources and effects of stormwater pollution:

* Road surface pollutants such as oil, grease, and petroleum, and other industrial processes are toxic to aquatic life.
* Fertilizers and detergents that contain phosphorus and nitrogen cause algae blooms that consume large amounts of oxygen from waterways, stifling their ability to naturally clean themselves through organic breakdown.
* Excessive amounts of organic materials, such as leaves and sticks or rusting metal, remove large amounts of oxygen from the water and may kill fish.
* Herbicides and pesticides from commercial and non-commercial properties are toxic and can enter the food chain.
* Metal toxins, such as lead, mercury, zinc, and copper, can also enter the food chain when concentrated into the sediment.
* Air-born pollutants from industry and motor vehicle emissions from leaded and non-leaded gasses are sources of road surface runoff.
* Sewerage overflows can contain viruses and bacteria, including pathogens that can cause diseases in swimmers and shellfish. These can come from illegal connections to stormwater drains and defective sewerage systems. Animal waste also contributes.
* Construction sites introduce sediments and suspended solids into the catchment. Together with the erosion resulting from construction, this clouds water and destroys habitat for aquatic life, causing adverse effects.
* Non-biodegradable materials such as fast food packaging, plastic bags, aluminum cans, and Styrofoam can accumulate in the catchment, causing unsightly trash to become caught on vegetation. Wildlife can become entangled in or ingest this trash, causing death and becoming another pollutant.
* Organic waste, including garden and food scraps as well as leaves and twigs, can contaminate stormwater. Up to 60–80% of stormwater may contain natural litter, depending on the land use within a catchment.
* Water acidity (pH units) that is altered by chemicals can kill native species of vegetation and cause opportunistic weed species and pests to take over. The lessening of acidity that is increased may mobilize toxic chemicals that can include heavy metals, oxides of nitrogen, sulfur, and other inert chemicals deposited in bottom sediments in the catchment.

 The local government has identified the Fairy Creek Catchment as one of its likely stormwater “hotspots” due to the presence of sewerage overflows. The sewerage system overflows at many different locations after heavy rainfall, with the points of discharge varying with each storm. Sewerage overflow that eventually makes its way to North Beach has serious potential health effects.

**Potential health effects to surfers and swimmers at North Weston Beach**

 The health effect of contaminated stormwater to surfers and swimmers is the same as diseases caused by sewage. Water quality tests taken by SeaWatch, the government body responsible for monitoring beaches, show evidence of danger to surfers and swimmers. According to SeaWatch, waters are unsuitable for swimming if:

* The median fecal coliform density exceeds 150 cfu/100 mL for 5 samples taken at regular intervals not exceeding 1 month; or
* The second highest sample contains equal to or greater than 600 cfu/100 mL for 5 samples taken at regular intervals not exceeding 1 month.
* The median enterococci density exceeds 35 cfu/100 mL for 5 samples taken at regular intervals not exceeding 1 month; or
* The second highest sample contains equal to or greater than 100 cfu/100 mL for 5 samples taken at regular intervals not exceeding 1 month.

 Fecal coliform and enterococci are both bacteria. Fecal coliforms inhabit the intestines of humans and other mammals and are present in feces. They are indicative of pollution from sewerage and other sources such as stormwater. They have a relatively short life span in salt water and if detected indicate a recent contamination. Enterococci are used to indicate the extent of fecal contamination in recreational waters. They are different from Fecal coliforms in that they are much more tolerant of seawater and their survival time in the marine environment is similar to the survival time of some pathogens.

**Issues**

 The most difficult problem with a case study on the causes of stormwater pollution in the Fairy Meadow Creek and at North Weston Beach is that a study has never been done to pinpoint the precise levels of stormwater pollution in the catchment.

 Prior to the 1990s, the focus on beach pollution from the government and the EPA had been on outflows from sewerage treatment plants along the coast. The Sydney beaches, such as Bondi and the inner harbor, were believed to be primarily contaminated by the sewerage treatment plants run by Sydney Water.

 Though sewage pollutes coastal beaches, particularly when it is discharged untreated, it is now fairly well accepted that stormwater is the most significant cause of beach pollution. Yet studies that scientifically prove the causes of stormwater pollution to North Beach are insufficient or do not exist. The Stormwater Trust Fund was established to address this problem through management plans such as the WCSMP. In reality, being able to pinpoint the causes of pollution in any catchment the size of Fairy Creek is probably unrealistic. Stormwater infrastructures are underground and inaccessible, and rarely examined except when a problem arises.

 The water quality testing at North Beach done by SeaWatch needs examining. Fecal coliform and enterococci levels are indicators of fecal contamination only, and there is much debate within the scientific community as to the usefulness of these in making assessments of public health risk.

 The controversy surrounding the effectiveness of current testing methods in determining public health risks clearly indicates a need for improvement. The associated high cost and newly developing technology for testing are a part of the problem. Testing for enterococci and fecal coliforms is relatively cheap and easy. However, there is enough debate on the effectiveness of this testing that no one really knows how safe it is to swim in the ocean at North Beach. In addition, testing is only done during the summer, ignoring the winter months. Why then is testing publicly purported as an accurate measure of water quality when even the testers themselves dismiss its accuracy? Is this public health or public relations?

 Beyond the controversy of testing for health risks and the limitations of absolutely identifying pollution sources, there is consensus that the Fairy Creek Catchment is stressed beyond its capabilities. This problem must be confronted soon if the Weston public wants clean and healthy beaches. The larger issue is what can be done to help prevent future pollution from entering the stormwater system.

**Conclusion**

 Overdevelopment, lack of an effective stormwater management plan, and the physical constraints of the area all contribute to the pollution of North Weston Beach. But public awareness is a large part of the solution when it comes to preventing the pollution of stormwater. Many people are not aware that stormwater is a major threat to clean and healthy beaches and that the everyday actions of individuals contribute to the problem. Some steps individuals can take include:

* Refrain from washing streets and driveways.
* Wash cars on lawns.
* Pick up dog droppings and dispose of them in a bin.
* Use pesticides and garden fertilizers sparingly and do not spray near waterways or storm drains.
* Prevent contractors from cleaning tools and disposing of cement, lime, paint, sand, oils and other construction materials in storm drains.
* Maintain autos so that oil and other fluid leaks don’t run onto the road.
* Compost lawn and leaf clippings; don’t deposit them in storm drains.
* Drain swimming pools into sewers, never into storm drains.
* Maintain native vegetation along stream banks and re-vegetate stream banks with native species in order to maintain a natural riparian zone.
* Use sustainable land management to conserve and improve water quality in your local catchment.
* Fence all farm animals to prevent them from entering creeks.

Though these measures seem simple, they could be effective in lessening the problem of stormwater pollution at North Beach.

 Clearly many other factors contribute to the problem of stormwater pollution and need to be addressed. Effective measures could include routine physical upkeep of the stormwater system, including re-engineering of the stormwater catchment, debris removal, routine inspections, and identification and removal of known pollutant sources. Measures to minimize the contamination of road runoff, such as street cleaning, could also be helpful. More effective, standardized water quality testing is also critical to ensure public health. Finally, and perhaps most importantly, there needs to be a public will to address this problem.