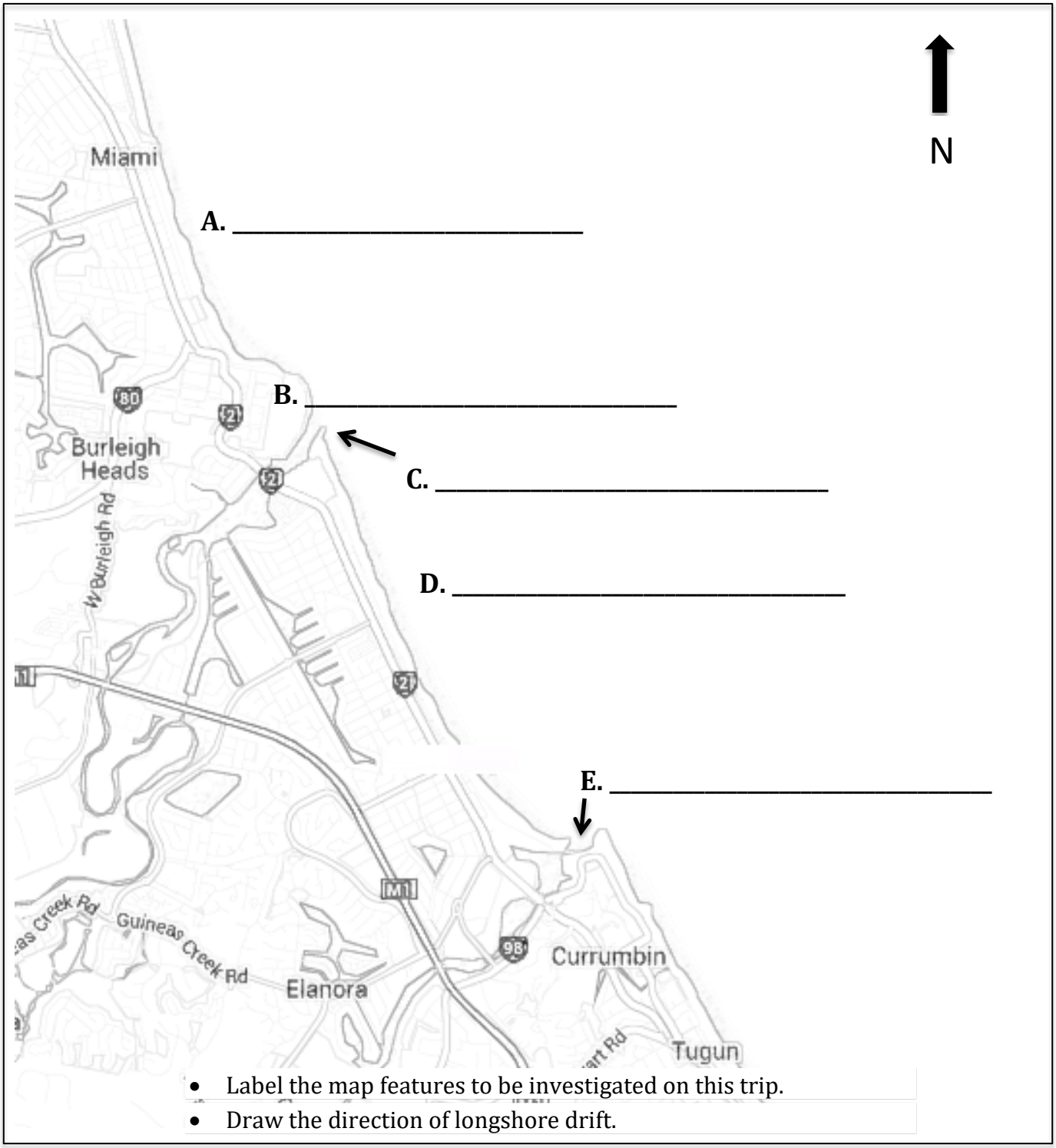
NUMINBAH VALLEY
ENVIRONMENTAL EDUCATION CENTRE

Inspiring Minds for a Sustainable Future

Coastal Management Study



- Label the map features to be investigated on this trip.
- Draw the direction of longshore drift.

NAME: _____

Longshore Drift & Sand Dunes

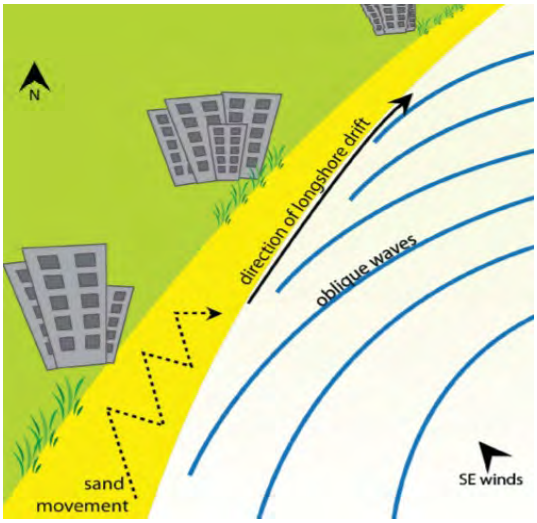
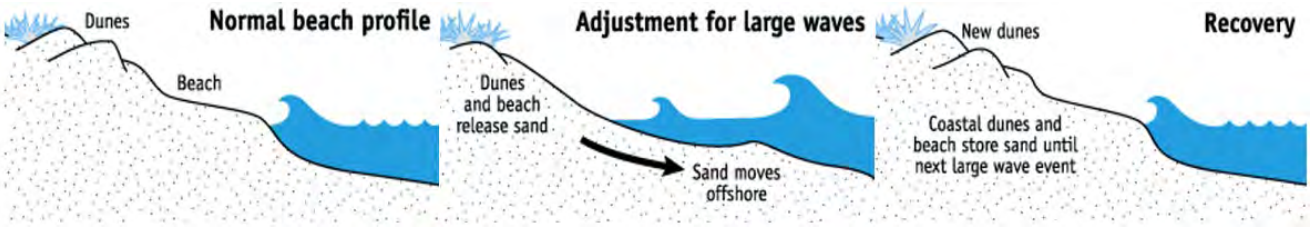


Image Source: GCCC - Discovering our coast_Longshore drift

Sand is created from the breakdown of marine organisms like shells and corals, and weathering and erosion of rock formations into sediment. Rivers and streams wash the eroded sediment from inland to the coast where it joins the ocean.

On Australia's east coast, winds from the southeast push sand-carrying waves & currents northwards along the coast **(longshore drift)**. The sand slowly accumulates during periods of small swells **(deposition)**, creating beaches, dunes and sand banks.

Beaches change shape (profile) during storm events. Sand is removed **(erosion)** from beaches by strong winds and high-energy waves and deposited offshore, forming offshore sand breaks, and often resulting in unstable beach cliffs and escarpments. When storm swells abate, the slow process of deposition & beach recovery resumes.

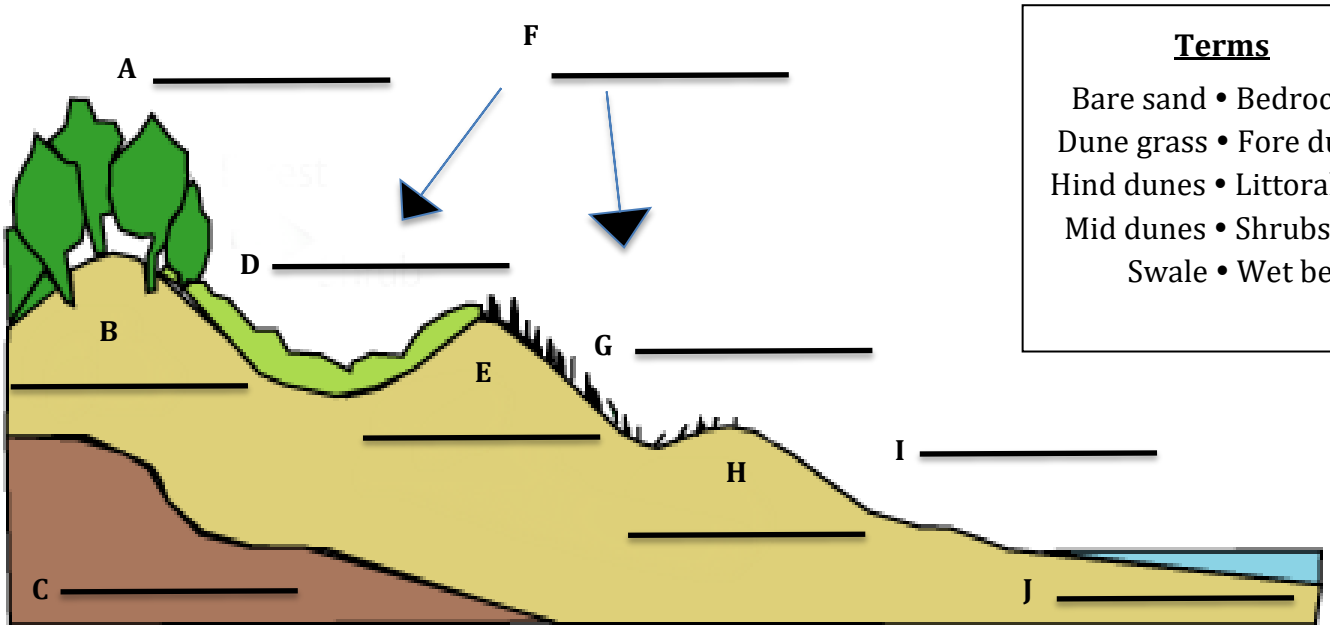


Adapted from Hawaii Information Consortium. http://www.state.hi.us/dlnr/exhibits/clp/CoastalErosion2.html

	Cause (What affects this process?)	**Timescale** (How fast does it happen?)	**Beach width** (wider or narrower?)
Longshore Drift			
Natural Erosion			

Stable sand dunes play an important role in protecting the coastline: they act as a buffer against wave damage during storms and protect the land behind from saltwater intrusion. The dunes also act as a reservoir of sand to replenish and maintain the beach at times of erosion. The development of this sand barrier allows the development of more complex plant communities in areas protected from saltwater inundation, sea spray, and strong winds.

(QLD Government Department of Environment and Heritage Protection: Coastal Dunes https://www.ehp.qld.gov.au/coastal/ecology/beaches-dunes/coastal_dunes.html)



Terms

Bare sand • Bedrock
Dune grass • Fore dunes
Hind dunes • Littoral forest
Mid dunes • Shrubs
Swale • Wet beach

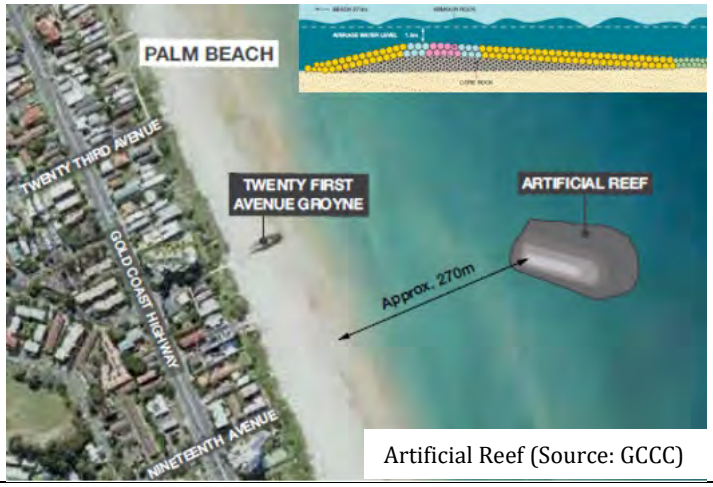
Image adapted from Ray Chai. http://www.landforms.eu/Lothian/dune%20succession.htm

Palm Beach

A long history of beachfront development has led to the destruction of the dune system and stabilising vegetation along Palm Beach. Limited protection against erosion, coupled with the fact that it is one of the most easterly beaches on the Gold Coast, means that it is regularly at risk of severe erosion.

In 2019, an artificial reef was constructed in an attempt to protect and stabilise Palm Beach.

Palm Beach 2009 (Source: GCCC)



Artificial Reef (Source: GCCC)

Beach Management Strategy:	**Artificial Reef**
Details:	

Tallebudgera Creek Training Wall

In the mid-1970s, the Gold Coast City Council (GCCC) began to build a rock training wall on the southern side of the Tallebudgera Creek mouth, extending the wall 300m towards the ocean. This training wall was built for three important reasons:

1. Due to the creek mouth blocking up with sand, heavy rain events would often result in the creek flooding inland, and the creek mouth would often break through to the ocean in another location, often through areas of residential or industrial development.

2. Tallebudgera Creek kept filling up with sand, blocking up the creek mouth and reducing boat access to the creek.

3. Palm Beach had low levels of sand deposition and the beach was eroding away faster than the natural process of longshore drift could mitigate. The last 50 years had seen some particularly destructive storm events and the beach was not fully recovering - the sand was ending up in the creek, rather than on the beach.

Tallebudgera Creek (1960)

Photo by Austin Joseph Tongue Image from http://www.panoramio.com/photo/108221393

List the advantages and disadvantages of the training wall at Tallebudgera Creek.

Beach Management Strategy:	**Training Wall**
Advantages	**Disadvantages**

Following the completion of the Tallebudgera Creek training wall, Gold Coast residents found that Burleigh Beach, Surfers Paradise and other beaches further north were eroding more than normal. The once-beautiful sandy beaches of the Gold Coast were narrowing quickly and storm events left ugly cliffs and escarpments on the beaches. Upon further investigation, the Gold Coast City Council (GCCC) found that as a result of the installation of the training walls at Tallebudgera Creek, Currumbin Creek, and Tweed Heads, longshore drift was being interrupted and not enough sand was travelling north to restore Burleigh and the northern beaches from erosion.

Erosion escarpments at Burleigh Beach 2013

Image from Courier Mail
http://www.couriermail.com.au/news/queensland/tourism-hurting-as-families-avoid-eroded-beaches-on-the-gold-coast-and-sunshine-coast-for-school-holidays/story-fnihsrf2-1226666483388

The Gold Coast beaches have a variety of groups of people (stakeholders) interested in the upkeep and maintenance of the beaches. List the main stakeholders who have an interest in Gold Coast beaches.

_____

_____

_____

_____

Dredging

Beginning in the 1990s, the GCCC implemented annual sand dredging and pumping at Tallebudgera Creek, taking sand from the creek mouth and offshore and pumping it onto Burleigh Beach in an effort to reduce the coastal erosion and reinstate longshore drift to the northern beaches.

Addressing coastal erosion on Burleigh beach is a priority because the beach has such high economic value due to its location as a popular tourist destination, as a recreational spot for locals, and as an area of high income from local businesses.

The amount of sand dredged from the creek varies each year – it depends on how much sand has filled up in the creek and how much erosion has occurred at Burleigh Beach. The amount of sand dredged ranges between 20,000 and 100,000 cubic meters. In 2013, 35,814 cubic meters of sand was dredged and pumped onto Burleigh Beach, costing $303,151 (or about $8.50 per m^3).
(Gold Coast City Council, http://www.goldcoast.qld.gov.au/tallebudgera-creek-dredging-4547.html; The Courier Mail June 21 2013)

Dredging, sand pumping and beach replenishment

Image from Dredging Today
http://www.dredgingtoday.com/2014/08/18/tallebudgera-beach-works-underway-australia/

Image from Dredging Today
http://www.dredgingtoday.com/2013/08/08/burleigh-beach-replenishment-kicks-off-australia/

List the advantages and disadvantages of the sand dredging and beach replenishment strategy at Tallebudgera Creek/ Burleigh beach.

Beach Management Strategy:	**Sand Dredging and Beach Replenishment**
Advantages	**Disadvantages**

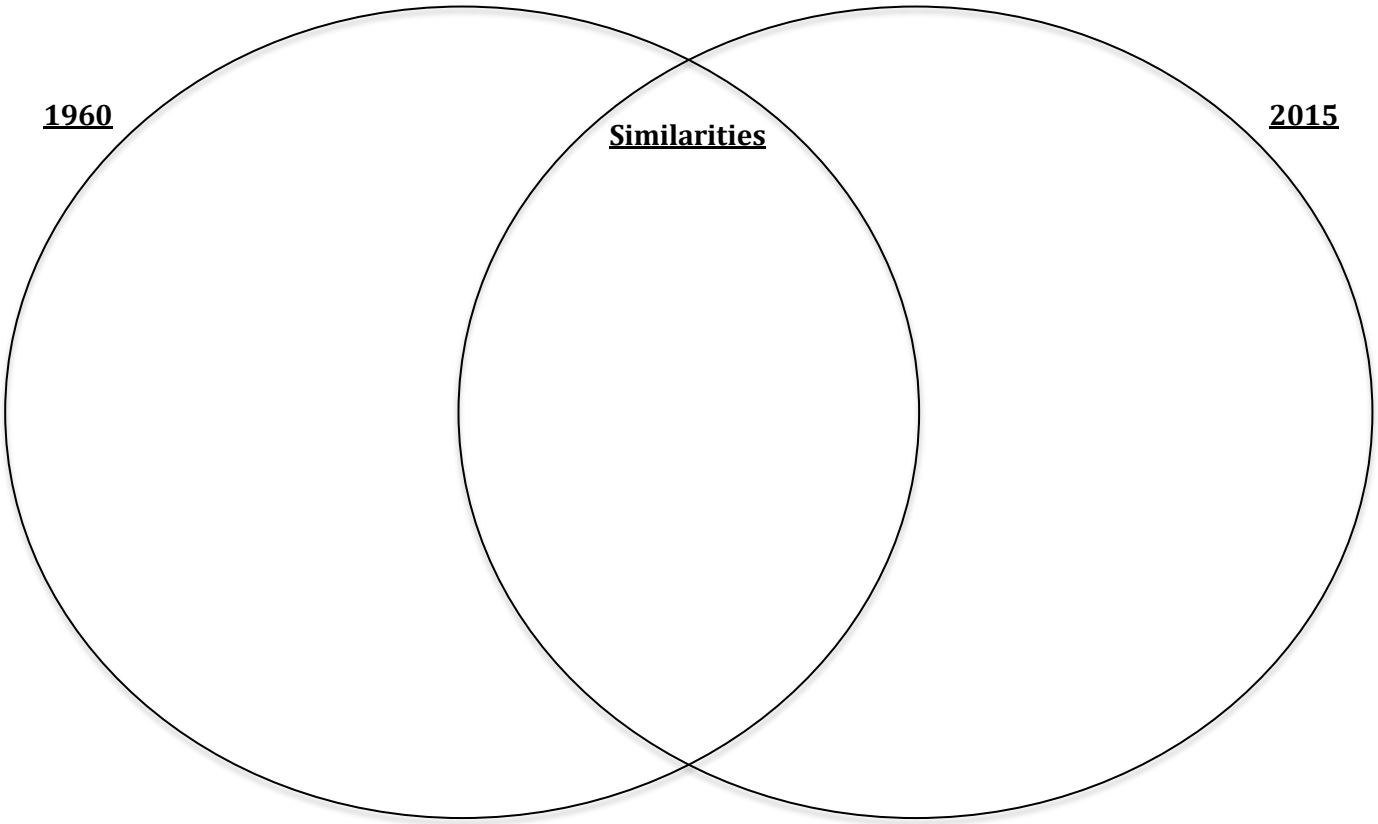
Burleigh Headland - Tumgun Lookout

Compare and contrast Tallebudgera Creek between 1960 (left) and 2015 (right).

Photo by Austin Joseph Tongue
Image from http://www.panoramio.com/photo/108221393

Image from https://keriruri.wordpress.com/about/

Tallebudgera Creek: 1960 and 2015



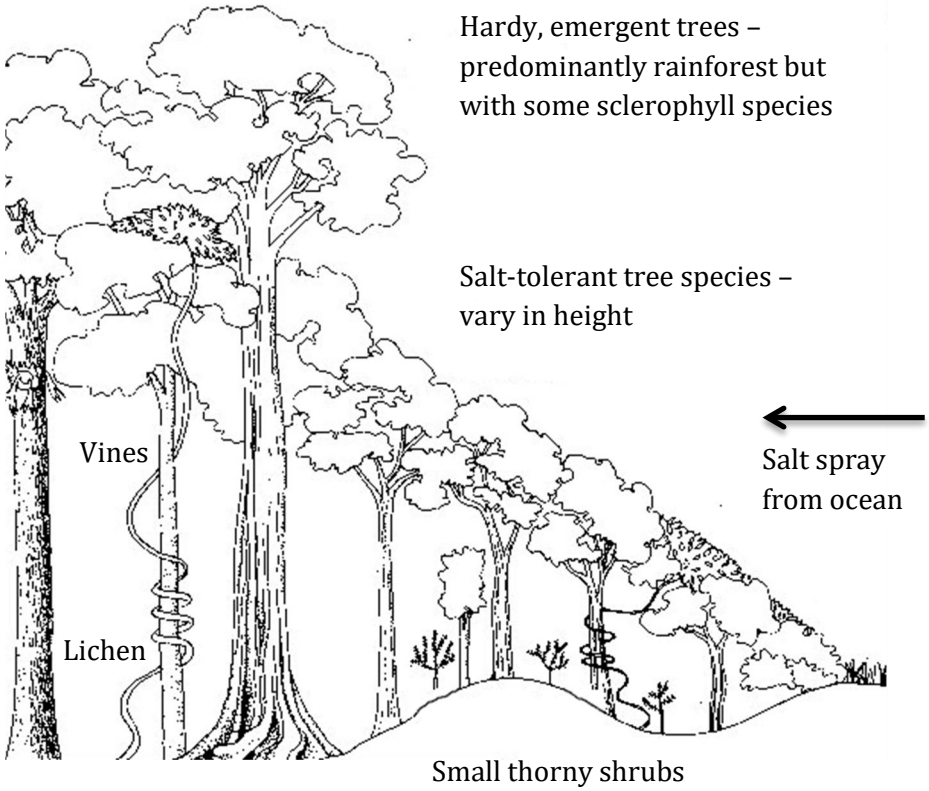
Burleigh Head National Park

The Gold Coast is located on the north-eastern flank of the extinct Tweed Volcano. The central summit of the volcano was located at present-day Mt Warning, and is estimated to have reached 2000m above sea level. Much of the Gold Coast, including Burleigh Heads is made up of basalt lava that flowed long distances before cooling, often forming hexagonal basalt columns. Due to the close proximity to the coast, the Tweed Volcano experienced heavy rainfall and the igneous rock gradually weathered to form rich soils that supported thick rainforests.

Known as *Jellurgal* in Yugambeh, "Dreaming Mountain" holds culturally significant sites that play an important role in the lives of the Aboriginal traditional custodians. https://www.jellurgal.com.au/

Named 'Burly Head' by a government surveyor in 1840 because of its big, rocky appearance. In 1886, the headland was set aside as a *Reserve for Public Purposes* and was protected from subdivision and multiple development proposals until in 1947, it was declared a National Park. The National Park is only 27 hectares, but contains a variety of habitats, including rainforest, eucalypt forest, pandanus groves, tussock grassland, mangroves, creeks, rocky foreshores, and beaches.

Typical Littoral Rainforest and Coastal Vine Thicket



Adapted from Sydney Royal Botanical Gardens
https://www.rbgsyd.nsw.gov.au/education/Resources/rainforests/Australian_Rainforests/Littoral_rainforests

10. Tick the characteristics that apply to this forest:

Altitude:

☐ <300m ☐ 300-800m ☐ >900m

Canopy height:

☐ <15m ☐ 15-25m ☐ >25m

Canopy cover:

☐ <60% ☐ 60-80% ☐ >80%

Fire frequency:

☐ Low ☐ Medium ☐ High

Vegetation:

☐ Shrubs ☐ Vines ☐ Ferns
☐ Epiphytes ☐ Lichen ☐ Moss

Soil:

☐ Fertile ☐ Infertile

Why was it important to classify Burleigh Headland as a National Park in 1947?

_____

_____

_____

<u>Draw a field sketch of Burleigh Beach and Surfers Paradise</u>, including the <u>beach line, coastal development, and coastal vegetation</u>.

1. Select a suitable observation point.
2. Consider why you are drawing and what you will highlight.
3. Determine the boundaries of your sketch area: background, middle ground, foreground.
4. Pencil in features and use shading to highlight changes of slope and vegetation.
5. Label important features on the sketch
6. Give your sketch a title, record the date and location.
7. Your sketch can be redrawn or tidied up and coloured to help distinguish between features.
8. Your sketch can be used to annotate a photograph of the site.

Field Sketch

Location: _____ Date: _____ Notes: _____

Burleigh Beach

Burleigh Beach is one of Gold Coast's most popular beaches. It is used weekly by thousands of residents and tourists for a variety of purposes, including swimming, surfing, boating, exercising, yoga, and dog walking. Directly behind the beach is *The Esplanade*, a busy street filled with cafes, restaurants, and a variety of shops, enticing beach-goers to spend more time and money in the area. But this development only stretches back 100 years. Prior to 1900, Burleigh Beach had a stable dune system that was covered with littoral vegetation.

Using the <u>dune system diagram on page 2</u>, list the changes that have occurred at Burleigh Beach.

In the late 1800s, local residents decided to preserve a section of land immediately north of Burleigh Headland for "protecting and conserving the environment, [and] valuing and appreciating the environment and landscape" *(Burleigh Heads Heritage and Character Study, 2010),* named Rudd Park. A year later, the adjacent Burleigh Headland was declared a *Public Reserve* and was upgraded to National Park status in the mid-1900s.

Rudd Park did not remain protected for long, however. In the 1930s, the land became used for football training, later becoming a campground, and is now the site of a tourist park. Locals decided to plant a large stand of Norfolk Pine trees along Burleigh Beach, and more have been planted over the years.

The 1940s saw sand mining take place on Burleigh Beach foreshore. The sand dunes were sifted for minerals containing titanium and zirconium. While the sand mining provided employment for local residents, it became apparent that the process was causing huge impacts to Burleigh Beach and the environment, and the sand mining was ended after about 15 years. Beach restoration efforts included planting grass for picnic areas, Norfolk Pine and casuarina trees, and turning the beachfront into wide parklands.

Despite all the changes to Burleigh Beach, it continued to be a popular tourist attraction and businesses began to grow. *The Esplanade* (the main road behind Burleigh Beach) became a bustling street, and more people moved into the area to live. Residential development boomed and property prices began to increase as people sought to live closer and closer to the ocean. Over time, houses began to be replaced with apartments and units, until today where the Burleigh Heads is a high-density suburb with nearly 10,000 residents.

Burleigh Beach Development
Image from Domain.com

More frequent storm events associated with global warming, together with the interruption of longshore drift and the destruction of dune systems, causes Burleigh Beach to frequently become disfigured with steep erosion cliffs and beach sand loss.

Businesses and residences near the beach can be affected by strong winds and high surf because there are no protective dunes between them and the ocean.

The erosion affects beach safety, aesthetics and pleasure, and the Gold Coast City Council must perform sand dredging and pumping to restore it.

Steep Erosion Cliffs
https://commons.wikimedia.org/wiki/File:Gold_Coast_Burleigh_beach_erosion_2013.JPG CC BY-SA

Complete the table below, comparing stakeholders who use Gold Coast beaches, their interests in the beach and how beach erosion affects them.

Stakeholder	How is the beach important to them? How are they affected by beach erosion?
Surfers	
Residents	
Traditional Custodians	
Tourists	
Local Businesses	
Local Government	

The GCCC's sand dredging and pumping method is very expensive and the long-term effectiveness of this method is questionable because the sand does not stay on the beach – it is removed by waves, wind, and storm events. Without a dune system that is stabilised by vegetation, sand pumping will need to continue in order to keep the beach from eroding away.

One management strategy that can help mitigate the problems of storm events and erosion is dune rehabilitation and revegetation. Without sand dunes and their stabilising vegetation, beaches are unable to hold onto sand, and the resulting erosion problems are severe. Creating a dune system on a beach and helping stabilise it with littoral species can significantly improve a beach's ability to retain sand and recover more rapidly from erosion. This method is not quick (it can take decades to fully establish the vegetation on the dunes) and is expensive (especially regarding maintenance), but the long-term results from it can significantly reduce the need for sand pumping and training walls and return the beach system very close to stability.

Dune rehabilitation and revegetation

Dune restoration
Image from Earth Studies UK Dune Restoration
http://www.earthstudies.co.uk/Geography/Coasts%20G3/Studland/Dune%20resto

Dune fencing
Image from Flickr Beach shots
https://www.flickr.com/groups/top20beach/

Dune revegetation
Image from Marmion Primary
http://www.marmionprimary.com/sand-dune-restoration-gallery/sand-dune-restoration/15954254

List the advantages and disadvantages of the implementing dune rehabilitation and revegetation at Burleigh beach.

Beach Management Strategy:	**Dune Rehabilitation and Revegetation**
Advantages	**Disadvantages**

You are part of the Gold Coast City Council committee that is deciding what to do about the erosion problem at Burleigh Beach. Use your notes from this booklet to <u>show the positive and negative impacts</u> of the following management strategies.

	<u>Management Proposal 1:</u> Do nothing and allow the coastal processes to return sand to Burleigh Beach over the next ten years.		**<u>Management Proposal 2:</u>** Install more training walls and use dredging and sand pumping to put sand onto Burleigh Beach.		**<u>Management Proposal 3:</u>** Implement sand dune restoration and rehabilitation with native vegetation at Burleigh Beach.	
	Positive	***Negative***	***Positive***	***Negative***	***Positive***	***Negative***
Environmental Impacts						
Social / Cultural Impacts						
Economic Impacts						
Political Impacts						

Notes