# Objectives of Beach Monitoring

## Port Fairy Coastal Group

- Develop an understanding of sand movement.
- Provide a bench mark of sand movement to assess any implemented remedial strategies.
- Provide government authorities with information about coastal erosion activity.

The Port Fairy Coastal Group is a registered organization of volunteers who have concerns for our coast line in the face of current storm surges and the influence of climate change factors. Our work concentrates on gathering actual data on physical beach conditions to enable timely and objective decisions on coastal management.

Beach monitoring teams conduct measuring sessions approximately monthly around the East Beach coastal reference points with the assistance of the Port Fairy Surf Lifesaving Club and at South Beach with students and teachers from Port Fairy's two primary schools.

A basic analysis of the results are circulated to the Moyne Shire, DELWP, coastal consultants and the group's members. The PFCG committee review the results each month and discuss with the Moyne Shire when necessary.

We would like to acknowledge the support provided by the Moyne Shire in facilitating our work on the beach.

In response to initial dune monitoring in 2012, the Moyne Shire commenced installation of the reference posts that are key to accurate beach data measurements.

As the capacity of our group progressed, the Shire provided a water proof camera, laser level and a laser distance measuring device. Additionally the Shire provided extra funds to operate the Surf Lifesaving Club's beach capable vehicle that carries PFCG members and equipment around the 4.5 km of East Beach to complete beach monitoring in a timely manner.

Coastal adaption to climate related issues will only become more necessary and the Port Fairy Coastal Group look forward to continuing their good working relationship with the Moyne Shire.

Erosion at the former Night Soil site

The Port Fairy Coastal Group was formed by concerned local residents to quantify erosion of the primary sand dune along East Beach.

Dramatic scenes like this distracted public interest from investigating potentially more serious erosion in other parts of the beach.

Unfortunately, hard rubbish was also dumped here prior to the site being closed and was solely responsible for creating such a poor public regard for this area. Soil and water tests show no contamination from the biodegradable material but the exposure of hard rubbish was unsightly as the dune face recessed.

Reshaping of the dune face together with Enviro matting and a double sand fence along with extensive natural vegetation have eliminated major dune recession at the former Night Soil site, now under the control of DELWP.

Coastal Group Beach Monitoring volunteers at work


**Top Left**

The Port Fairy Coastal Group conducts beach monitoring all year round and during the winter months that usually means commencing while it is still dark, always cold and sometimes wet. Collecting measurements on the beach is time critical because more measurements can be made when the tide is lowest, so the cold wet early start on a winter Sunday morning is necessary in order the recover the most useful data. Such is the community spirit and dedication of the Coastal Group members.

After years of measurements, we have discovered that very useful data comes from a point at least 30 metres seaward of the reference post where the beach is rarely out of water and subjected to wave action for much of the time.

**Lower Left**

Volunteers often make their own purpose built measuring equipment including the mechanical frame being evaluated here to measure beach profiles. Further testing found that a builder's laser level was more suited to the large number of measurements needed and the Moyne Shire supplied the group with a dedicated laser level. The laser level is a key piece of equipment for beach monitoring and is used for all profile measurements. The Moyne Shire also provides additional support to the Port Fairy Surf Lifesaving Club for the use of their beach vehicle to transport the monitoring team and equipment around the 4.5 km of the East beach coast.

**Far Right**

Along most parts of East Beach, it is usually possible to achieve a distance of 30+ metres from the reference post for the transverse profile but in front of the WEDs and beyond to posts 11 and 12, members often have water levels at knee height before reaching the magic 30 meter distance.

When the minimum low tide level is above 0.5 metre, transverse profiling is delayed until tide levels are more favourable.

PFCG Reference Points on the Port Fairy Coast

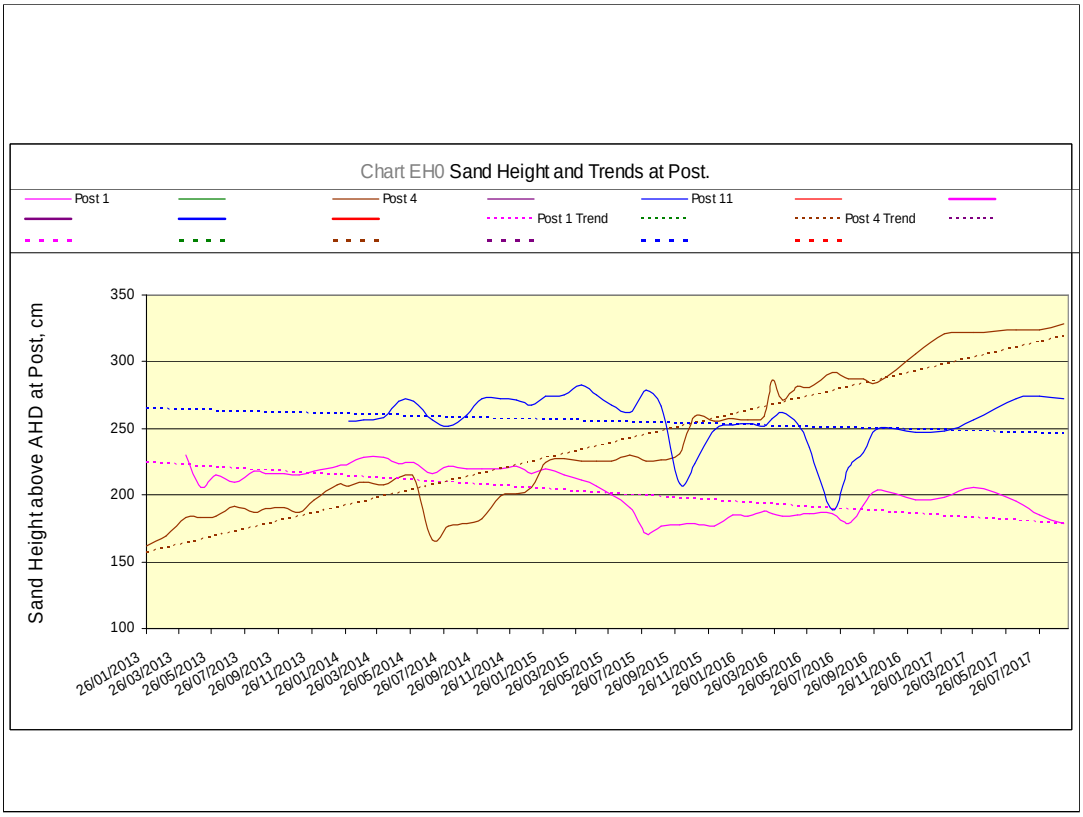

East Beach at Port Fairy Bay has fourteen surveyed reference posts of which twelve are used in the measurement of sand profiles on the beach. Post 4 currently has the highest sand level at a dune face and post 8 is in front of the dunes containing the former tip site.

The Port Fairy Surf Lifesaving Club ATV transports members and their measuring equipment over the 4.5 km of East Beach enabling the team to complete monitoring in under 2 hrs.

Note the visible wave and swell activity centred around post 8.

Posts 21, 22 and 23 are used to monitor popular parts of the South coast beaches.

Reference point 30 will be used for sand level surveys in the bay itself.

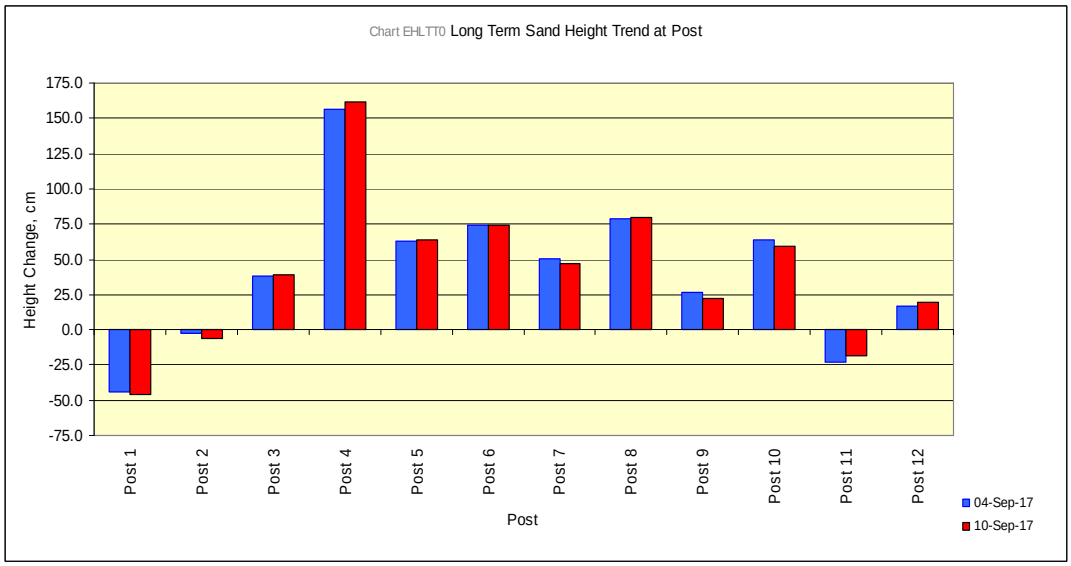



Linear Trend Analysis takes account of the complete known history of sand height at the post and provides an estimate of the net accumulation of sand at that point.

Information about the sand height trend for each post is collected and used to summarize trends on the next page.

In future revisions of the spreadsheet of data, evaluation of the height trend will be available at other distances from the reference post and principally from the 30m distance as this is proving to be the most active part of the foreshore currently being monitored.

Changes in Sand Height Trends provide early warning of new beach conditions




This analysis has only just been introduced although it is based on all measurements since March 2013. Detailed trend analysis will be extended to other distances from the post as we develop the mathematics to help understand our beach sand systems.

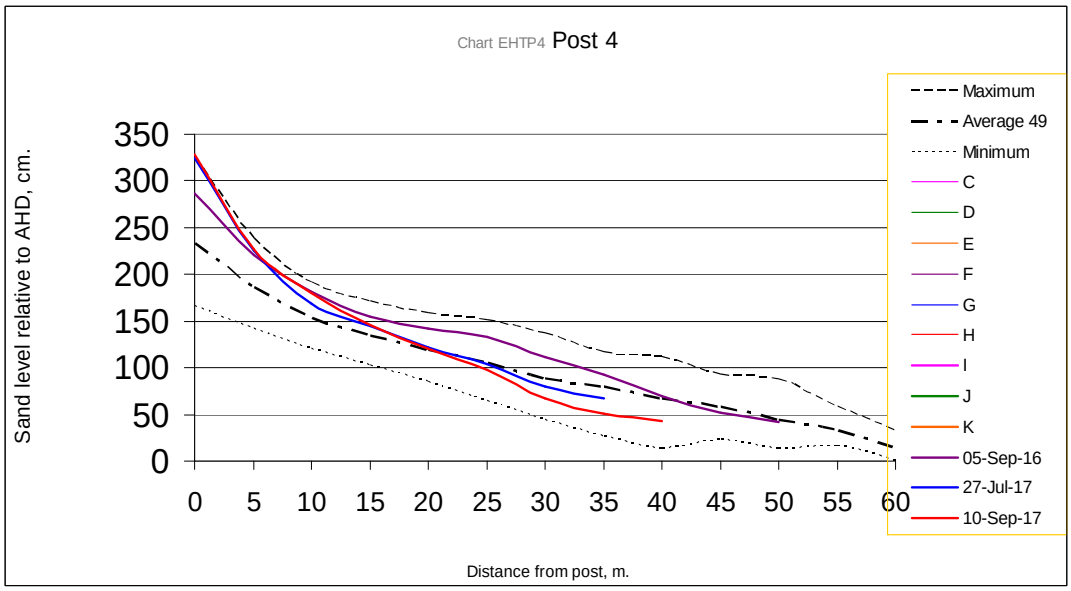
The long term monitoring of sand height at the posts provides data on the overall rate of accretion or decline of sand levels on the beach. High sand levels reduce the impact of wave surges on erosion of the dune face by its presence as a physical barrier and as an energy absorber when some of the sand is washed away.

Given the location of post 8 in a part of the beach subjected to higher wave activity, its non conformance with the adjacent posts is attributed to it being protected by the Wave Energy Dissipation structure. (WEDs page 13)

The Google image of the coast on page 4 confirms high wave activity in this area.

Post 4 shows a very high rate of accretion at the dune face. This additional sand is deposited by wind action and is centred at the post close to the dune face but at a distance of 10m in front of the post and beyond, sand levels resume normal beach height. This is evidence of wind blown sand and means a loss of sand from some other location.

A typical transverse profile of the beach from the dune face to water's edge




Transverse profiles are measured at thirteen locations around East Beach and three locations at South Beach. A beach profile shows the sand height from the post near the dune face to near the water's edge. All heights are referenced to the Australian Height Datum by way of the surveyed reference post where its height above the datum has been previously measured.

Profile charts are used to gauge how much of the beach is accessible with dry sand and by coastal engineers to assess sand volumes.

In order to provide the clearest representation of the beach condition, only three profiles are plotted on a chart; they are the last measurement, the previous measurement and a measurement from about one year ago. This gives an immediate assessment of the current change and how the situation is tracking compared to last year.

The current position in relation the average reading is also available. In the chart data for post 4, 50 readings have been made and the first 49 readings have been used to calculate simple statistics of minimum, average and maximum values of sand height. These statistical values are plotted with dotted lines and form an 'envelope of limits' within which normal beach values will plot. If a new reading plots beyond the envelope, it is readily detectable and can be investigated for a special cause event.

Wave Energy Dissipation structure halts dune recession


Parts of the coast in Port Fairy Bay have been measured to have an actual dune recession rate equivalent to 1 metre every year since this photograph was taken in January 1996.

Although many years after the tip was closed, the outline of the tip area was still visible and it shows just how close the dune face came to exposing buried waste.

The yellow line indicates the estimated position of dune recession just before the protective rock barrier was installed in front of the old tip site. We know this point very precisely because the car park was surfaced with a yellow road base material . This residual yellow material has been clearly visible just below the dune crest as it receded and the yellow road base ends up on the beach, providing the clues to how much of the dune has been removed since the photograph was taken.

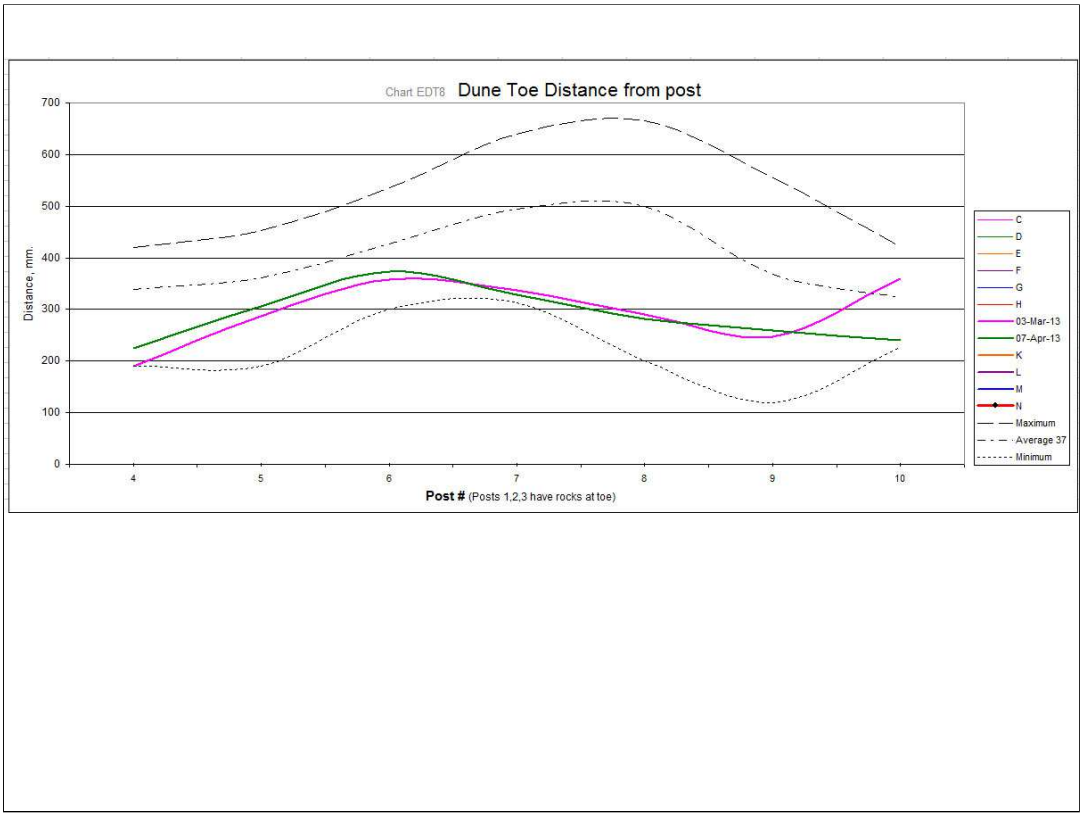

This was reference post 8 in front of the old tip site prior to the construction of the rock wall and is a typical scene for most of the East Beach reference posts.

**The process of dune recession**

Water erosion by wave action starts at the toe and undermines the dune face. Sand then slumps down the face to replace the sand washed away. Eventually, the crest of the dune is undermined to such an extent that the dune crest shears off and migrates down the dune face to be eventually washed away. The dune face slumps at an angle between 30 and 40 degrees to the horizontal depending on grain size and moisture content. Erosion of the dune face is also caused by wind action and dune recession can still occur albeit at a much lower rate than with water erosion.

In order to quantify dune recession, the distance of the dune toe from the reference post has been monitored. Dune toe distance monitoring is easily achieved with just a simple tape measure but it is not sufficient to evaluate just one or two readings.

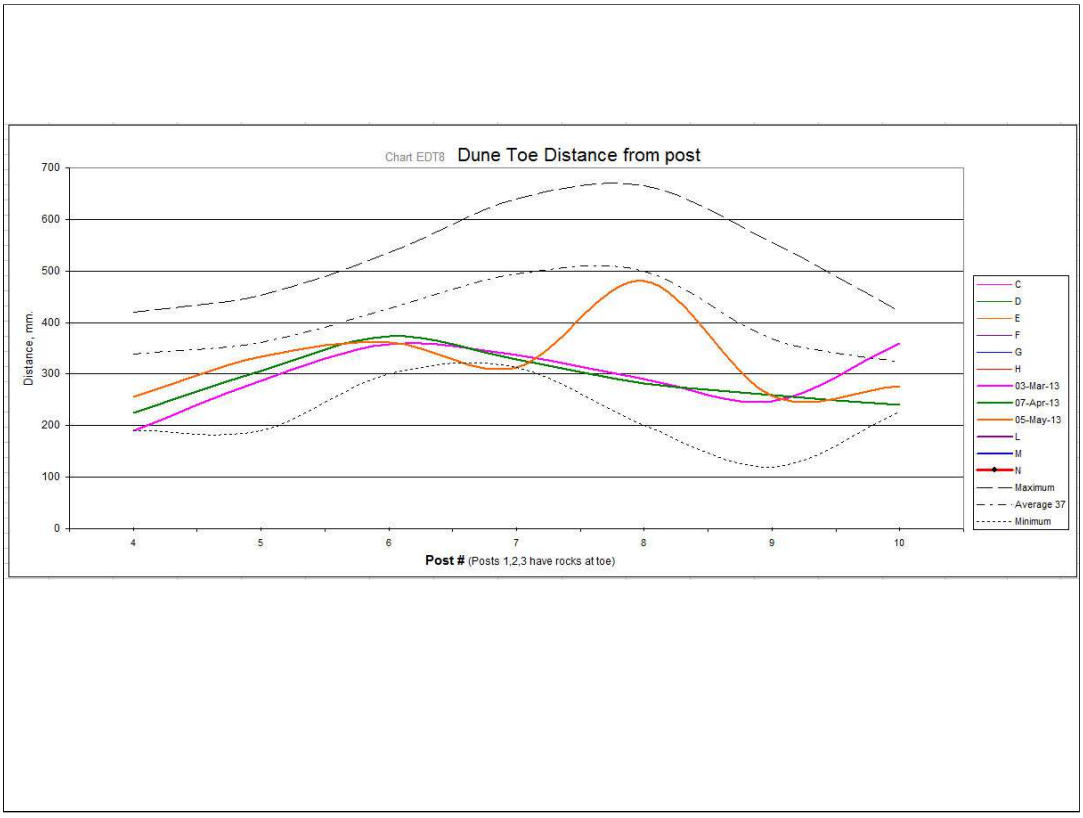
Many readings over time are needed to give a history and to be able to interpret changes detected in future measurements. This technique allowed the Coastal Group to find abnormally high dune toe recession that only occurred at post 8 during May and June of 2013. This discovery is considered a highlight of the Coastal Groups short history as it prevented major dune loss.




Measurements of the dune toe distance commenced in march 2013 and are shown above for those posts in front of a dune toe. A second measurement one month later confirmed stable toe distances except for post 10 where a slumping event caused a reduction in the toe distance.

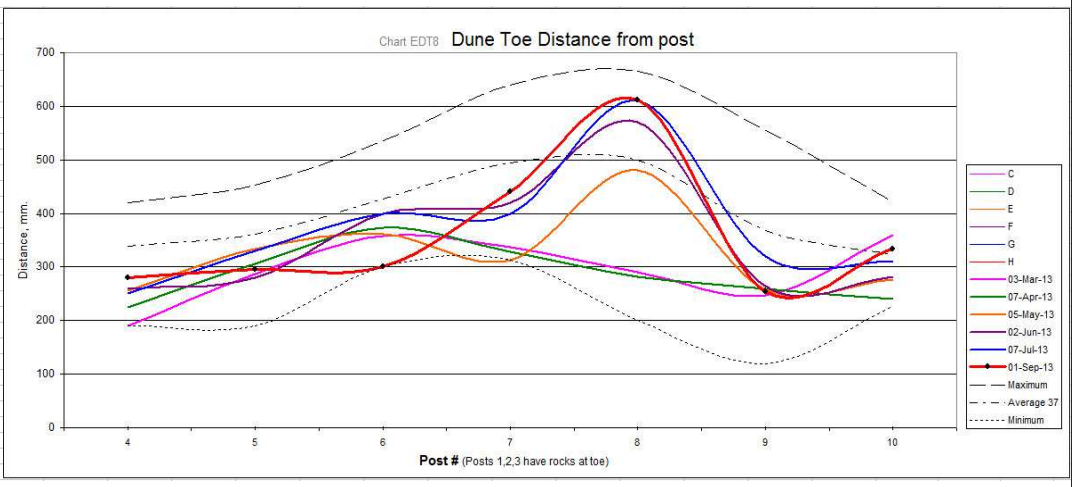
The dotted lines represent the extreme and average distances ever measured for dune toe distances.

Monthly toe measurements continued.




In May of 2013,the situation appeared to change dramatically when the toe distance at the former tip site (post 8) jumped by about 20cm. Monthly monitoring continued.

Water erosion concentrated around post 8 at the tip site.




Over the next three months of toe measurements, there was confirmation of intense water erosion concentrated around the tip site at post 8.

Up until now, public concern about erosion at the Night Soil site (Post 5) had dominated public interest in East Beach erosion.

This evidence refocused attention to the former tip site at post 8.

The Moyne Shire investigated the old tip site and confirmed there was significantly less sand available to contain the tip contents  This disturbing finding initiated the design and construction of the Wave Energy Dissipation structure to protect the dune face and prevent the contents of the tip from entering the beach.

## Wave Energy Dissipation structure May 2014

In response to the potential of a major dune breach, a special rock structure was designed and constructed to dissipate wave energy and protect the dune toe from further erosion.

The structure was completed a few weeks before the winter storm event in late June 2014.

Storm protection for the old tip site - WEDs ver.1

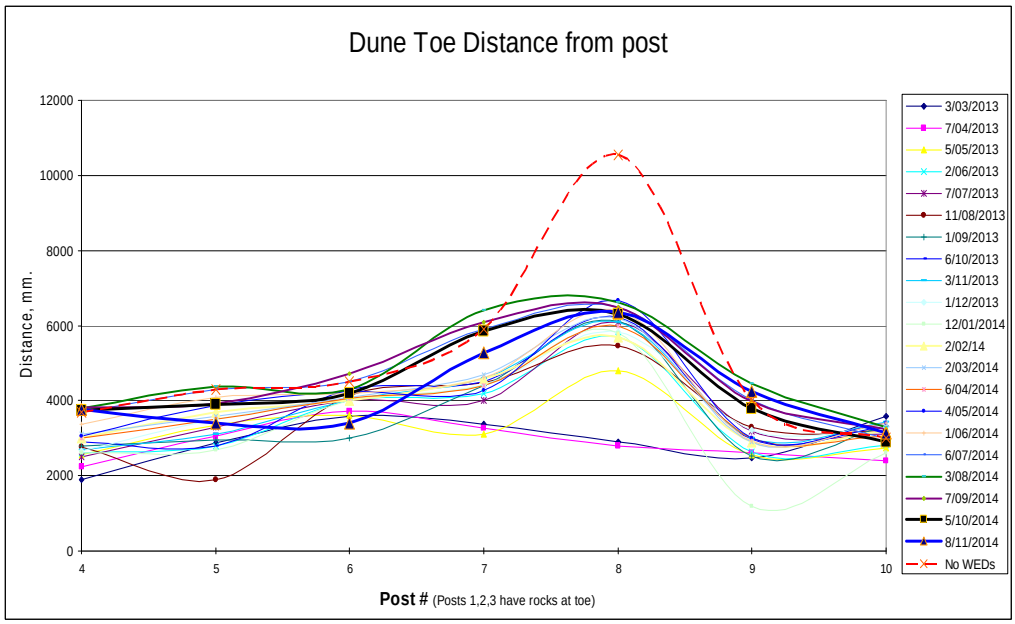

The Wave Energy Dissipation structure installed during May 2014 is positioned well in front of the dune toe to provide maximum protection from waves penetrating the rocks.

PFCG members conducted an initial measurement around the rocks and then incorporated the measurement systems into future beach monitoring tasks.

Monitoring of the WEDs requires a total of 56 measurements and is accomplished by two separate teams where the monitoring is split up into transverse and longitudinal measurements; the latter being independent of the tide status.

Since this picture was taken, the dune toe has moved closer to post 8 with a great deal of sand added to the dune face and then stabilized with Enviro matting and replanted with native vegetation to retard wind erosion. Replanting of the dune face was a school project organized by the Moyne Shire. Not only has the dune face developed strong vegetation but plants have also appeared in the sand between the toe and the rock wall.

## Prediction of Erosion without Rocks




By studying the historic relation between dune toe movements at posts 7, 8 and 9, it was possible to work out a correlation between changes in the dune toe distance at post 7 and dune toe changes at post 8.

Based on this correlation, the predicted sand loss at the post 8 dune toe could have been as large as 4m if the rock barrier had not been in place for the storm event in late July 2014.

It is estimated that a 4m dune recession would have been a serious breach and expose much of the tip contents to the beach.


Five months after the storm event, this high altitude photograph clearly shows the large area of dry sand behind the wall, indicating sand height has been maintained for most of its length and protecting the dune toe from further water erosion.

Also visible is the increased dune erosion at the ends of the wall which was expected. Design changes were incorporated and included an increase in length to protect more of the tip site and the addition of double sand trap fences (known as Wattle and Wire, page 18) to minimise wash out at the wall ends.

All data indicates the wall was a successful prevention strategy.

# Old tip site protection

Wave Energy Dissipation structure - 2017

Sand Height Profiling to measure effectiveness

Scale: One green arrow is 60m long


Rock wall extensions were completed in 2015 and included the double sand trap fences at each end. The sand fence has been very successful at minimizing erosion at the southern end but there is still activity visible at the northern end.

Assessment of the protection is monitored by measuring the sand height along the toe of the dune behind the rocks. Two additional posts (7.5 and 8.5) where installed by the Moyne Shire for this purpose and together with the existing post 8, allow sand height monitoring along 350m of protected dune toe.

A good quantity of dry sand is also visible behind the rocks in this Google image.

Reference points 7.4 and 8.6 are posts that are part of the sand trap fences and are used to measure dune recession in the wash out areas with a laser distance measuring device.

The double sand trap fences at work

The sand trap fence known as Wattle and Wire is a lot more technical than just a picket fence on steroids.

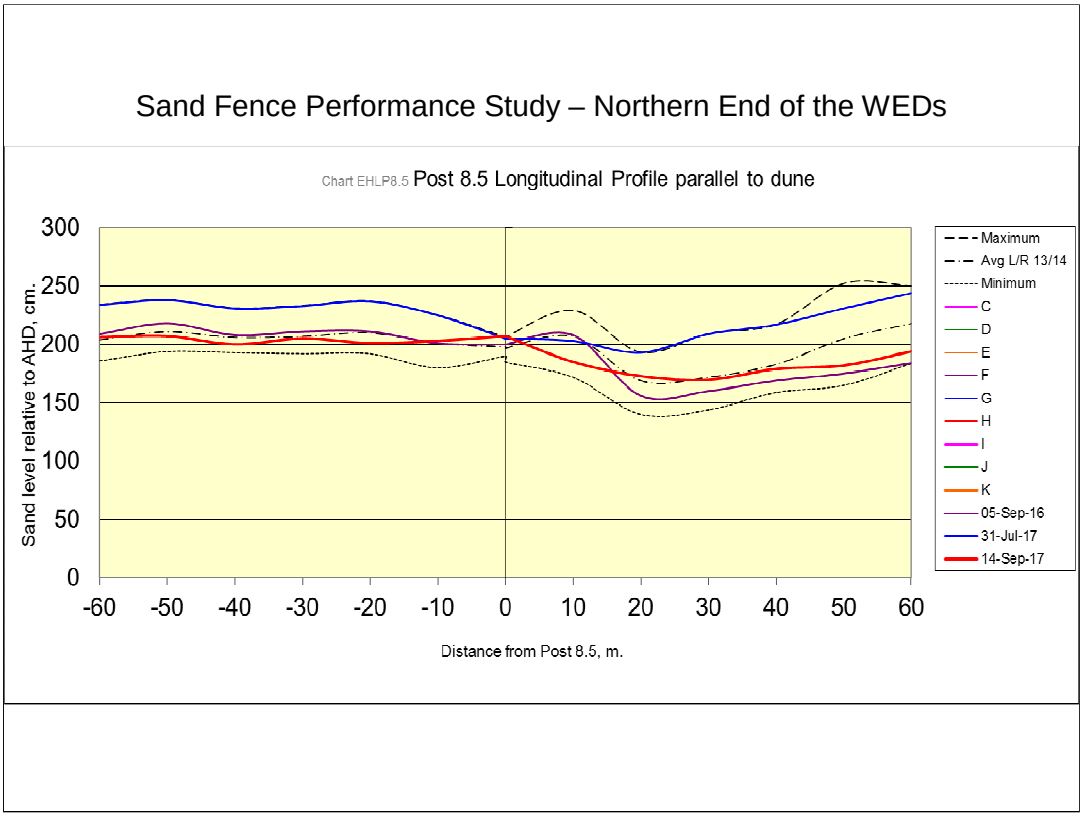
Its effectiveness in reducing the wave surge is evident in the above image (Courtesy of PHP Productions from the video Defend Port Fairy).

Wave height is reduced as it passes through each fence so that in a relatively short distance, a large wave is reduced to low energy foam with insufficient energy to damage the dune toe. However, for very large waves that over top both fences, some of wave energy will reach the dune toe.

Sand trap fences are also designed to provide wind protection and work well in dry sand due to the special shape of the timber “pickets”. Each picket is a flattened diamond shape which is oriented side on to the prevailing water/wind and generates turbulence as the fluid passes between the pickets, almost independently of the angle of approach.

When operated as a wind break, the Wattle and Wire fence is said to have a high protection ratio; that is for every metre of fence height, several metres of distance behind the fence will have an effective wind break.

The effectiveness of the sand fences on each end of the WEDs is monitored by the Coastal Group and reported in the Longitudinal Profiles for Posts 7.5 and 8.5. The following chart EHLP85 is an example of monitoring for the above fences.




A Wave Energy Dissipation structure usually causes concentrated dune toe erosion near its ends as wave fronts deflected by the face of the WEDs are displaced sideways and eventually accelerate around the end of the rock wall.

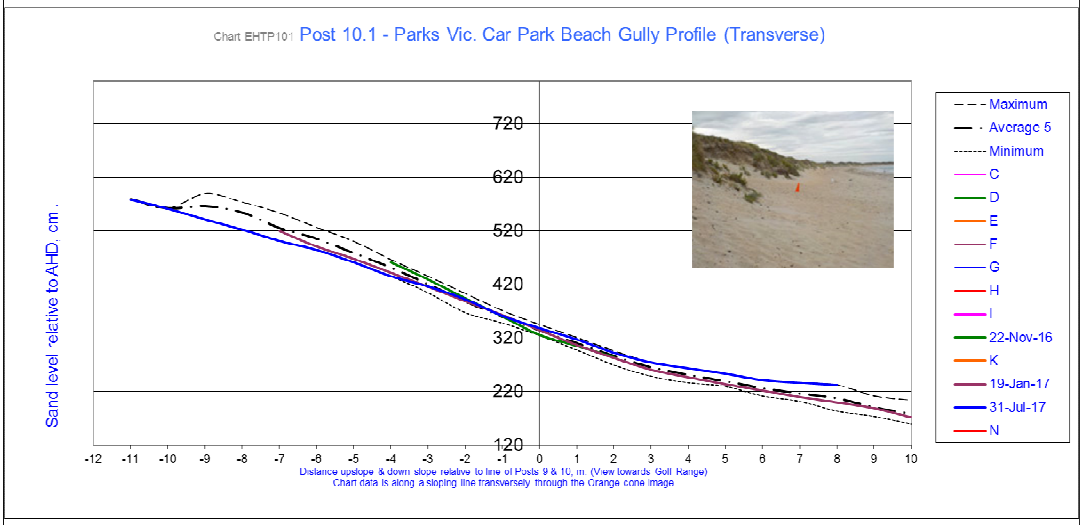
Sand monitoring from post 8.5 covers the northern end of the rock wall and the sand trap fences. There is more activity detectable at this end due to more aggressive wave action as can be seen in the earlier Google image of Port Fairy Bay, page 4.

In the above chart, the sand fences are approximately at the +40 to +60 metre position. The sand height from 12 months previous (purple graph) is about the lowest recorded and it extends behind the rock wall caused by the waves which flow around behind the wall. More recent measurements (The red and blue graphs) show that sand height has progressively returned. The lack of a sand peak in the recent graphs at the 10m distance are due to a new system of measurement adopted on 31/07/2017.

Previously, the 60m measurement to the right commenced at post 8.5 and followed rough ground whereas now it commences on flat sand mid way between post 8.5 and the rocks as shown on page 17.

The presence of the tip in a part of the dune that is most susceptible to water erosion is unfortunate but it has ensured the dune will be protected from recession when it otherwise may have been left to naturally erode.

# Parks Victoria Car Park Gully Monitoring

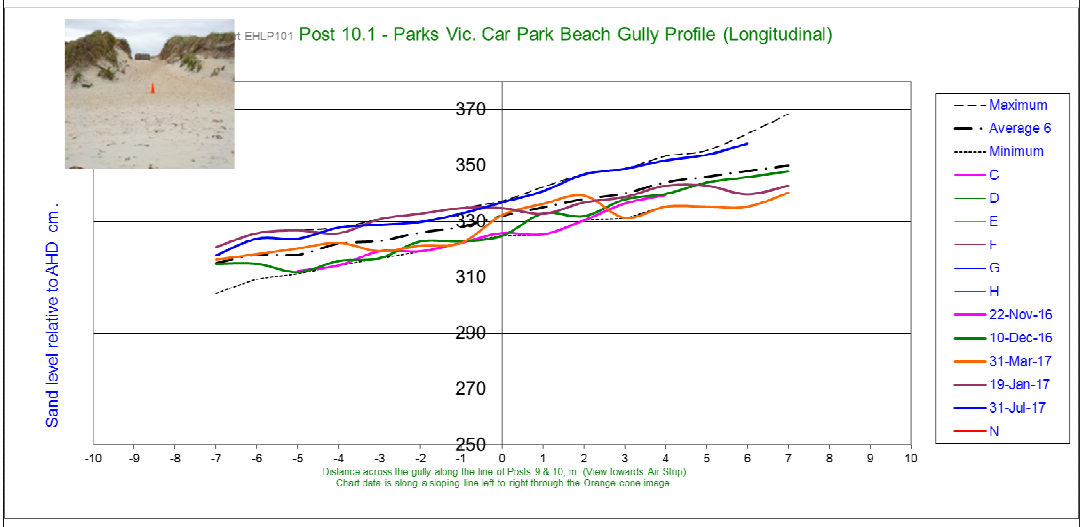



Almost any part of the beach can be selected for special purpose monitoring.

Special monitoring is conducted at the ‘gully’ access to the beach from the Parks Victoria car park adjacent to the Golf Links.

In this case, extensive use of the gully to access the beach by horses has been studied over recent months. Particular interest centres on the transverse profile which shows the level of sand down the gully slope.

# Parks Victoria Car Park Gully Monitoring




Longitudinal *(parallel to shoreline)* profile of special purpose monitoring at the car park gully. This shows the slope of sand in the gully from side to side at the extended reference point from posts 10 and 9.

Monitoring techniques are still being refined as measurement of sand height in the gully has unique difficulties. A major concern is the requirement to measure laser beam heights in excess of 4m above the beach.

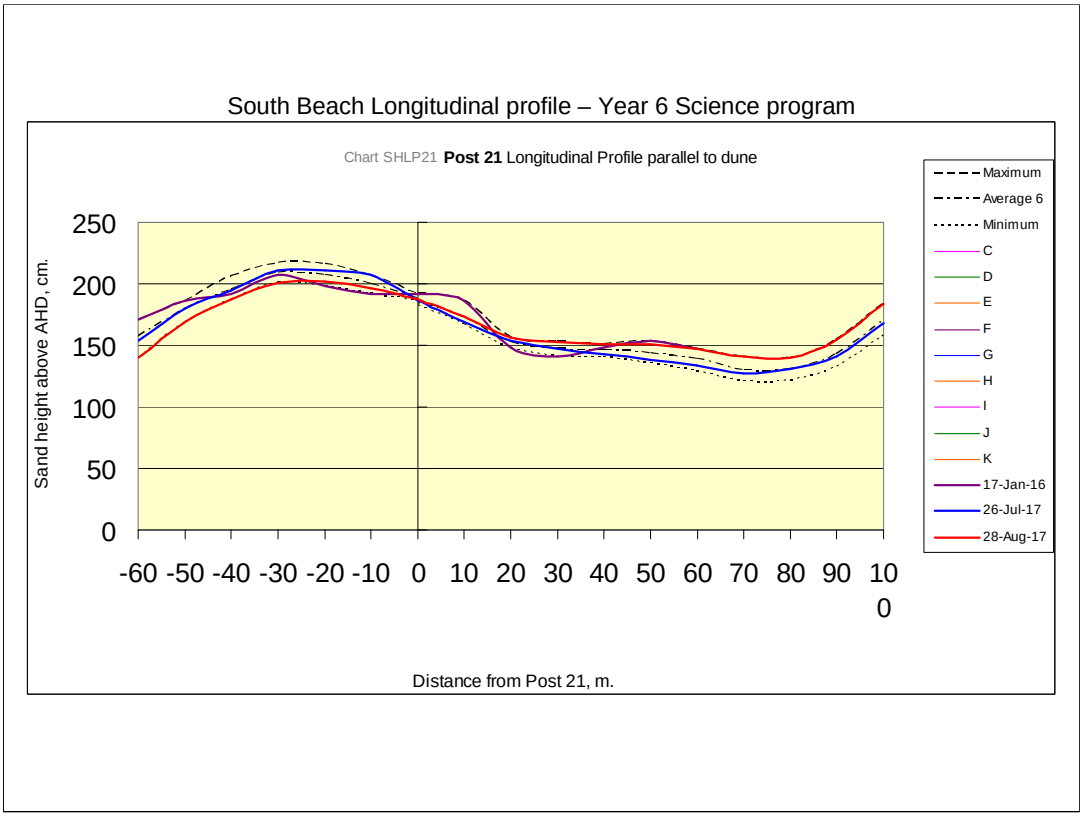
## South Beach monitoring

A year 6 science project for our two primary Schools


Posts 21, 22 and 23 are on the South coast beaches and are measured by students of Port Fairy's two Primary schools as part of their year 6 science programme sponsored by the Moyne Shire under the guidance of the Port Fairy Coastal Group.

Particular attention is given to the beach areas adjacent to rock wall protection between posts 21 and 22. Longitudinal profiles monitor sand height in front of the rocks and transverse profiles monitor sand height down to the water's edge.

In general, South beach monitoring shows the effectiveness of the natural off shore reefs in reducing the impact of normal wave action on beach erosion however, it is more susceptible to damage from storm surges due to the low flat area with houses in close proximity to the beach.

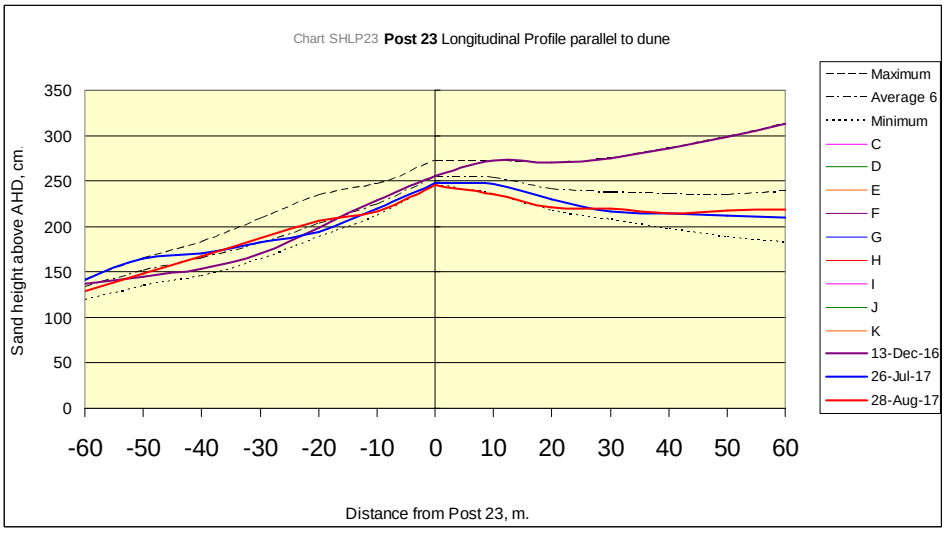



The available beach in this area is reduced by extensive outcrops of rock that also provide natural protection from water erosion.

While our data on South beach is not as comprehensive as East Beach, our measurements have shown these areas to be more stable than any part of East Beach but the potential for storm surge inundation still exists in the low lying areas of Ocean Drive.

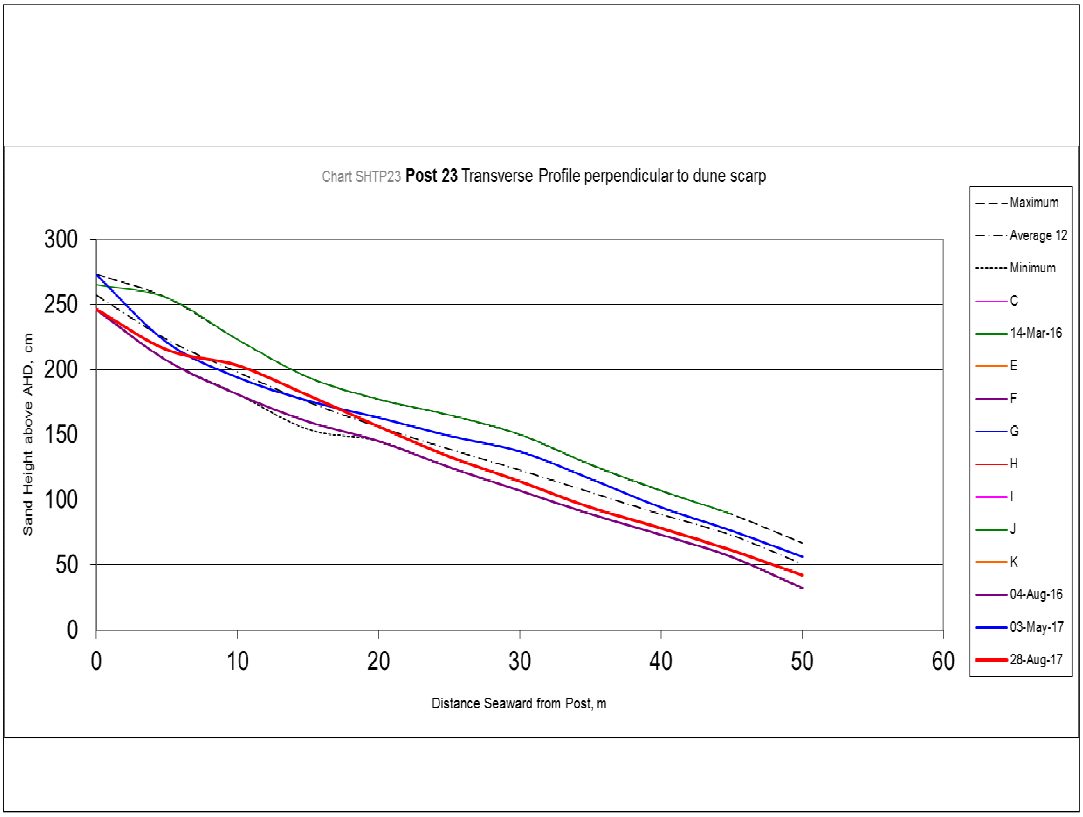
The right half of the profile chart plots sand height in front of a recently installed rock wall protecting the dune face. Regular measurements conducted by the year 6 students under the guidance of the Port Fairy Coastal Group give advanced warning of any changes in sand conditions.

South Beach Longitudinal profile – Year 6 Science program




Longitudinal profiles are height measurements parallel to the dune face and sensitive to water and wind erosion. This area (also known as the dog beach) has a large expanse of relatively flat sand and is very popular with locals and their dogs.

Data from the transverse profiles indicate this area is slightly more active in the foreshore area than other parts of the South coast that we monitor.




A Transverse *(from the post to water's edge)* profile for South Beach indicates a little more activity than at Pea Soup beaches, probably due to this beach being slightly more exposed as the rocks are further from the shore.

Measurements to a 50m distance from the post are common and reflect the large and relatively flat sand area that make the location so popular for dog walking.

Our work with beach monitoring and data collection is ongoing as we develop and refine systems to meet changing circumstances.

The Port Fairy Coastal Group continues to analyse the long term cyclic nature of sand movement around East Beach with the aim of predicting major storm events at our coast line.
This would enable more timely budget planning and deployment of coastal adaption strategies.

Accessibility of our beach data is being revised on a regular basis. Future proofing the access to our data is a big concern as computer software and hardware manufacturers continue to upgrade and launch new systems that are usually not backward compatible more than a few years.

In practical terms this means data in a spreadsheet today may not be able to be opened in 20 years time. For this reason we maintain archival quality paper records of the collected beach data that will eventually be stored by the Moyne Shire so that researcher's in hundreds of years time will be able to use our data.

Coastal Engineers tell us that in order to make a one in a hundred year storm prediction of useful certainty, you need three hundred years of history data. On that basis, we still have 296 years of data collection in front of us.

Further information and contacts for the PFCG about Beach Monitoring are available at the web site: www.pfcg.org.au

PFCG
October 2017.

*Editor's Note.*

*The purpose of this document is to provide an overview of the work carried out by the Port Fairy Coastal Group.*

*The charts in this document are taken from the PFCG spreadsheets that record all beach measurements and were current at the time this document was edited, so it may not reflect the current status of the beaches.*

*The group attempts to add new monitoring data monthly however, the timing is subject to sea conditions and availability of personnel and equipment.*