

## **Candidate D**

**To what extent are the current coastal defences at Swanage Bay the correct way to combat the threat of coastal erosion?**

## **Geography Investigation**

by

**To what extent are the current coastal defenses at Swanage Bay  
the correct way to combat the threat of coastal erosion?**

Candidate number: .....

Centre Number: .....

Date: .....

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# To what extent are the current coastal defenses at Swanage Bay the correct way to combat the threat of coastal erosion?

**Hypothesis (H1) (Alternate hypothesis):** The social opinion on the correct level of coastal management will disagree with the economic reasoning behind the various forms of coastal management used at Swanage Bay.

**Hypothesis (H0) (Null hypothesis):** The social opinion on the correct level of coastal management will agree with the economic reasoning behind the various forms of coastal management used at Swanage Bay.

**Sub question 1:** Is long shore drift occurring at Swanage Bay?

**Sub question 2:** What is the social opinion on the correct level of coastal management that should be used at Swanage Bay?

**Sub question 3:** What is the economic reasoning behind the correct level of coastal defenses at Swanage Bay?

**Sub question 4:** How do the different strategies vary throughout Swanage Bay?

Through my investigation at Swanage Bay, I aim to understand the different perspectives on coastal defense. Firstly, the economic perspective on coastal management at Swanage Bay; and secondly, the social perspective on coastal management at Swanage Bay. I will carry out a range of primary and secondary data collection methods to investigate this topic, these data methods will include qualitative and quantitative data to provide evidence to prove or disprove my hypotheses.

## Introduction

Swanage is located on the south coast of the UK as seen on Figure 1. Swanage has a population of 9,600 people. Over time Swanage has had a variety of different functions. Initially during the seventeenth century Swanage grew as a settlement due to the increase in demand for Purbeck stone. This was as a result of the Great Fire of London.

Alongside quarrying, Swanage was also a fishing settlement. The function of Swanage gradually changed after the year 1823 with the construction of a seafront road, followed by a railway station in 1843. This allowed faster and cheaper access to the seaside town, meaning it was no longer an exclusive destination for the rich. Consequently, Swanage was transformed from a quarrying and fishing settlement to a tourist destination. Due to Swanage's success in the tourism industry, it has become a precious location on the south coast of the UK.

Over time it became apparent that the coastline was slowly retreating, due to coastal erosion. In the 1800's construction of a small sea wall began and grew until it covered a large amount of Swanage Bay. Whilst the sea wall did provide vital defense for the cliffs, it reduced the beach area. Due to Swanage heavily relying on tourism, a beach was necessary, this led to the construction of timber groynes in 1925. These groynes have since been refurbished in 2005/6 at the same time as beach nourishment took place.



Figure 1: Map from: <https://earth.google.com>

Alongside the historical background to Swanage and its coastal defenses it is also important to look at the geological background to understand better the rationale for coastal management.

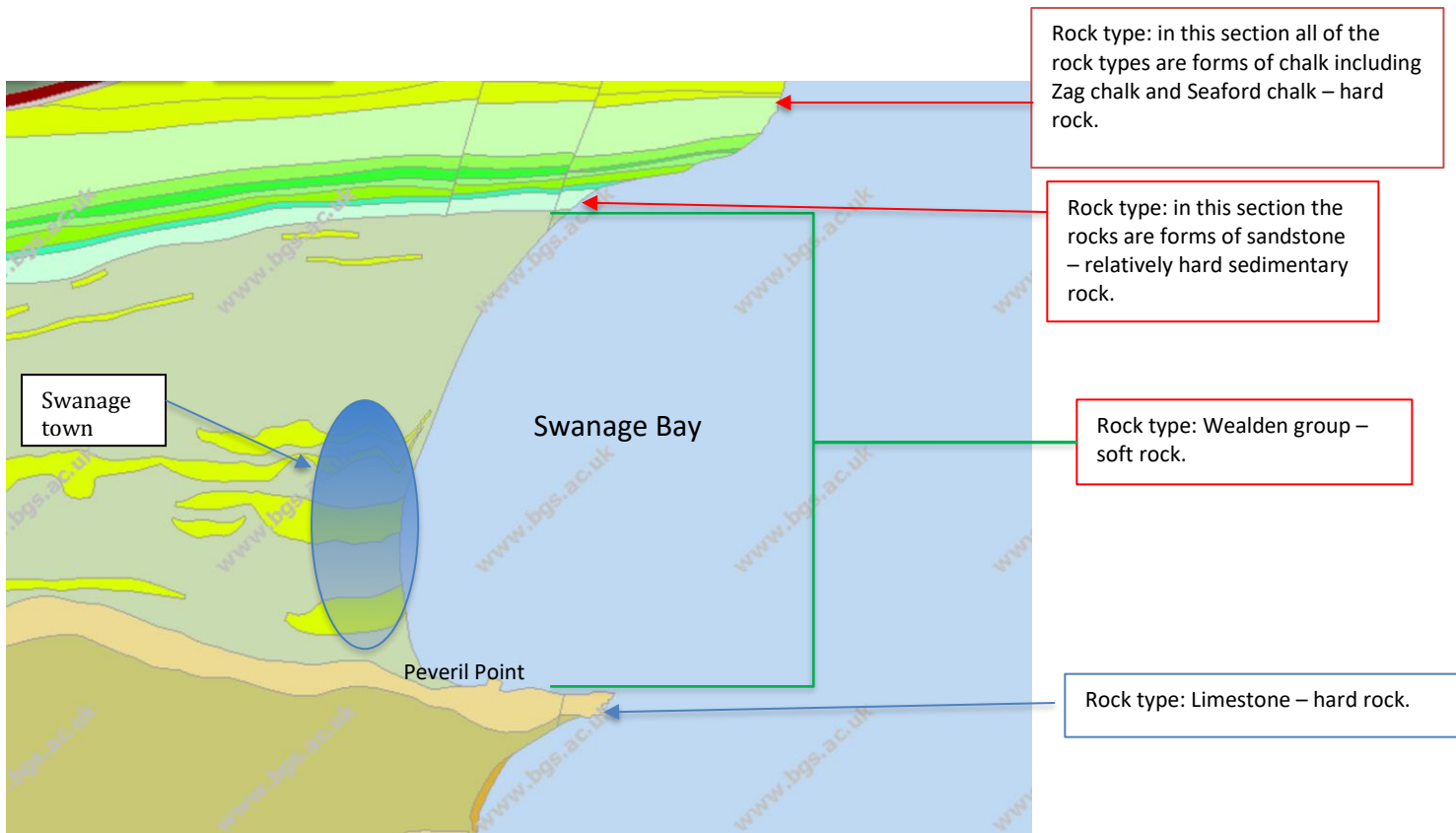


Figure 2: Peveril Point.  
Source: <http://mapapps.bgs.ac.uk/geologyofbritain/home.html?>

It can be seen in Figure 2 that there is a region of soft rock (Wealden group) between two areas of hard rock. As erosional processes have taken place a bay has been created due to the softer rock eroding at a faster rate than the hard rock. When referring to Figure 2 it can be seen that a lot of Swanage is located in this soft rock location and therefore coastal management has to be implemented to protect the town. Long shore drift seems to be taking place. This means that sediment in front of the cliff face is transported away causing the cliff face to be vulnerable to erosion. In my investigation, I plan to prove that long shore drift is taking place through data collection. Long shore drift occurs when a wave's wash strikes the beach at an angle picking up and moving sediment along the beach. The backwash moves sediment back down the beach, following gravity. This process deposits the material further along the beach.

Different strategies have been adopted in different areas of the coast. In the recent shoreline management plan, it has been decided that there will be different coastal management techniques. These three zones can be seen on Figure 3.

- In Zone 1 the policy option of 'no active intervention' is being used. "This is a policy decision not to invest in the provision or maintenance of any defences. Where there are no existing defences the shoreline will continue to evolve naturally." ([http://www.twobays.net/about\\_smp.htm](http://www.twobays.net/about_smp.htm)).
- In Zone 2 the policy option of hold the line with maximum approach has been put in place. This is where defences are maintained and upgraded or replaced in their current position where funding permits to a maximum level.

- In Zone 3 a hold the line minimum approach has been adopted. This is where defences are maintained and upgraded or replaced in their current position where funding permits to a minimum level and with minimum spending.

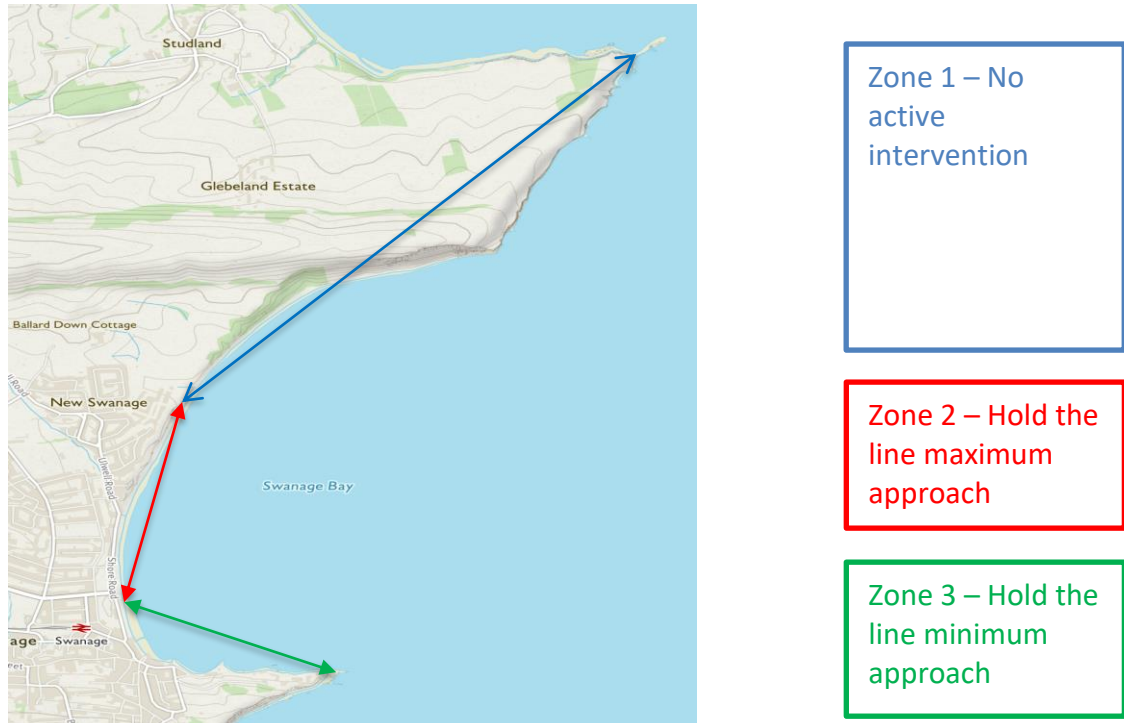


Figure 3: The Zonal Treatment of Swanage Bay  
 Source: <https://osmaps.ordnancesurvey.co.uk/50.62490,-1.93751,14>

## Methodology

I chose Swanage Bay as the location of my investigation site because it is a very clear example of a coastal town that requires coastal defense. There are also many of examples of coastal defenses throughout the bay. Swanage Bay has many different industrial activities such as farming, tourism, fishing and quarrying. Therefore, there is a wide variety of different stakeholders involved in the coastal management resulting in many different opinions on the matter. Swanage Bay is also a perfect case study because a wide range of coastal management strategies are used, such as, the hold the line maximum approach; the hold the line minimum approach; and the no active intervention approach.

For this investigation I have gathered many different forms of data including primary data and secondary data.

Swanage Bay is split into three zones when it comes to the strategy of coastal defense. The northern most zone (Zone 1) undertakes the strategy of no active intervention. This zone stretches from the last groyne to Old Harry, a local coastal erosion feature. Zone 2 stretches from the groynes to Swanage Pier. In this zone the strategy of hold the line with maximum intervention has been used. The final zone, Zone 3, extends from Swanage Pier to Peveril Point. The method of intervention here is holding the line with minimum effort. The three different zones, therefore, have a variety of different coastal management techniques. When collecting my primary data I grouped my results into the three different zones. The different zones can be seen in Figure 3.

## Primary data collection techniques

### Questionnaire

My first form of primary data that I collected was a questionnaire. This gave me a strong piece of qualitative data. I formed a questionnaire based on statements. I read out a statement and asked a number of members of the public to what extent they agreed with the statement on a scale of 1 to 5, with 5 being 'completely agree' and 1 being 'completely disagree'. Before doing the questionnaire, I asked the interviewee if they minded taking part and also explained the different strategies of coastal defense in each zone and the chosen method of intervention e.g. 'no active intervention in Zone 1'.

I walked from one end of the beach to the other and asked every person that I saw until I had filled out 12 questionnaires for each zone. All of the questionnaires were asked on the beach or on the walking path that runs alongside the beach. Below is a copy of three completed questionnaires for each zone (Figure 4).

*not a local  
no problem*

1. Are you a local here?

On a scale of 1-5 how much do you agree with the following statements (5 = completely agree)

- 1 2. The method of intervention is at the correct level for this region?
- 2 3. This method of intervention is sustainable
- 3 4. No changes should be made to the level of intervention
- 4 5. The cost of erosion outweighs the cost of the coastal defences/ maintenance
- 5 6. Holding the line with maximum intervention is better in this region than a do nothing approach

Questionnaire results									
	Hold line max			Hold line min			No active intervention		
	Person 1	Person 2	Person 3	Person 1	Person 2	Person 3	Person 1	Person 2	Person 3
1	5	5	5	5	5	5	5	4	5
2	4	5	2	5	3	4	5	5	5
3	3	5	2	5	2	5	5	4	5
4	5	5	5	5	4	3	5	3	5
5	5	5	4	5	3	4	2	3	1
6	<i>needed due to house price</i>								
	<i>not sustainable eventually nature will win</i>								

Figure 4: Completed Questionnaire

Below the answer table I have written interesting quotations from the people that undertook the questionnaire.

The sampling type I used was a systematic sampling technique due to the fact that I asked every person that I walked past when walking from the north of the Bay to the south. The data I collected was qualitative data. The questionnaire helps me research my investigation title because it allows me to understand better the social opinion of the management strategies used in their different locations.

Below my table of questionnaire answers I noted down any interesting remarks that the person in question said. I decided to do this because I found that often, after completing the questionnaire, I would end up having a conversation about the area with the person.

Although I viewed the questionnaire as a successful piece of data collection there were some issues:

- Firstly some of the people that I asked were not prepared to be interviewed. These tended to be younger people and therefore my data may be slightly biased towards the opinion of the older generation;
- Secondly, I also came across some foreign people who could not understand English well enough to properly fill out the questionnaire; and
- Thirdly, when filling out the questionnaire with some people, other members of the public walked past meaning that I missed some opportunities for questionnaires to be completed.

I carried out a number of simple and quick data collection processes, this was purely to gather a small amount of information about Swanage Bay so that I could better understand the area and get to know the economic value of the region, for example, the estimated property count.

#### *Estimated property count*

I decided to count the number of properties in a close proximity (100 meters) to the beach so that I could get a general idea of the value of property at risk from the process of coastal erosion, alongside gathering some numerical data to add to my investigation. The sampling type for this data collection was "Pragmatic". I collected this data from walking from the north of each of the three zones to the south and counting all of the properties. I only counted the properties approximately 100 meters back from the beach (where the beach meets the cliff face/sea wall) as this is where the real estate is most at risk.

I decided to count beach huts as properties once I was informed that some of the beach huts were of significant value. An average hut in Swanage Bay has a value of around £50,000, and in some cases this price tag was significantly exceeded.

Due to time constrictions, I decided to count the properties to the nearest 50 due to the timescale involved. I also estimated the 100 meter distance from the end of the beach. Despite these numerical estimates, I still remain confident that my counting was as close to accurate as possible given the time constraints. One issue that I did come across was the obstructed view either by the cliff or other properties. This meant that it was a lot harder to collect the data.

#### *Sighting the different strategies of coastal management in the different locations*

This primary data collection involved once again walking along the three zones from north to south and noting down the different forms of coastal management at each zone. Although this method of data collection may seem simple the main flaw in the collection is the coastal defenses that cannot always be seen. For example, Swanage Bay undertook beach nourishment in the years 2005/6. This form of coastal management is hard to spot and therefore could easily be missed when recording data in this way.



### *Counting the number of people in each of the three zones*

In order to understand better the use of the beach at Swanage Bay I decided to carry out a person count at each of the three zones at three different times of the day. This gave me some numerical data, which can help to determine some of the economic and social reasoning behind the coastal defenses. The method behind this count is very simple. I walked from the north of the bay to the south counting all of the people on the beach. Despite this data coming across as simple to collect I did encounter some difficulties. For example, some people came on to the beach just after I had walked past them and so it was difficult to determine if I should count them. I overcame this problem by counting to the nearest ten. I undertook the count three times during the day: at 9:30am, at midday, and in the afternoon, at 3:00pm.

### *The apple throw*

As previously mentioned, one of the main erosion processes acting at Swanage Bay is the process of long shore drift. I decided that it would be wise to collect some data to prove that this process was occurring. I decided to throw an object into the sea and measure the time and direction it traveled in five minutes. The object that I decided to use was an apple. I used an apple because if I could not retrieve the apple it is still biodegradable and therefore better for the environment than other objects such as a tennis ball.

I started by throwing the apple into the sea and attempting to throw it approximately 15 meters offshore. I would then start the timer and place a ranging pole into the ground in line with where the apple had landed. After five minutes, I placed a second ranging pole into the ground in the location of the apple and measured the distance the apple had traveled using a tape measure. I then repeated this three times to exclude any anomalies and recorded the results in a table (Figure 9).

I did encounter some issues when collecting this data. The main issue was seagulls. Often, once the apple was thrown, seagulls would come and pick up the apple and fly away with it. This meant that the experiment had to be redone. The second problem encountered was in Zone 1 the apple was washed up, causing a halt in the movement in the apple and so this also had to be repeated. Finally, in some cases we lost sight of the apple and therefore we had to repeat the experiment because we couldn't measure the distance traveled. Because of the time taken to carry out this data collection, the measurements were recorded at different times of the day. Therefore, wind speed may have changed causing the effect of long shore drift to be different, thus making the results less accurate.

### *Photography*

Throughout my time at Swanage Bay I also took photos that could help support my investigation. For example taking a photo of the tourist services to show the economic value of the land. However, this may cause slight bias, as I was unable to take photos of every aspect of Swanage Bay.



Figure 5: Measuring the gradient of the beach

## Secondary data collection techniques

### *Shoreline Management Plan for Swanage Bay*

I will be using the Swanage Bay Shoreline Management Plan, produced by the local council, as a piece of my secondary data. It can be found on the website: <http://www.twobays.net/smp2.htm> under the section "Policy Development Zone 4". This source will give me useful information on the different strategies used at Swanage Bay, since it shows a complete cost/benefit analysis of the defences and therefore their economic viability.

All of this will be useful for my geographical investigation as it takes many of the economic variables into consideration, but one has to bear in mind potential bias in its production to the extent that it might tend towards supporting whatever work the local council has undertaken. Despite this a lot of the data is statistical data and therefore not opinion based.

### *Zoopla house prices*

The website [www.zoopla.co.uk](http://www.zoopla.co.uk) allows me to see the approximate house prices of the real estate in the area of Swanage Bay. Understanding the house prices of the area will allow me to understand better the economic value of the region. This source is not biased as it states statistical information about the area and Zoopla does not have any stake holding in coastal management at Swanage Bay. Despite the benefits of Zoopla, it does not show an economic value for services in the area such as the tourism industry and also the house prices might be out of date. In addition to this, Zoopla does not show social statistics. However, my questionnaire will provide this information.

## Data Presentation and Analysis

### *Primary data collection analysis*

*Chi squared statistical test for my questionnaire*

Hypothesis H1, Alternative Hypothesis:

There will be significant difference between the number of people agreeing/disagreeing with the Hold The Line Maximum Intervention versus the Hold The Line Minimum Intervention approaches.

Hypothesis H0 Null Hypothesis

There will be **no** significant difference between the number of people agreeing/disagreeing with the Hold The Line Maximum Intervention versus the Hold The Line Minimum Intervention approaches.

A chi squared test is a test that compares two variables within data to determine if they are related. The smaller the chi statistic result, the greater the correlation.

The traditional chi squared formula is:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

*O = the frequencies observed*

*E = the frequencies expected*

*∑ = the 'sum of'*

I have adapted it slightly for the circumstances so that the formula that I have used is:

$$X^2_c = \sum (O - E)^2 / E$$

Where:

c = degrees of freedom

O = observed value

E = expected value

95% = 3.84 – if higher than this = significant

Expected = (row total x column total) ÷ grand total

I have used a contingency table to calculate table to calculate my chi squared. This allows me to summarise the relationship between multiple category variables. This is a type of frequency distribution table where two variables are shown together.

	Hold the line maximum intervention	Hold the line min intervention
Agree (2 decimal places)	$(19 \times 11) \div 23 = 9.09$ (2dp)	$(19 \times 12) \div 23 = 9.91$ (2dp)
Disagree (2 decimal places)	$(4 \times 11) \div 23 = 1.91$ (2dp)	$(4 \times 12) \div 23 = 2.09$ (2dp)

**Scale:**

Agree = above 3 on questionnaire

Disagree = below 3 on questionnaire

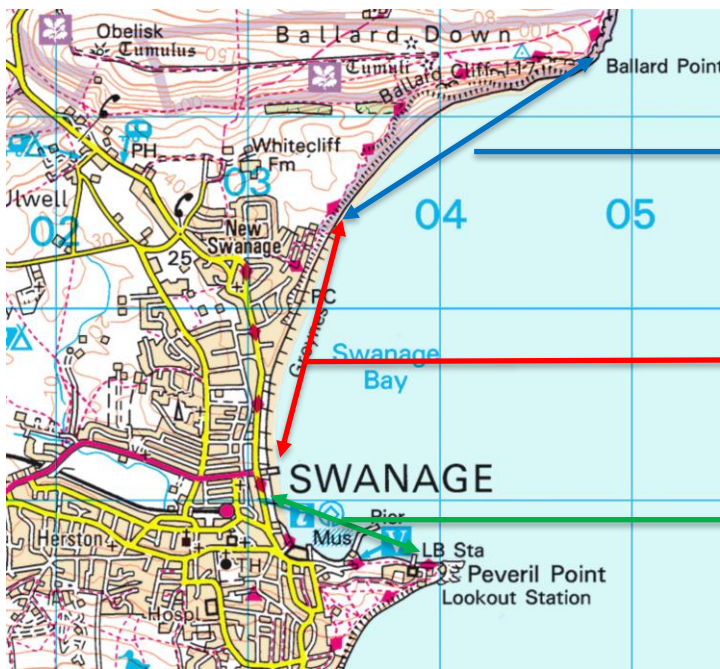
Figure 6

	O	E	O-E	(O-E) <sup>2</sup>	(O-E) <sup>2</sup> ÷ E
Agree, max Intervention	9	9.1	-0.1	0.01	0.001
Agree, no active Intervention	10	9.9	0.1	0.01	0.001
Disagree, max Intervention	2	1.9	0.1	0.01	0.005
Disagree, no Active intervention	2	2.0	0	0	0

Sum = 0.007 = no significant difference. This supports my H0 (Null Hypothesis) hypothesis “There will be **no** significant difference between the number of people agreeing/disagreeing with the Hold The Line Maximum Intervention versus the Hold The Line Minimum Intervention approaches”.

This statistical test supporting my null hypothesis surprised me as I would’ve thought that the majority of people would want a hold the line maximum approach throughout Swanage bay, thus disagreeing with the current coastal management strategy in place.

*Sighting the different coastal management strategies used in the three zones*



**Zone 1** - no active intervention. When assessing the site first hand I did not notice any coastal management other than a small platform/sea wall towards the Southern end of the Zone. Beach nourishment sediment may have made its way into this zone from further south on the beach.

**Zone 2** – hold the line maximum. Here I noticed evenly spaced groynes throughout the zone as well as a small sea wall/platform. Upon talking to a member of staff at my place of residence I was informed that beach nourishment has taken place in the past (2005/2006).

**Zone 3** – hold the line minimum intervention. Here the sea wall/platform continues to run along until it meets stone walling which continues on and off along the headland.

Figure 7: treatment of different zones

<http://osmaps.ordnancesurvey.co.uk>

Through sighting the different coastal management strategies used at each zone, I am able to see clear variations in levels of defense between each of the three zones and the different approaches that the council has adopted to deal with the threat of coastal erosion, such as no active intervention versus maximum intervention.

Counting the number of people in each of the three zones

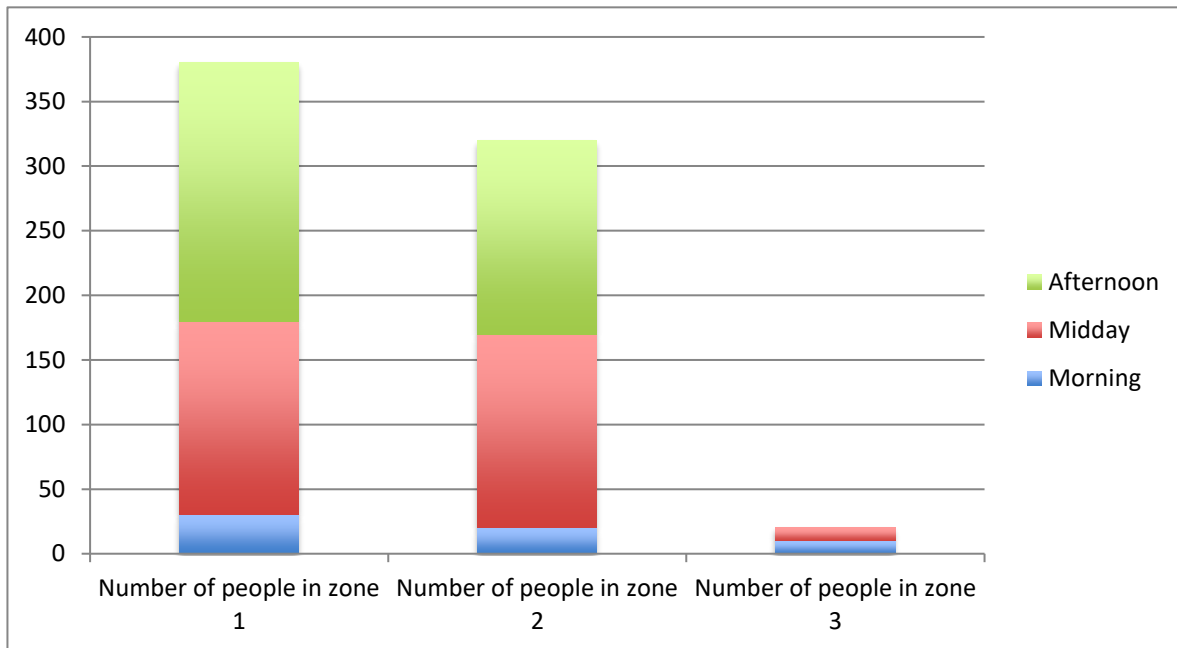
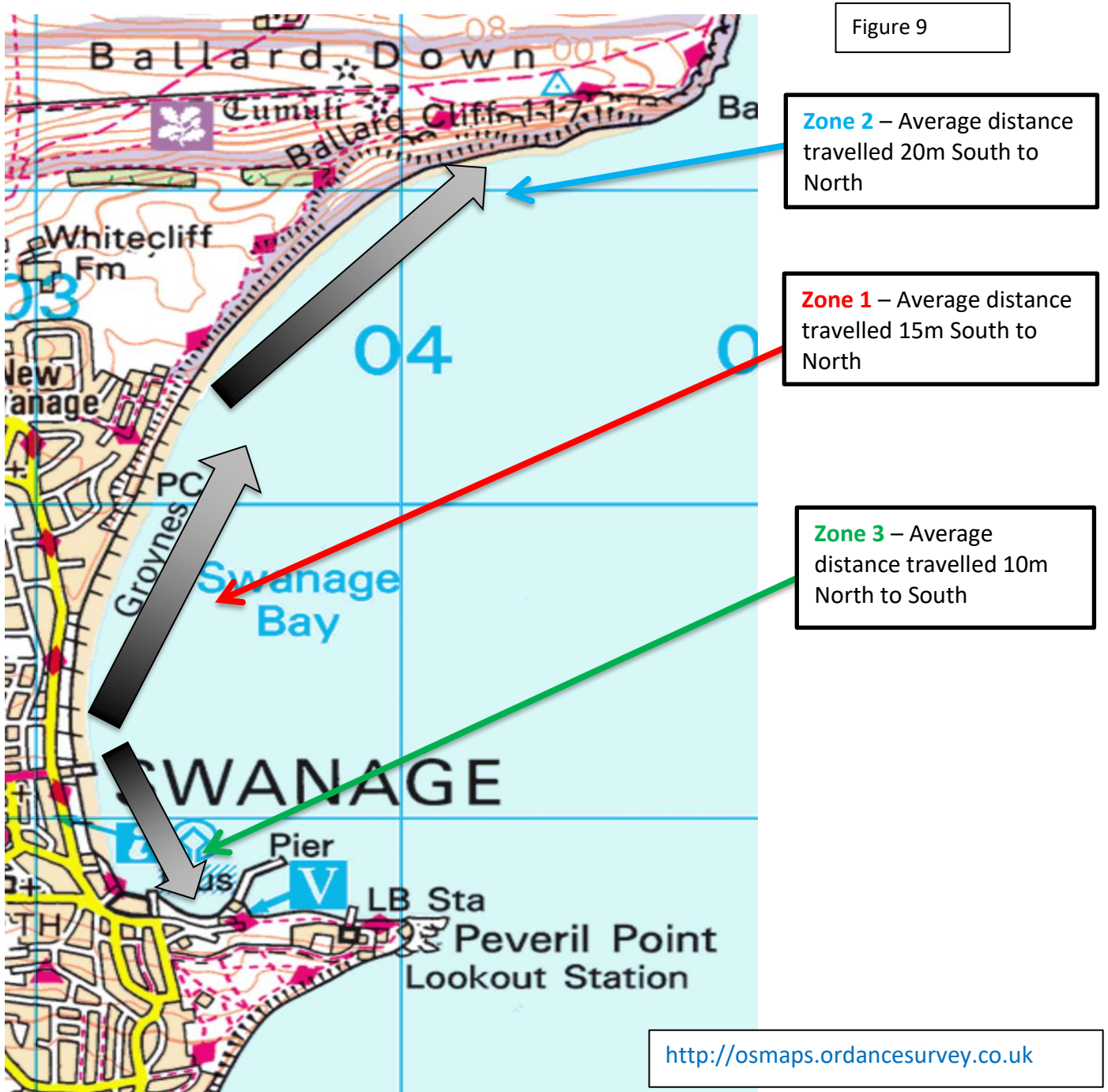


Figure 8: People in each zone by time of day

The smaller number of people in Zone 3 might in itself explain the selected approach of No Active Intervention, since fewer people implies less use of the site and therefore less socio/economic value and therefore less need for intervention.

The Apple Throw

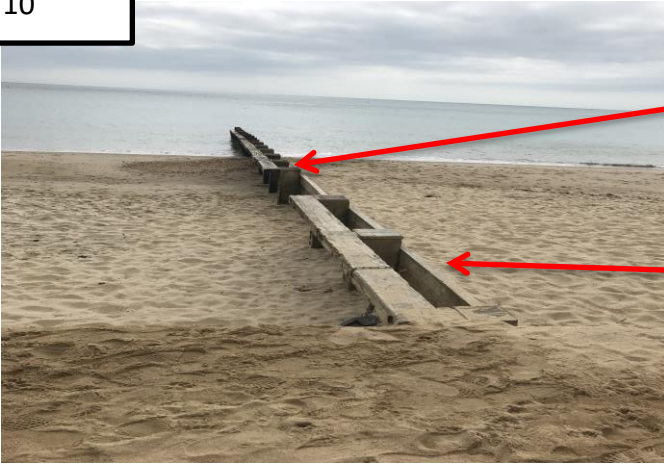
The map and table below shows the results of the apple throwing data collection technique:



Location	Distance travelled by apple in 5 minutes (m)			Average distance travelled (m)	How far apple thrown into sea (m)	Direction of apple movement
Zone 1 - No active intervention	54.3	55.5	60	56.6	15	South -> North
Zone 2 - Hold the line maximum approach	23.1 (seagull)	30	35	32.5	20	South -> North
Zone 3 - Hold the line minimum approach	11.7	12	11.5	11.73	10	North -> South

Photography

Figure 10



Groyne

Sand on this south side of the groyne showing that long shore drift is taking place in a northerly direction

Figure 11



Properties at the top of the cliff face showing high economic value of the area

Cliff that could be at risk of erosion if the beach was not situated in front of it

Beach huts showing economic value at the base of the cliff some beach huts in this region can be worth over £50,000

Groyne

Figure 12



Property near the coastline showing high economic value of the area

An arcade located close to the seafront is an example of the tourist industry within the areas, highlighting that this is an economically active region

Tourist

A road, there is pre-existing infrastructure in Swanage Bay which could be costly to rebuild if too much coastal erosion takes place



Figure 13



A seagull moving an apple that was being used in the experiment measuring long shore drift, causing an anomalous result

Figure 14



A newly built complex with a restaurant on the ground floor

The sea wall

Figure 15



In this area there are a lot of houses increasing the value of the area. This may contribute to the need for a sea wall currently in place

A small beach as a result of the sea wall gradually turning into no beach further along the coastline

A ranging pole

Figure 16

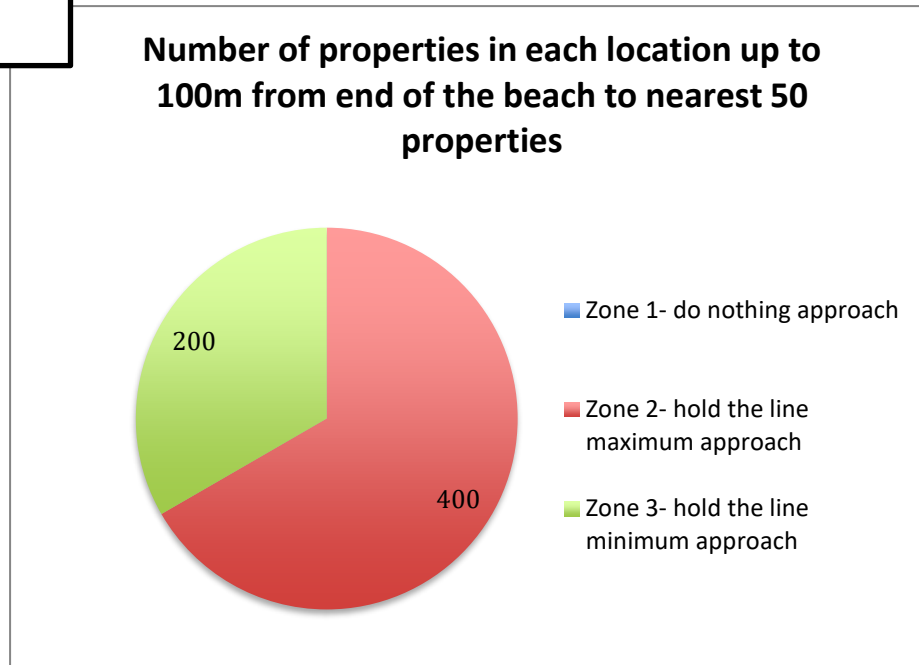


A surf school, showing economic activity at Swanage Bay

### Estimated property count

From my estimated property count, I counted the number of properties in each of the three zones, and I was able to get an idea of economic value within the three zones in terms of housing.

Figure 17



In Zone 1 there were no houses that I could see. This was due to the fact that the area is mainly farmland. Zone 2 and Zone 3 both had many properties (figure 17).

### Comments received when doing the questionnaire

Often when doing the questionnaires I would end up having a conversation with the subjects about the coastal management. During these conversations I decided to record some comments. Below are some of the comments that I recorded, being those that are more controversial. These are from different people, noted down across the three zones, therefore bias is reduced.

*“The level of defense here is needed due to the house prices” – Zone 2*

– Here it can be seen that people’s opinion on the correct level of coastal management is taking into account the economic reasoning behind the level of coastal management in place.

*“Not sustainable eventually nature will win” – Zone 2*

- An example of someone understanding that a hold the line maximum approach is not always sustainable.

*“I like to see nature in action that’s why I like the lack of defense” – Zone 1*

- An alternative reasoning for the lack of coastal defenses in Zone 1.

*“Since the defenses the beach has completely changed from a pebble beach to a sand beach” – Zone 2*

- Recognition of the effects that implementing coastal management can have on the environment.

*“Nature will always take its own course” - Zone 2*

- Another example of someone understanding that a hold the line maximum approach is not always sustainable.

*“Leave the coast to do its own thing as it is all a natural cycle” – Zone 1*

- An example of social opinion being against the coastal management.

*“We wouldn’t want to lose everything here if the management wasn’t here” – Zone 3*

- Example of the appreciation of the possible loss at stake if coastal management is not in place.

From the comments that I noted down when completing the questionnaire, it is clear to see a support of my null hypothesis. The social opinion on the correct level of coastal management throughout Swanage Bay is often agreeing with the economic reasoning behind the coastal management at Swanage Bay. This was also seen in my Chi squared results.

*Sighting different strategies used in the three different zones in Swanage Bay*

I collected this data by noting down what management strategies I saw in Swanage Bay. However, I had also been told that beach nourishment had taken place, therefore I noted that down despite not being able to see the nourishment.

<b>Location (zone)</b>	<b>Different strategies of coastal management used in this area</b>
Zone 1 (Do nothing approach)	Groynes, sea wall, beach nourishment
Zone 2 (Hold line maximum approach)	Sea wall, headland protects area
Zone 3 (Hold line minimum approach)	Nothing, small beach will protect cliff to some extent

**Figure 18**

## Secondary data presentation and analysis

### *Shoreline Management Plan*

My secondary data outlines that the defenses currently in place, as outlined by the shoreline management plan, are cost effective. This is because the value of the 'domestic' properties outweigh the expenses of the coastal management. The groynes that have been put in place throughout Swanage Bay cost £2.2m according to the research center I visited at Swanage. Whilst this is a large sum of money, it would protect 144 properties with the value of £36,062,000 (figure 20) as well as a flourishing tourist industry which is home to restaurants, bars, surf schools and an arcade. Furthermore, this estimated value of property does not include the costs associated with destruction to local businesses, to families and the local economy as a result of coastal erosion e.g. Sea Breeze Fish and Chips, Ocean Bay water sports and the Cabin.

The economic assessment by the Two Bays website shows that the pursuit of no active intervention would not just affect the property closest to the coast in Swanage town center but also many businesses. According to Figure 20, if the method of no active intervention was pursued, within 20-50 years there would be a domestic loss of £7,012,000 to 28 properties in New Swanage, Town Centre and Peveril Point north.

The shoreline management plan perfectly justifies the current strategy in place. After taking the data from the shoreline management plan into account I would propose that the holding the line approach would be the sufficient level of coastal management in the Zones 2 and 3. I would use a hold the line maximum approach purely due to the economic value of the land in both the zones. Even though Zone 3 is a more erosion resistant rock type I would still recommend a hold the line maximum approach compared to the hold the line minimum approach that is currently in place. This is because the economic value that could be lost is still high. In addition to this, the cost of coastal defenses to maintain a hold the line maximum approach in Zone 3 will still be less than that of Zone 2 due to the rock type.

[The shoreline management plan from [www.twobays.net](http://www.twobays.net) provides a clear economic rationale for the coastal defenses at Swanage Bay.]

**Table 1. Economic Assessment**

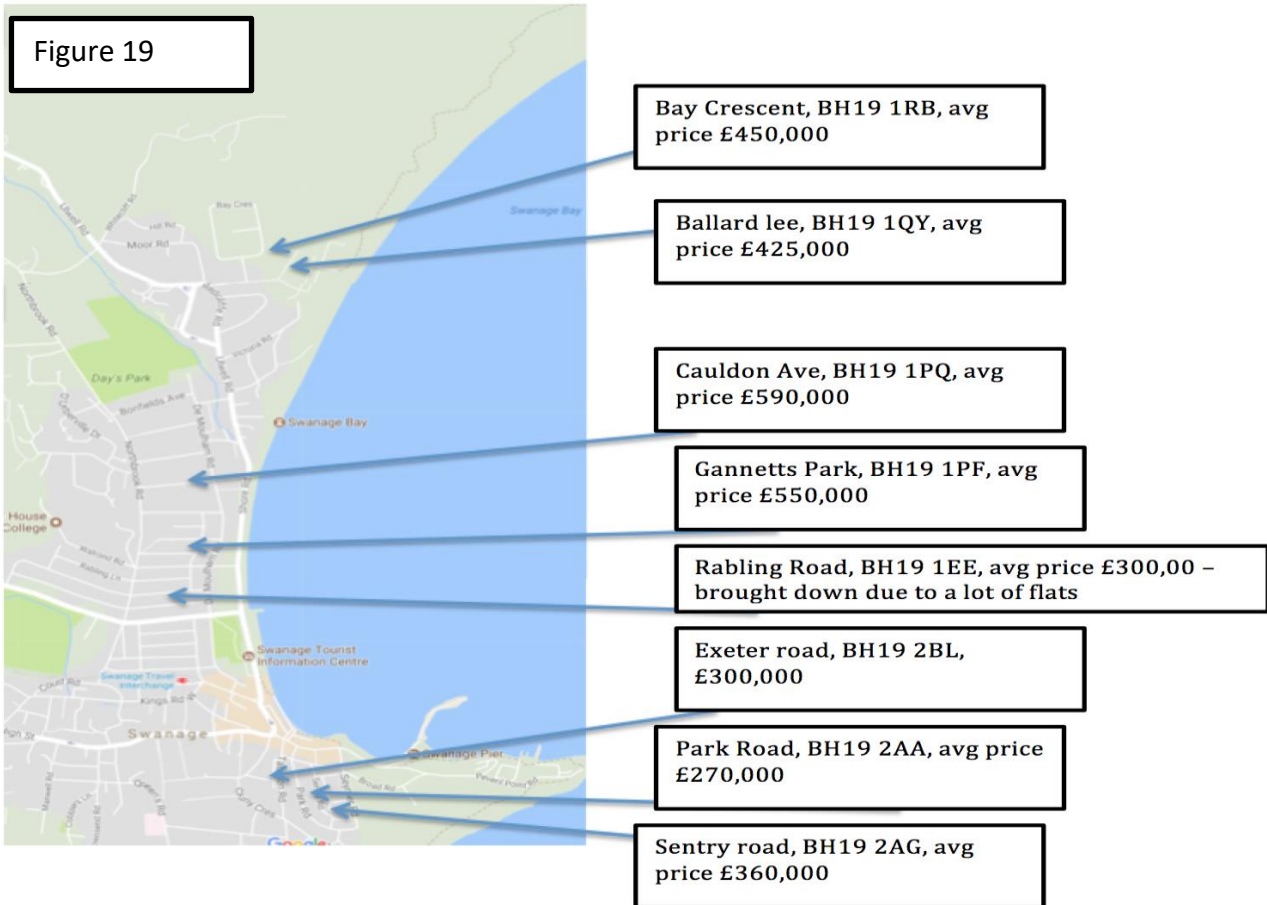
The following table provides a brief summary of damages determined by the SMP2 analysis for the whole PDZ. Further details are provided in Appendix H. Where further, more detailed information is provided by studies, this is highlighted. The table aims to provide an initial high level assessment of potential damages occurring under the two baseline scenarios. The damages for each epoch are current values. These are discounted to give present values in the final column. It is important for the reader to note that the loss figures quoted only refer to domestic dwellings and no account has been taken of commercial, industrial or infrastructure property values.

**ASSESSMENT OF EROSION DAMAGES**

No Active Intervention <i>Location</i>	Epoch		0 -20 year		20 - 50 years		50 - 100 years		Present Value Damages (£x1000)
	SMP1 MU		Number of properties	Value x £1000	Number of properties	Value x £1000	Number of properties	Value x £1000	
New Swanage	SWA 3		0	0	5	1252	97	24292	3,092
Town Centre	SWA 2		0	0	13	3256	44	11,019	2,357
Peveril Point North	SWA 1		0	0	10	2504	3	751	971

## Zoopla house prices

I used the website [www.zoopla.co.uk](http://www.zoopla.co.uk) to gather a collection of house prices within the area in order to show the different economic value in the three different management strategy zones. However, it seems that the house prices are constant throughout the bay (figure 19).



<https://www.google.co.uk/maps?source=tldsi&hl=e>

## Conclusions and their Validity

### Sub question 1: Is long shore drift occurring?

A lot of the research that I carried out on the beach was to answer this sub question such as the apple throw. It is the foundation of the investigation. If long shore drift is not occurring then there would not be the need for the level of coastal defenses that are currently in place. The apple throw, measuring the beach angle and photography helped to show that long shore drift is occurring at all three zones, although at different rates.

The apple throw allowed me to clearly see that long shore drift is occurring at Swanage Bay in all three management zones. Although it was clear to see that in the zone of no active intervention there was the highest rate of long shore drift this can be seen on Figure 9 where the apple traveled an average of 20 meters in five minutes. This would contradict the lack of coastal defenses in place here. This is where the economic value of the land comes in to the coastal management decision making. Because Zone 1 has little economic value it does not matter that long shore drift is the greatest here out of all three of the zones, the cost of implementing coastal defenses will outweigh the cost of lost land without coastal defense. The apple throw experiment clearly answers my sub question proving that long shore drift is occurring.

Some of my photography provided evidence for this sub question. In Figure 10 and Figure 11 it is clear to see that there is a buildup of sediment on the south side of the groyne compared to the north. This sediment will have built up on the south side of the groyne due to the process of long shore drift occurring at Swanage Bay. This photography has provided me with visual evidence which allows me to answer this sub question. Long shore drift clearly is occurring at Swanage Bay with sediment moving in a northern direction.

### Sub question 2: What is the social opinion on the correct level of coastal management that should be used?

The chi squared calculation is the main piece of data that answers this sub question. The chi squared and the questionnaire clearly showed me that most people agree with the level of intervention that is in place in the three separate zones. The chi squared statistical test (Figure 6) clearly showed that there is no significant difference between the number of people agreeing/disagreeing with the hold the line maximum intervention versus the hold the line minimum approaches. Therefore, this means that the overall social opinion is that the correct level of coastal management is being used in the different zones even though there are different approaches being used.

Some comments that I noted down were controversial and therefore this could suggest that the social opinion disagrees with the economic reasoning for the correct level of coastal management. However, the only reason some of these quotes were noted down was because they were controversial. For example "*nature will always take its own course*" – Zone 2. This is clearly disagreeing with the hold the line maximum approach in Zone 2. "*I like to see nature in action that's why I like the lack of defense*" – Zone 1. Here it is clear to see that no active intervention is clearly the social opinion on the correct level of coastal management.

Counting the number of people in each zone clearly provides evidence for the social opinion on the correct level of coastal management. If there are more people in certain zones on a daily basis there will be more reason to preserve the coastline in that zone e.g. the beach through groynes. Figure 8 clearly shows that most people reside in Zone 2 and Zone 3 or Swanage Bay and these zones are where most of the coastal defense resources are located.

All of the data I collected to answer this question was extremely valuable as it perfectly answers this sub question. However, it seems that the data I collected to answer this sub question supports my null hypothesis. I did not expect this hypothesis to be proven right because I thought most people would want a hold the line

maximum approach all the way along the coast in order to protect all of the land. However, it seems that many people understand that a hold the line maximum approach towards coastal management is not always the best approach.

**Sub question 3:** *What is the economic reasoning behind the correct level of coastal defense?*

My secondary data played a big part in answering this sub question. The Zoopla property count allowed me to understand some basic economic value within the area in a domestic sense, although the results were not as expected. The house prices remained fairly constant throughout the bay even with the different management strategies in place as seen in Figure 19. House prices in Zone 3 were between £270,000 and £360,000 whereas in Zone 1 house prices were between £425,000 and £450,000. However, there are other factors affecting the economic value within the bay such as income sources like tourism. In addition to this the value of the properties may be fairly similar throughout the bay but the quantity of properties drastically varies between the three zones. Zone 1 has significantly fewer properties as seen in Figure 17, the estimated property count. Zone 1 houses may also be larger due to the amount of free land available whereas the properties in Zone 3 will be smaller but there will be a greater quantity.

The Shoreline Management Plan let me understand the council's view on the situation and often their view is based on economics rather than people's opinions. The Shoreline Management Plan clearly shows that it is economically viable to maintain the current level of coastal defense throughout Swanage Bay. In addition, my secondary data, counting properties and photography, allowed me to see economic value through tourism. As mentioned earlier the groynes that have been put in place throughout Swanage Bay cost £2.2m according to the research center I visited at Swanage. These groynes protect 144 properties with the value of £36,062,000 (Figure 20).

Photographing aspects of Swanage Bay such as the arcade and the surf school (Figure 12 and Figure 16) allowed me to see the economic value of Swanage Bay that the Zoopla house prices and the shoreline management plan do not show me. The photography demonstrates the thriving economy within Swanage Bay e.g. arcade, surf school, restaurants, although I do not have an exact figure on how much this is worth. It is clear to see that there is a large economic value to the industries that operate throughout Swanage Bay.

I think it is clear to see from the Zoopla property prices, the shoreline management plan and the estimated property count that it is economically viable to maintain the current level of coastal management throughout the zone. The economic reasoning for the variation in management approaches can also be explained due to some areas of Swanage Bay having less economic value than others.

**Sub question 4:** *How do the different strategies differ throughout Swanage Bay?*

Most of my data collection revolved around this sub question, because before I found out economic and social reasoning and opinions it was important to understand what is currently in place throughout Swanage Bay. The Shoreline Management Plan clearly outlines what defense is currently in place but in addition to this I noted down on-site what I saw. My photography also clearly shows coastal management such as a sea wall and groynes.

Sighting the different coastal management strategies was clearly relevant in order to answer this sub question. Figure 7 clearly shows how the management strategies vary throughout the bay in the three different intervention zones. The management strategies vary due to Zone 1 being a no active intervention zone, Zone 2 being a hold the line maximum zone and zone 3 being a hold the line minimum intervention zone.



The apple throw shows that there are differing levels of long shore drift between the three zones and this could explain the different management approaches between Zone 2 and Zone 3. The longshore drift in Zone 3 is not as severe as that of Zone 2 and therefore this could explain why Zone 3 uses the strategy of hold the line minimum intervention compared to the method used in Zone 2 of hold the line maximum intervention.

My photography clearly shows the actual management strategies in place and it also highlights groynes (Figure 10 and Figure 11) as well as a sea wall (Figure 15). This gives me a clear, visual understanding of what is currently in place in Swanage Bay. In addition to this Figure 18 also gives me clear evidence of the coastal management strategies in place as I simply noted down the different strategies in the three different management zones.

My data collection and research has allowed me to understand that there are economic reasons that mean certain forms of coastal management are better suited to some regions than others. With regards to the social opinion of the correct level of management, I was surprised to see that many people supported a lack of coastal management in some areas throughout the bay. This provided evidence to help support my null hypothesis.

### **Final conclusion**

**Hypothesis (H1) (Alternate hypothesis):** The social opinion on the correct level of coastal management will **disagree** with the economic reasoning behind the various forms of coastal management used at Swanage Bay.

**Hypothesis (H0) (Null hypothesis):** The social opinion on the correct level of coastal management will **agree** with the economic reasoning behind the various forms of coastal management used at Swanage Bay.

**Sub question 1:** Is long shore drift occurring at Swanage Bay?

**Sub question 2:** What is the social opinion on the correct level of coastal management that should be used at Swanage Bay?

**Sub question 3:** What is the economic reasoning behind the correct level of coastal defenses at Swanage Bay?

**Sub question 4:** How do the different strategies vary throughout Swanage Bay?

Successfully answering all of my sub questions has allowed me to prove one of my original hypothesis correct. At the start of my investigation I was certain that I would prove my Alternate hypothesis correct (Hypothesis (H1): The social opinion on the correct level of coastal management will **disagree** with the economic reasoning behind the various forms of coastal management used at Swanage Bay.) However, having reviewed my collected data from both primary and secondary sources as well as carrying out a statistical test. It has become apparent that I can prove my null hypothesis correct (Hypothesis (H0) (Null hypothesis): The social opinion on the correct level of coastal management will **agree** with the economic reasoning behind the various forms of coastal management used at Swanage Bay). This can be seen from my answers to my sub questions. My questionnaire results were the most controversial piece of data and was the turning point in making me realise that many people's opinion on the correct level of coastal management throughout Swanage bay actually agrees with the economic reasoning for the current coastal management strategies at Swanage Bay. In my opinion, I think it is important to take into account social and economic opinions on the correct levels of coastal management as it allow more factors to be considered. Whilst this may make the coastal management decision processes longer, in the long run, it will lead to greater satisfaction and a more efficient allocation of resources.

## Evaluation and further research

Data collection format	Strengths	Weaknesses	Improvements
Questionnaire	<p>Allowed me to better understand people's opinions on the management strategies used</p> <p>Was a vital piece of data when calculating my chi squared</p>	<p>It was difficult to transfer the data into correct data for the chi squared formula</p>	<p>I could have asked more people to increase my data set</p> <p>I could have collected more suitable data in order to make chi squared calculations easier</p>
Sighting the different forms of coastal management used within the three different zones	<p>Allowed me to fully understand what forms of coastal management were being used</p>	<p>Some of the management strategies can't easily be seen. For example, beach nourishment that has taken place in Swanage Bay.</p>	<p>Asking more people may have allowed me to find out about more management strategies that are in place</p> <p>I could have noted down on a map exactly where different defenses are located</p>
Counting the number of people at each of the three zones	<p>Helps back up economic reasoning for increased levels of defense in some areas compared to others</p>	<p>Counting may have been inaccurate as it was hard to distinguish everyone</p> <p>The day was not a particularly good day in terms of weather, therefore numbers may have been lower than normal</p>	<p>I could have done multiple counts to improve accuracy</p> <p>I could have counted on different days and then calculated an average to avoid anomalous results.</p>
The 'apple throw'	<p>Was carried out with a lot of precision</p> <p>Allowed me to understand part of the cause of the eroding coastline and how the sediment moves throughout Swanage Bay</p> <p>Using an apple is better for the environment than using an object such as a tennis ball if the item was to be lost</p>	<p>Seagulls interrupted the data collection although we accounted for this by excluding anomalous results when calculating averages</p> <p>Results may have been affected by changes in tides throughout the course of the data collection</p>	<p>Repetition of the experiment would allow me to acquire more accurate results.</p>
Photography	<p>Was useful to illustrate the bay and to show some of the infrastructure in place</p>	<p>May have been bias in some cases as not every aspect of Swanage Bay was photographed. For example, there is a farm, which was not photographed. This would have illustrated economic reasoning for increased coastal defense at the zone of no active intervention</p>	<p>More photography would prevent me from missing key features throughout the bay and would increase the data I have to use when drawing conclusions</p>
Estimated property count	<p>Gave me a rough idea as to how many properties were close to the shoreline in each zone which gave me more information to better understand the economic reasoning behind the management strategies</p>	<p>It was only a rough count and so could be inaccurate</p> <p>View was obstructed in many cases</p>	<p>I could have carried out the count using software such as Google maps to increase accuracy.</p> <p>I could have accurately measured the distancing to increase accuracy</p>
Zoopla house prices	<p>Showed a variety of different house prices throughout the bay to better understand how the house prices related to the level of management within each zone</p>	<p>May not have been enough house prices to get a proper understanding</p>	<p>Using more house prices would increase accuracy within my data.</p>

## Risk assessment, management and ethics

Data collection	Risks	Strategies to avoid risks
Questionnaire	<p>People may be hostile when approached by students</p> <p>Some people's properties may be at risk and may not wish to discuss the situation</p> <p>People may wish to be anonymous</p>	I was polite to the people and made it clear that the participants would remain anonymous. It was also made clear what the information was used for.
Sighting the different forms of coastal management used within the three different zones	Traveling down the beach over groynes may be dangerous as there can be steep drops over the groynes	Walking along the beach with caution wearing appropriate footwear.
Counting the number of people at each of the three zones	People on the beach may be hostile towards someone standing and counting for a long period of time.	I stayed out of people's way and did not draw attention to myself in order not to attract unwanted attention
The 'apple throw'	<p>Throwing an object into the sea may cause injury if it collides with someone</p> <p>If seagulls eat the object harm could be caused</p> <p>Pollution to the environment if the object is not biodegradable</p>	I used a biodegradable object (an apple). I also threw carefully when it was safe to do so.
Photography	People may not wish to have photos taken without their permission	I asked permission of all of the subjects in the photographs despite the monotony of doing so.
Estimated property count	Locals may be hostile and find it strange if someone stands outside a property for a prolonged period of time	I did not stand directly outside properties to avoid suspicion. I also did not draw attention to myself
Zoopla house prices	Staying safe whilst using the internet and only using official websites	I only used verified websites

## Literary review

Much has been written on the subject of coastal erosion particularly as it affects the Swanage Bay area. However, since so much of this material has been produced by the Department of the Environment, a government ministry that wishes to justify its stance and more recently limited expenditure during a period of austerity. It has been my preference to avoid influencing my findings by absorbing this data in advance of this exercise. However, I have viewed one literacy article which can be found on the website: <http://bedfordschoolgeography.blogspot.co.uk/2013/03/evaluation-of-coastal-management-at.html>

This source suggests that the current level of defense does not meet the social and economic needs and suggests usage of gabions and rip rap rock armor. However, in my opinion gabions are not a sustainable method of coastal management due to their short life span and high cost. In addition to this, the use of gabions and rock armor would cause there to be no beach. This would occur because there would be nothing protecting the sediment from longshore drift, a job that the groynes located at Swanage Bay are currently doing. It is clear to see from my investigation that the beach is highly important to Swanage Bay socially and economically. This is due to the thriving tourist industry that is located in Swanage Bay.

## References

Listed throughout

Main sources:

- Google maps

- British Geological Survey

- Two Bays website, Policy Development Zone 4

- Ordnance Survey

- Zoopla

