
Surf's up?

Requirements:

- Internet access
- Web browser (e.g. Internet Explorer, Mozilla Firefox, Google Chrome)**
- An Esri ArcGIS Online school subscription account user – provided by your teacher

Username: _____

Password: _____

**Please ensure that pop ups are not blocked for the arcgis.com site.

Introduction:

This assessment activity requires you to comprehensively apply spatial analysis, with direction, to solve a geographic problem.

Tauranga and Mount Maunganui are located in the Bay of Plenty, on the north-east coast of New Zealand's North Island at 37°41'S and 176°10'E. Both locations are located west of the Australian / Pacific plate boundary and in an area of active volcanic activity. The Kermadec Trench, on the Australian / Pacific plate boundary, is an area of high earth movement. An earthquake in the Kermadec Trench could cause a tsunami event in the Bay of Plenty.

The Ministry of Civil Defence and Emergency Management (CDEM) is an organisation that works to make New Zealand communities resilient to hazards and disasters. CDEM needs to know where and what the effects of a potential tsunami might be. CDEM require a report that shows who needs to be evacuated from Tauranga and where and how the evacuees would travel to escape a tsunami expected to hit Tauranga.

Imagine that you have the job of producing this report for CDEM. Your task is to:

- Work through the simulation using ArcGIS Online.
- Produce a layout that includes maps/images to show where the effects of the tsunami will be felt as well as possible evacuation options.
- Write a report which includes:
 - The areas of Tauranga that are at risk of a tsunami and **reasons** why they are at risk.
 - The tsunami safe zones and the problems associated with them.
 - An evacuation plan to explain how you would evacuate people from risk areas. Include reasons why you have chosen this plan.

You will work individually to produce several maps/images that will make up a layout on one side of an A4 or A3 piece of paper depending on the page size print out your school printer can produce.

You will be assessed on how well you are able to apply spatial analysis to solve this geographic problem.

You will share your map with your teacher and hand in your layout and your written report.

Your final work is due on:

Tsunami hits Tauranga!

In an emergency, there are a number of factors that need to be considered. An Emergency Management Planner has a very important role in ensuring that as many people as possible (hopefully everyone) can be evacuated to a safe place in as short a time as possible.

*In this SIMULATION you are part of the GIS team for the Bay of Plenty Emergency Management Team. It is your job to respond to the crisis and solve the problem of **WHO** needs to be evacuated and **HOW** they will be evacuated if a tsunami warning is issued. You will create a layout and write a report for the CDEM.*

Some Background...

Tsunamis have not generally been perceived as a particular threat to the Bay of Plenty. Since 1840, localised tsunami with height at shore of between 1m and 3m, are known to have affected places along the Bay of Plenty and Eastern Coromandel coastline eleven times. Recent work indicates that tsunamis may be more of a threat than previously thought. In the past 4000 years two major regional and four localised paleo-tsunami events (events that happened before human settlement of New Zealand) have been recorded – all equal to or greater than five metres.

The enormity of the 2004 Boxing Day tsunami tragedy and the damaged caused by the 2011 Japanese Tsunami prompted Tauranga and Western Bay Emergency Management centre to reassure residents that tsunami planning is well underway in this area of the world.

“We live on a coastline which is exposed to regional and distant tsunami sources.”

“This means tsunami are likely to be a ‘when’, not an ‘if’ scenario, so we all have a responsibility to be prepared.” <http://bit.ly/1l1Eo4y>

Breaking news! 8am

You have just received a message on your mobile phone from the head of the Emergency Evacuation Team that an earthquake has occurred in the Kermadec Trench. A tsunami wave as a result of the earthquake has been detected. It is predicted to reach Tauranga in approximately 60 minutes.

The size of the tsunami has been predicted to have an average height of 4m. This means waves could get up to 5 metres when they hit shore – depending on the way the land is shaped.

You and your team have been given the task of evacuating those in the danger zone!

What do you already know?

There are a few key pieces of information that you know already: Information that will help you plan for, and conduct your evacuation. What are they?

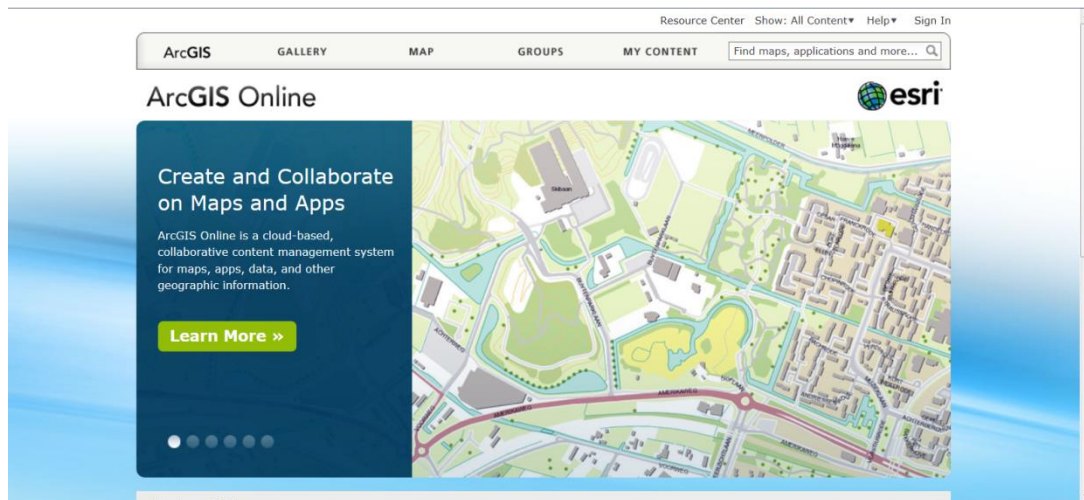
1. _____
2. _____
3. _____

Complete the activities on the next few pages to help you solve the problem of evacuation. By following each step, you will be able to construct a layout and write your report for the CDEM.

Setup

Task A: Setup ArcGIS Online

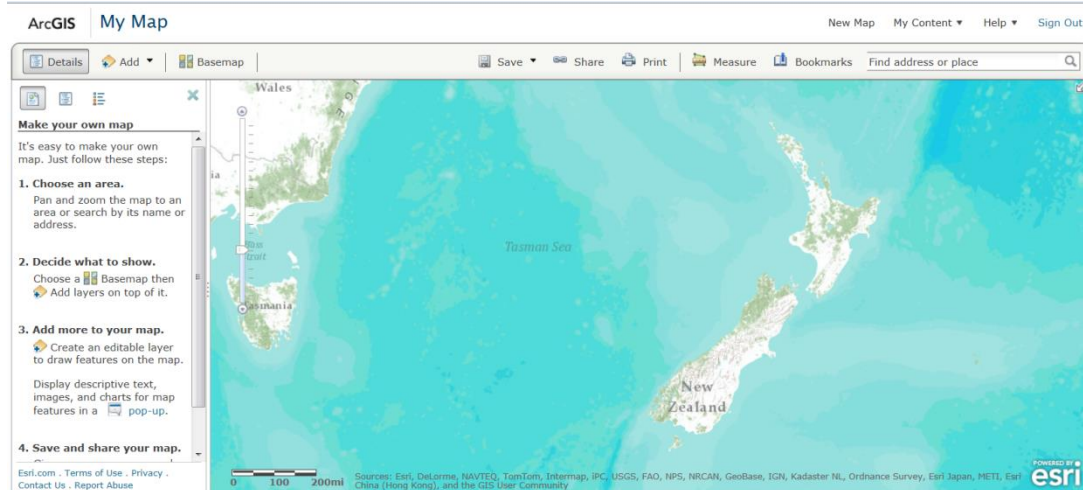
- Open ArcGIS Online (<http://www.arcgis.com/home/>).



- Click Sign In to ArcGIS Online and sign in using the account details provided by your teacher.

A screenshot of the ArcGIS Online Sign In form. The form is titled "Sign In" and features the Esri logo. It contains fields for "Username" and "Password", a checkbox for "Keep me signed in", and a "SIGN IN" button. Below the button are links for "Forgot password?", "Forgot username?", and "Sign in with your enterprise login".

- Click on Map to open a new map.



- Using the basemap option change the basemap. Try the Oceans basemap and the World Topographic basemap.

Save your map.

- Click the Save button.
- Fill in the Save Map dialog that appears with the appropriate information. You should prefix your title with your name; tags are words that are used to search for a WebMap.

- Click Save Map.

Tip: Remember to click Save before you sign out of ArcGIS Online or close your browser to save all map updates.

Task B: Create a folder

- In your personal drive, create a folder where you can save your data.

Task C: Prepare a document for your layout

- Open a new word document. Save it to the folder you created in Task B using a name of "yourname_tsunami_assessment".
- Change the orientation of the document to landscape, and the page size if you can print at A3 size. This document will be your LAYOUT.
- Save the document.



IMPORTANT!

As you work through the simulation, you will come across this symbol.
This tells you how the scenario is playing out. Make sure to read it

Create, Collect and manipulate spatial data

Hint: You should take screen captures to include in your layout as you complete each task



BEFORE THE TSUNAMI HITS

The earthquake in the Kermadec Trench has been felt across the North Island of New Zealand. In the Bay of Plenty it is felt in Tauranga, Whakatane and Maketu.

Task A: Distance from earthquake epicentre to Bay of Plenty locations

- In ArcGIS Online, go to Add
- Click on Add map notes. Create a layer with a name of Locations.

Add Map Notes ×

Name:

Template:

Use Map Notes to create basic shapes in a wide variety of applications.

CREATE **CANCEL**

- Using the pushpin edit tool to create points at each of the Bay of Plenty locations that felt the earthquake, give each pushpin you create a name, feel free to change the symbol for each location.

Hint: You can use the search tool to help locate these places, remember that this search box searches for locations all over the world.

- Use the distance measure tool to calculate the distance for the Kermadec Trench to each of the three locations.



Hint: Using the Oceans basemap might help you more easily locate the Kermadec Trench

Hint: Make sure the distance measurement is set to kilometers

- Kermadec Trench to - _____ = _____ km
- Kermadec Trench to - _____ = _____ km
- Kermadec Trench to - _____ = _____ km



A 4m high wave moves in the direction of Tauranga. It will reach Tauranga in 60 minutes

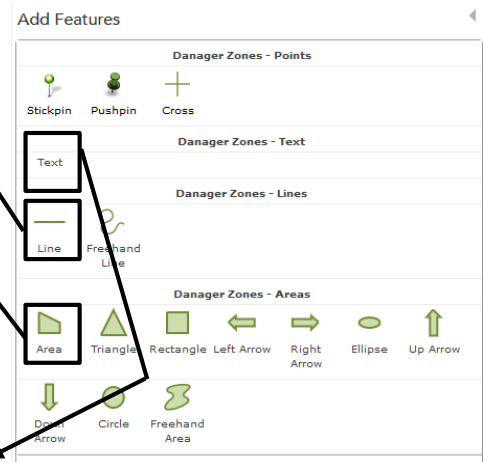
Q1 What direction will the wave come from?

Task B: Danger Zones - Create areas that will need to be evacuated



Zone 1: Mount Maunganui – An official warning has been issued by the Bay of Plenty Civil Defence department. Evacuations of at risk areas are necessary. All areas within 0.75km of the main coast must be evacuated.

- Locate Concord Ave, Tauranga on your map, zoom out slightly
- Go to Add, click on Add map notes. Create a layer with a name of Danger Zones.
- Click the Measure menu, and select the Distance tool
- In the Add Features pane click the Line tool.
- Draw a line perpendicular to the shore and approximately parallel to Concord Street that is 0.75km long.
- In the Add Features pane click the Area tool.
- Zoom out and draw a polygon from the base of Mt Maunganui to the line you just created. Make your polygon green in colour and 50% transparent. Give the polygon an appropriate title.
- In the Add Features pane click the Danger Zones Text tool.
- Label the polygon that you just created 'Mount evacuation zone'.



Zone 2: Papamoa beaches – Large parts of Papamoa are reclaimed swampland. Consequently, its elevation is low and the treat of the tsunami extends 1km inland.

- Using Concord Ave as your starting point, draw 5-6, 1km long lines that are perpendicular to the shore making sure they are evenly spaced from Concord Ave to the end of the houses at the end of Papamoa beach road
- Use these lines to draw a rectangular polygon around this area, using your lines as a guide. Make your polygon orange in colour and 50% transparent. Give the polygon an appropriate title.
- Label the polygon 'Papamoa evacuation zone'

Q2 What is the rough area of this polygon? **Hint:** area = base x height

Q3 There is a population density of 680 people per km². Calculate how many people in Papamoa this evacuation is likely to affect.



Zone 3: Pilot Bay – Pilot Bay will also be affected up to 0.5km inland.

- Draw a polygon on the Pilot Bay side of the mount, from Mount Maunganui to the start of the Harbour Bridge. The polygon should follow the coast and be 500m wide, Make your polygon blue in colour and 50% transparent. Give the polygon an appropriate title and label it 'Pilot Bay evacuation zone'
- Close the Measure menu.



Zone 4: Low lying area in Tauranga – Low-lying parts of other suburbs will need to be evacuated. These include Fraser Cover, Matua and Matapihi as the water level in the harbour and estuaries will increase because of the wave.

- Add red point (pushpin) to your map to show these places, assign appropriate titles.



Zone 5: Schools at risk – Schools within the evacuation zone are at great risk and need to be evacuated quickly and effectively.

- Ask you teacher where they have stored the Tauranga schools information in spatial format for this exercise.
 - a. Ask specifically for the network location and the zip file name
- Locate the schoolstauranga.zip file on your school network drive.
- Copy and paste the schoolstauranga.zip file to the folder you created on your personal drive for this exercise.
- Add a layer from file to the map:
 - a. Click Add
 - b. Click Add Layer from File
 - c. Browse to your folder on your personal drive and select the schoolstauranga.zip file
 - d. Choose to keep the original features
 - e. Click IMPORT LAYER
- Change the appearance of the layer so that all the school points in the map have the same symbol.
 - a. Click on 'Choose an attribute to show' – change it to *Show location only*.
 - b. Click 'Location (Single Symbol)' / *Options*.
 - c. Choose an appropriate symbol (change the size and colour of the symbol as you desire)
 - d. Click OK
 - e. Click Done

List 4 schools that are in the risk zone and will need to be evacuated.

Hint: click a school symbol to find the name of the school

- Click Add, click Add Map Notes. Create a layer with a name of Schools.
- Add a point to represent each of the four schools you listed on your map.
- Turn of the schoolstauranga layer
- Zoom out so that you can see all of your polygons and points.

Don't forget to save your map regularly and take a screen shot of your work at the completion of each task to add to your layout.

Task C: Getting People Out – Evacuations by road



People will need to move to higher ground as soon as possible. The three main evacuation routes will be on SH2 via the Harbour Bridge towards Pyes Pa, along SH29 over the Maungatapu Bridge and on SH 2 towards Te Puke. No traffic will be allowed to go towards the beaches so all lanes will be opened to traffic leaving Mount Maunganui and Papmoa. This will speed up the process and make it easier for more people to leave as quickly as possible.

Identifying evacuation routes

- Turn off the points, lines and polygons you have created so that you can see the roads clearly
Hint: Changing the basemap to World Streets might help
- Add another map notes layer to your map called Evacuation Routes
- Add three paths to your map to show the evacuation paths, assigning an appropriate colour and title for each route:
 - a. The quickest route from the base of the Mount to Elizabeth Street and Cameron Road intersection using SH2 and the Harbour Bridge.
 - b. The quickest route from Bayfair to the Maungatapu Roundabout using SH29 and the Maungatapu Bridge.
 - c. The quickest route from Fashion Island to Te Puke via SH2

Task D: Getting to higher ground – Safe Areas



The wave is getting closer and the road network is jammed – everyone is trying to get out but time is running out. The best chance of survival is to get to higher ground or inland. Mount Maunganui is one obvious choice for natural high ground – but walking will be the only way to get there. There are approximately 60 minutes left until the tsunami hits. If people are able to walk at 3km per hour, people within approximately 3km of the Mount will make it.

Evacuation by foot

Name the furthest street (perpendicular to Marine Parade) from which people will make it to The Mount.



Another alternative escape route is to move inland as far as possible. However, the Wairakei Stream behind Papamoa East is a barrier and will prevent people from escaping on foot.

The council has therefore begun the process of constructing 6 foot bridges over the water to allow people to escape on foot. They will be 500m apart.

Foot bridges

Two such bridges are complete and are located on Calypso Drive and Shaun Close.

- Click Add, click Add map notes. Create a layer with a name of Footbridges
- Add lines across the Wairakei Stream to represent each of these bridges. Give each line an appropriate title.
-

Hint: changing the basemap to World Imagery may help locate the stream.

There are areas within the Mount and Papamoa that while not very high, are deemed to be safe areas. People close to these areas are encouraged to walk there instead of driving.

Other tsunami safe zones

- Ask you teacher where they have stored the csv (comma separated values) file containing the high ground safe zone information.
 - a. Ask specifically for the network location and the csv file name
- Locate the HighGround.csv file on your school network drive.
- Copy and paste the HighGround.csv file to the folder you created on your personal drive for this exercise.
- Add a layer from file to the map
 - a. Click Add
 - b. Click Add Layer from File from the drop down menu

Add Layer from File



Locate the file you want to import. You can import a zipped shapefile (ZIP) with up to 1000 features in it, a comma, semi-colon, or tab delimited text file (CSV or TXT), or a GPS Exchange Format (GPX). CSV and TXT with addresses can have up to 250 features.

File: No file selected.

IMPORT LAYER

CANCEL

- c. Browse to your personal drive and select HighGround.csv
- d. Click IMPORT LAYER

- Change the appearance of the layer so that all the high ground points in the map have the same symbol.
 - a. Click on 'Choose an attribute to show' – change it to *Show location only*.
 - b. Click 'Location (Single Symbol)' / *Options*.
 - c. Choose an appropriate symbol (change the size and colour of the symbol as you desire)
 - d. Click OK
 - e. Click Done

Don't forget to save your map regularly.

Vertical Evacuation Structures



You have now identified the areas that need to be evacuated as well as high ground safe zones. Those near the natural high ground, you have located above can go there, but there is no natural high ground in some parts of Papamoa. Therefore, the Tauranaga City Council are planning to erect Vertical Evacuation Structures. These structure will need to be 12 metres above sea level (masl) to be effective. The Gordon Spratt Reserve is 5masl so the proposed structure will need to be 7-8m high. The structures are designed to accommodate a few thousand people. They will have no long term survival supplies but will help people to survive the influx of water.

- Ask you teacher where they have stored the csv file containing the proposed vertical evacuation structures.
 - a. Ask specifically for the network location and the csv file name
- Locate the StructureLocation.csv file on your school network drive.
- Copy and paste the StructureLocation.csv file to the folder you created on your personal drive for this exercise.
- Add this csv file as a layer to the map
- Change the appearance of the layer so that all the vertical evacuation structure points in the map have the same symbol.



People will need to be within a 3km radius to reach these platforms and high ground locations. To work out where to send people, you need to know which area is closest to them.

Reaching Safe Areas



Create circle buffer zones that represent the reach of each high ground areas / structures (you should have 11 circles when you are finished):

- Locate and click the Perform Analysis option under the HighGround layer
- Click the sideways arrow beside the Use Proximity option
- Click Create Buffers
- Make sure the drop down box below the 1 contains the HighGround layer
- Change the distance to 3 kilometers



- Set the result layer name to 'HighGround_Buffer', add an underscore (_) and your initials to the end of the layer name e.g. HighGround_Buffer_jxh
- Untick use current map extent
- Click Run analysis

Please Note: The buffer tool can take a few minutes so be patient.

- Repeat this process with the StructureLocations layer.
- Change the buffer circles so they only have a thick (4px) blue outline using the change style button below the layer name. 
- Turn the Wairakei East and West Platforms off as they do not exist and there are no plans to build them in the near future.
 - a. Click the Filter button below the StructureLocations_Buffer layer name 
 - b. Set the Structure Locations field to not contain (does not contain) Wairakei

Structure Locations

▼

is not contain

▼

Wairakei

☒ Value
 ☐ Field
 ☐ Unique

☐ Ask for values ▼

c. Apply the Filter

Notice that you only have the Gordon Spratt Reserve Buffer from the StructureLocations_Buffer layer displayed in your map

Q4 Are there any areas that are too far to reach the existing platforms? Yes / No (circle one). If yes, name two areas.

Q5 Do you think that this is a problem? Explain your answer.

Q6 What other reasons could result in people not reaching the platforms? List at Least 4.

Q7 How could these problems be solved? Give 2 ideas.

Don't forget to save your map regularly and take a screen shot of your work at the completion of each task to add to your layout.

Produce a Layout

Task A: Collate your screen shots into a layout and annotation where appropriate

Produce one annotated, A4 or A3 sized layout that shows how and where the tsunami would affect Tauranga as well as some possible ways to evacuate. Your layout should contain the maps / images that you created throughout this exercise as well as annotations and labels to explain your images. Your layout should clearly and accurately show:

- The location of Tauranga in New Zealand and the Kermadec Trench (the source of the tsunami)
- The location of the areas that will be most affected by the tsunami
- The main roads and footbridges used for evacuations
- The location of the high ground and vertical evacuation structures and the areas that can reach them in time.

Organise your layout so it is effective and interesting to look at.

Fully explain a valid answer solution supported by detailed evidence.

Task A: Analyse your data to provide a solution to the geographic problem

This task requires you to provide a report for Bay of Plenty CDEM (Civil Defence Emergency Management) in which you suggest an evacuation plan.

Your written report must **fully explain** the following:

- The areas of Tauranga that are at risk of a tsunami and **reasons** why they are at risk.
- The tsunami safe zones and the problems associated with them
- An evacuation plan to explain how you would evacuate people from the risk areas. Include reasons why you have chosen this plan.

Make sure that you:

- refer to your layout specifically
- include **specific details** in your answer, such as distances, elevations, suburbs, streets, and other relevant statistics.

You may use the internet to gather additional information to include in this report. You should reference this at the end of the report. Try to include some of the Important Geographic Concepts in your answers.

Important geographic concepts: environments, perspectives, processes, patterns, interaction, change, sustainability.

Your report should be typed in Word and be 1 -2 pages in length.

Submit your work by the due date.

Ensure that you:

1. Share your map with your teacher.
 - If you are ready to share your map for marking, click the share button and put a tick in the box beside the name of the group for this lesson.
 - Click Close. Your map is now shared with your teacher for marking.

Note: If you get stuck with sharing you map visit Sharing Items at http://help.arcgis.com/en/arcgisonline/help/index.html#/Sharing_items/010q000000100000000/ for help.
2. Hand a layout to your teacher.
3. Hand a written report to your teacher.
 - Your written report must include a cover sheet with your name and assessment details on it
4. You must hand your booklet in on the due date too.

THE TSUNAMI WAVE HITS



Roads are damaged, water rushes inland destroying vegetation and houses and destroying as well as damaging infrastructure. There will be a long and expensive rebuilding process. **HOWEVER**, there is no loss of life. Thanks to your manipulation and calculations, your layout and your report, evacuations were carried out and everyone made it to safety.

How will you know the level of your own work in relation to the requirements of the standard?

Achieved

You will *apply spatial analysis* which involves:

- Collecting spatial data relevant to the geographic question or problem
 - High ground locations
 - Structure locations
- Completing simple manipulations of the spatial data
 - Adding points
 - Drawing polygons – Area drawn with good accuracy
 - Buffer zones for each high ground and structure locations
- Creating a layout based on the manipulations.
 - Contains one to three images/maps
 - At least one of the annotated image / map help to explain the WHO needs to be evacuated and HOW they will be evacuated
 - Images / maps are completed to a good standard
- Writing a report based on the manipulations and layout.
 - Valid comments lacking detail

Merit

You will *effectively apply spatial analysis* which involves:

- Collecting sufficient spatial data to address the geographic question or problem
 - As above
- Completing simple manipulations of the spatial data
 - polygons more accurate and complete
- Creating a layout based on the manipulations.
 - Contains two or more images/maps
 - At least one of the annotated image / map help to explain the WHO needs to be evacuated and HOW they will be evacuated
 - Images / maps show information accurately and most conventions are appropriate
- Writing a report based on the manipulations and layout.
 - Images / maps in layout referred to
 - Valid comments with some detail

Excellence

You will *comprehensively apply spatial analysis* which involves:

- Collecting sufficient spatial data to address the geographic question or problem
 - As above
- Completing simple manipulations of the spatial data
 - As above
- Creating a layout based on the manipulations.
 - As above
- Writing a report based on the manipulations and layout.
 - a detailed and comprehensive explanation of the location of WHO needs to be evacuated and HOW they will be evacuated
 - Images / maps in layout referred to, to provide locational detail
 - Valid comments with extensive detail