



## Are coastal storm inundation events in Auckland on the rise?

Dr Rob Bell and Dr Scott Stephens



23 Jan 2011



Benjamin Eitelberg

Ex TC Ita: 14 April 2014



Leila Robinson

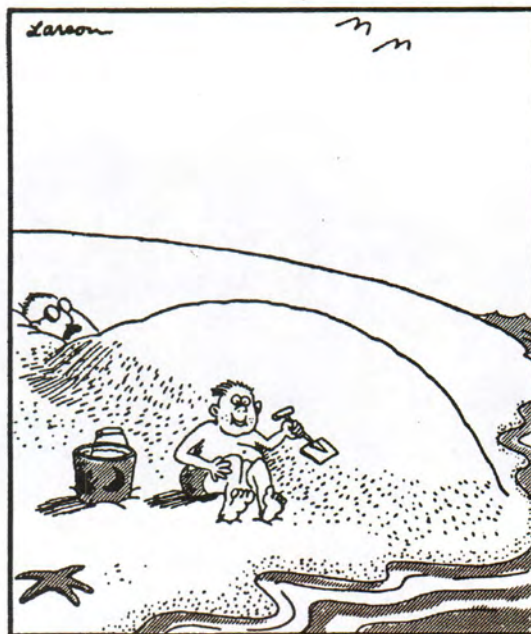
enhancing the benefits of New Zealand's natural resources



NIWA video link  
Have mp4 file in same directory

“Time and tide  
waits for no man”

Tides ride on the  
back of the mean  
sea level



“Okay, Billy ... tide's coming in now. ... Dig me out, Billy. ... Billy, I don't want to get angry. ...”



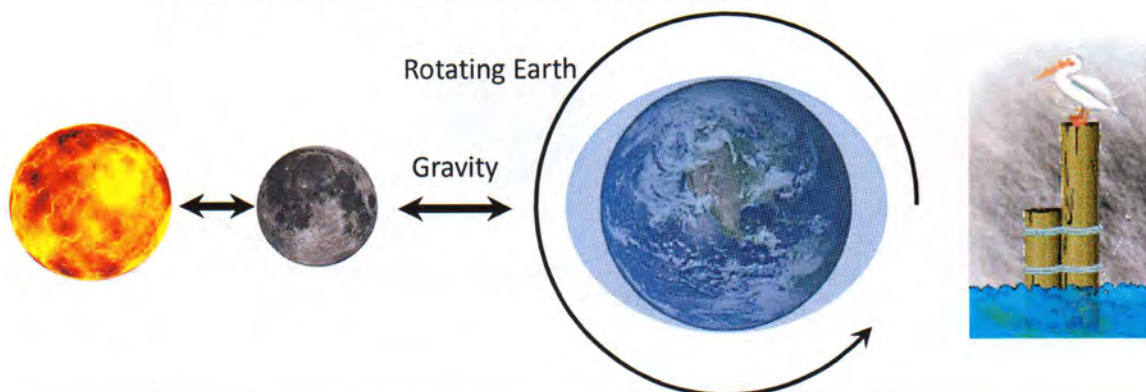


Chamberlains Bay, Ponui

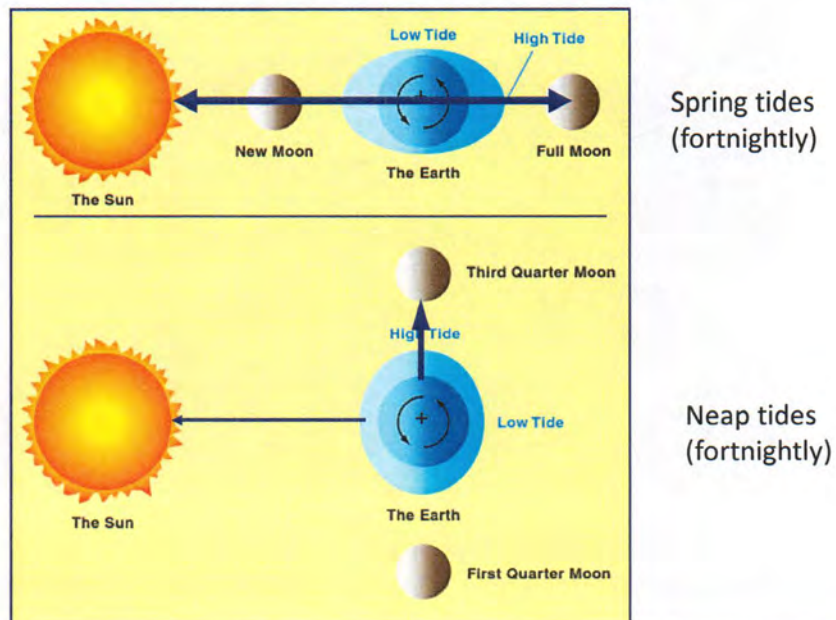
Tamaki Drive construction 1926 to 1932  
Had working knowledge on tides – less on storm-tides and waves

## A handy definition of tide ...

**"Tide"** is the regular rise and fall in sea level with respect to the land, produced by the **gravitational attraction** between Earth and both the Moon and Sun.

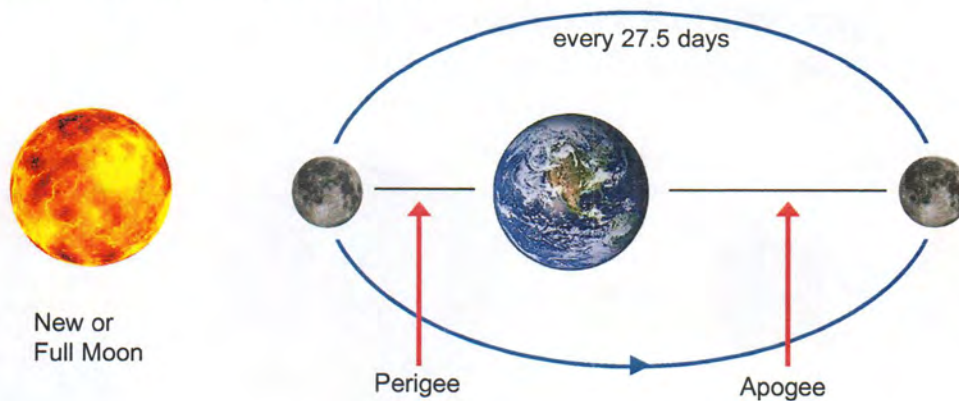


Ocean tides occur during the tug-of-war between the sun & moon on the earth: 29.5 day cycle



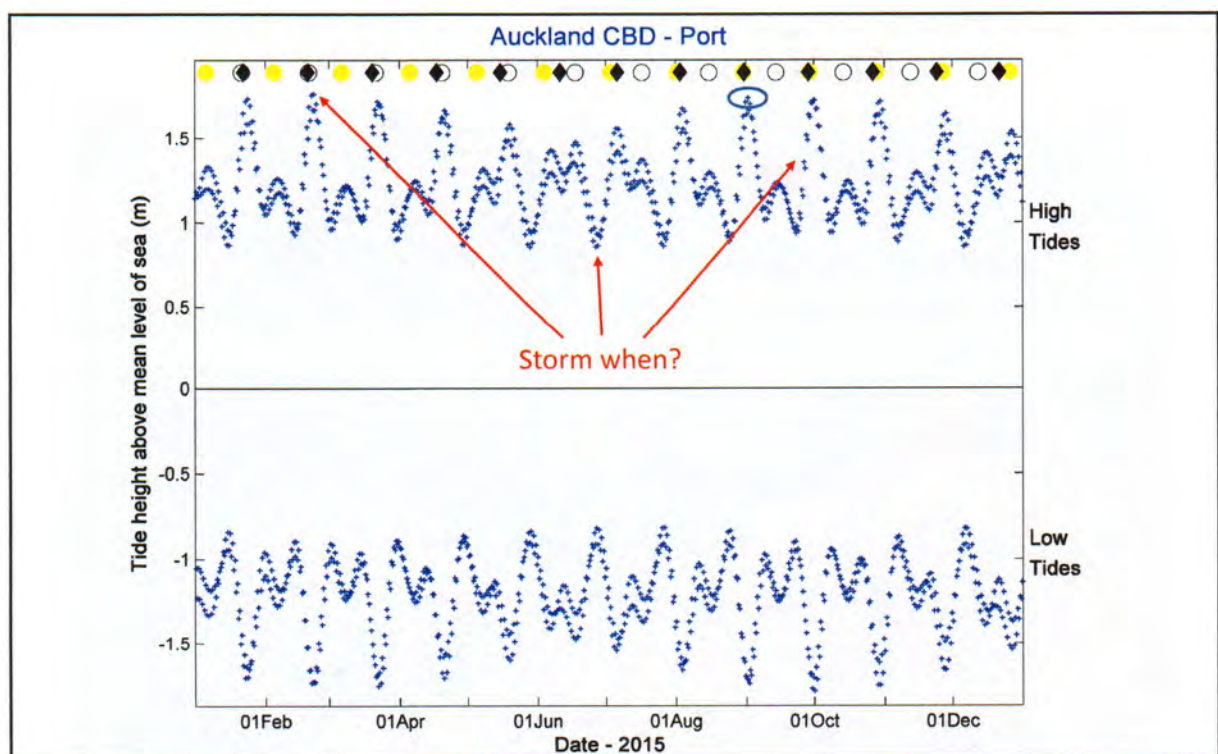
## Perigean-spring or "king" tides

The moon's elliptical orbit around Earth



Line-up of sun and moon's perigee peak around every 7 months







# Forward red-alert tide planner

Very high tide dates (red-alert) with increased coastal inundation potential  
and carefree low high-tide dates for Auckland – East Coast

2015

January							February							March						
Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su
5	6	7	8	9	10	11	2	3	4	5	6	7	8	2	3	4	5	6	7	8
12	13	14	15	16	17	18	9	10	11	12	13	14	15	9	10	11	12	13	14	15
19	20	21	22	23	24	25	16	17	18	19	20	21	22	16	17	18	19	20	21	22
26	27	28	29	30	31		23	24	25	26	27	28		23	24	25	26	27	28	29
														30	31					
April							May							June						
Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su
6	7	8	9	10	11	12	4	5	6	7	8	9	10	1	2	3	4	5	6	7
13	14	15	16	17	18	19	11	12	13	14	15	16	17	8	9	10	11	12	13	14
20	21	22	23	24	25	26	18	19	20	21	22	23	24	15	16	17	18	19	20	21
27	28	29	30				25	26	27	28	29	30	31	22	23	24	25	26	27	28
July							August							September						
Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su
5	6	7	8	9	10	11	3	4	5	6	7	8	9	7	8	9	10	11	12	13
13	14	15	16	17	18	19	10	11	12	13	14	15	16	14	15	16	17	18	19	20
20	21	22	23	24	25	26	17	18	19	20	21	22	23	21	22	23	24	25	26	27
27	28	29	30	31			24	25	26	27	28	29	30	28	29	30				
October							November							December						
Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su	Mo	Tu	We	Th	Fr	Sa	Su
5	6	7	8	9	10	11	2	3	4	5	6	7	8	1	2	3	4	5	6	7
12	13	14	15	16	17	18	9	10	11	12	13	14	15	8	9	10	11	12	13	14
19	20	21	22	23	24	25	16	17	18	19	20	21	22	15	16	17	18	19	20	21
26	27	28	29	30	31		23	24	25	26	27	28	29	22	23	24	25	26	27	28

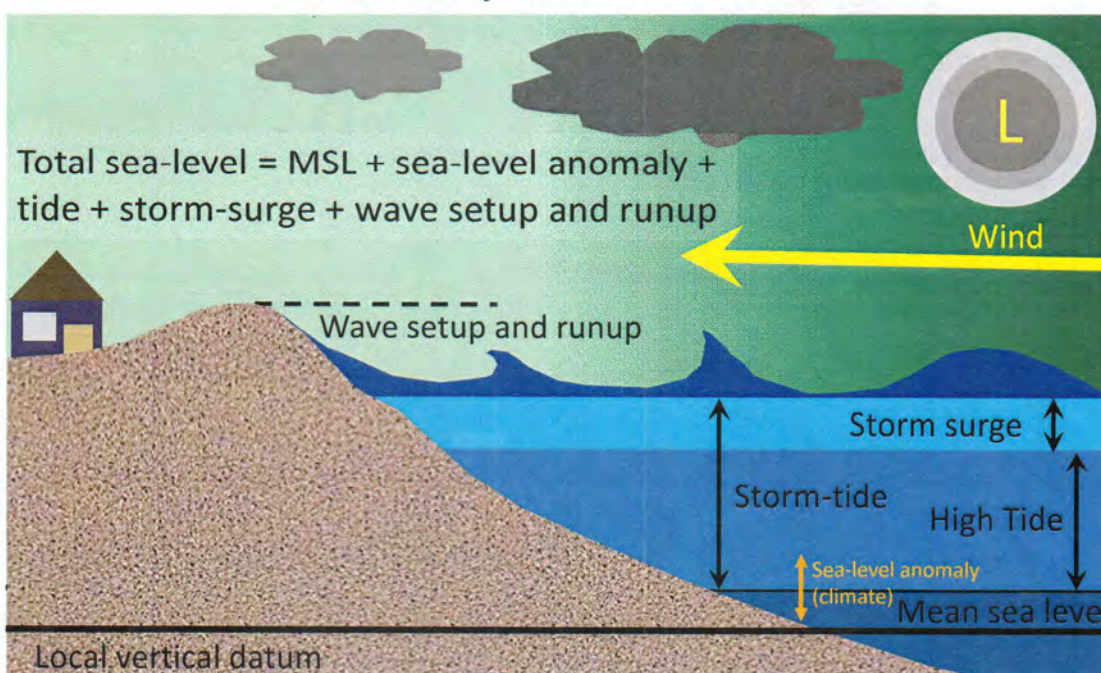
red alert tide dates (highest perigean-spring high tides)

carefree tide dates (lowest neap high tides)

highest red alert tide dates

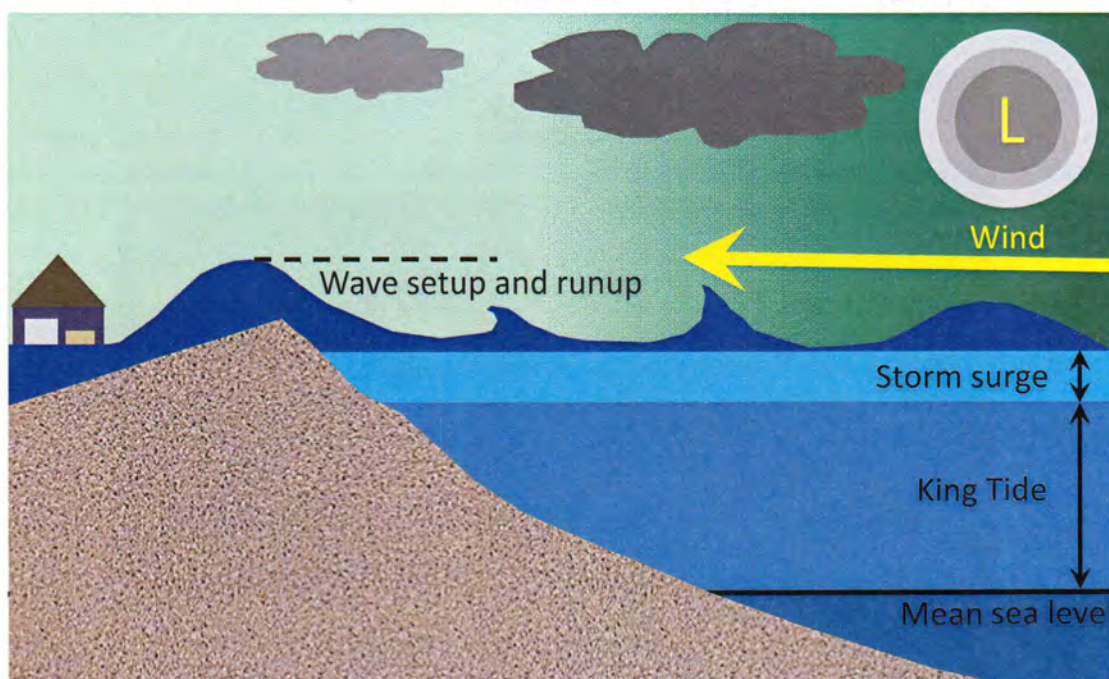
<https://www.niwa.co.nz/our-science/coasts/tools-and-resources/tide-resources>

## Anatomy of a storm tide





## Anatomy of a storm-tide – king tide



### EFFECTS OF THE CYCLONIC STORM : EXTENSIVE DAMAGE ON AUCKLAND WATERFRONT

AUCKLAND DISTRICT SWEEPED BY FIERCE GALE YESTERDAY: ABNORMAL TIDE AND FIERCE WIND RESULTS IN EXTENSIVE SEA ENCROACHMENT ON FORESHORE PROPERTIES

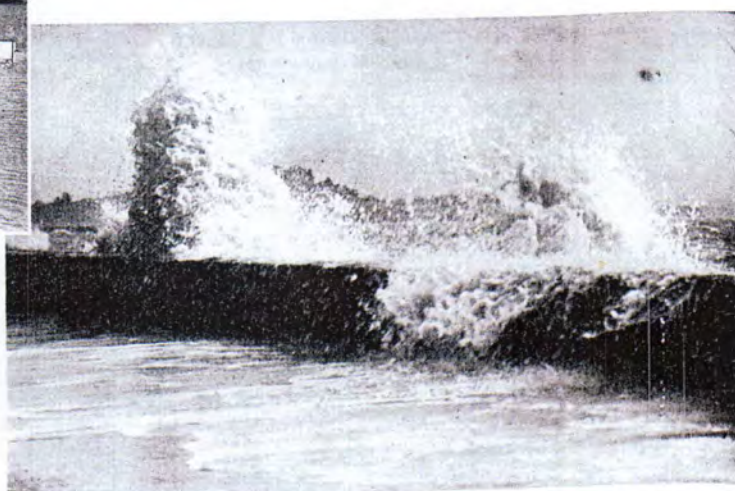
NZ Herald 27 March, 1936



Parnell Baths – Judges Bay (2 ft above baths)

**Event was highest  
storm-tide up to 2011**

3.99 m Chart Datum  
Port of Auckland  
26 March 1936



A typical scene on the Kohimarama waterfront at high tide yesterday morning.



## Happens elsewhere: Whitianga (23 August 1989)



Also sizeable coastal inundation events in 1936, 1968, 1972, 1978

## Auckland awash – 23 Jan 2011 – highest storm-tide on record at Auckland



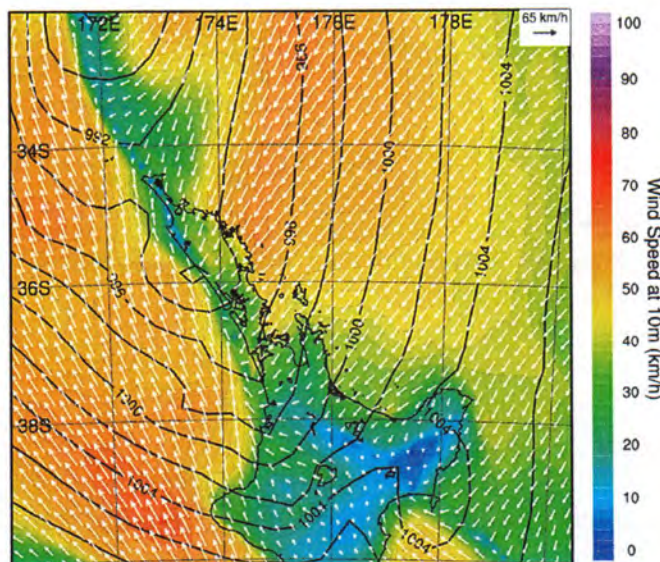
Courtney Agate



NZTA: AMA

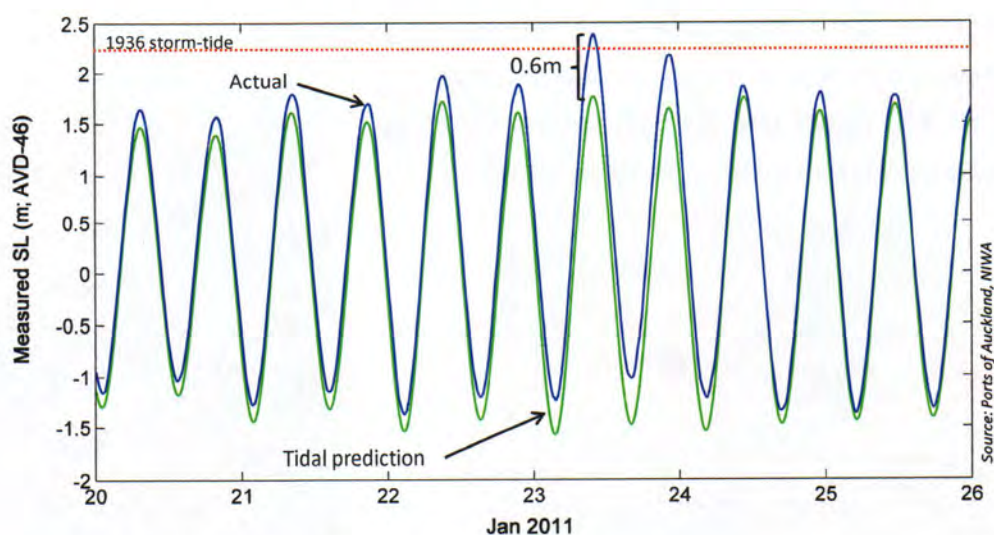


## NIWA EcoConect forecast: 23 Jan 2011

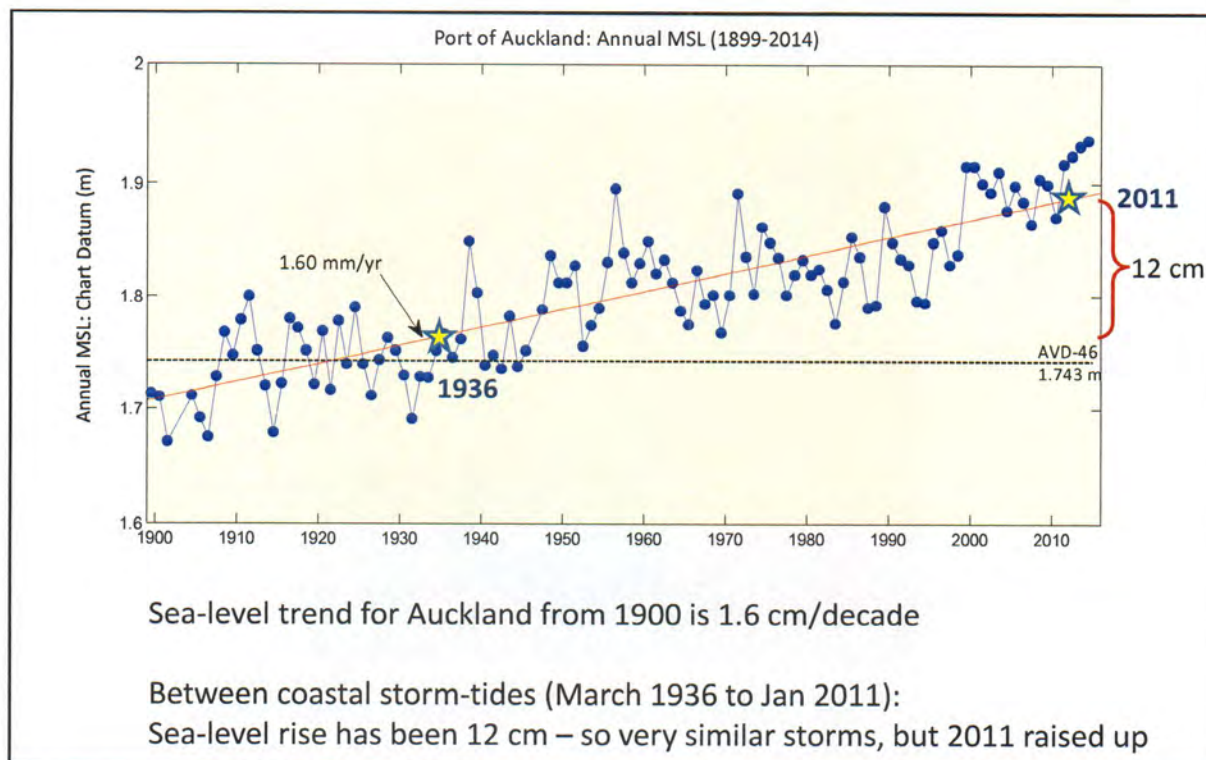


Forecast for 1200 NZST 23 January 2011 (issued 1800 hrs 22 January)

## Storm-tide: 23 Jan 2011 - new record 4.13 m



**A high perigean-spring tide**  
and a 60 cm additional water height (low barometric pressure and wind setup)



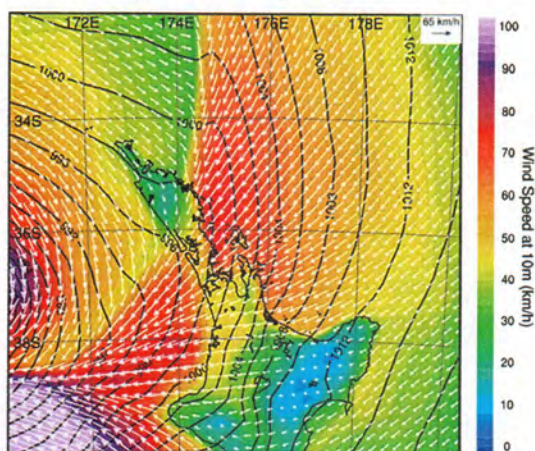
## Tamaki Drive – 17 April 2014 ex TC *Ita*

Tide: lower spring tide (not red-alert)

Moderate storm surge – wind setup

**WAVES! from the NE (shooting the gap)**

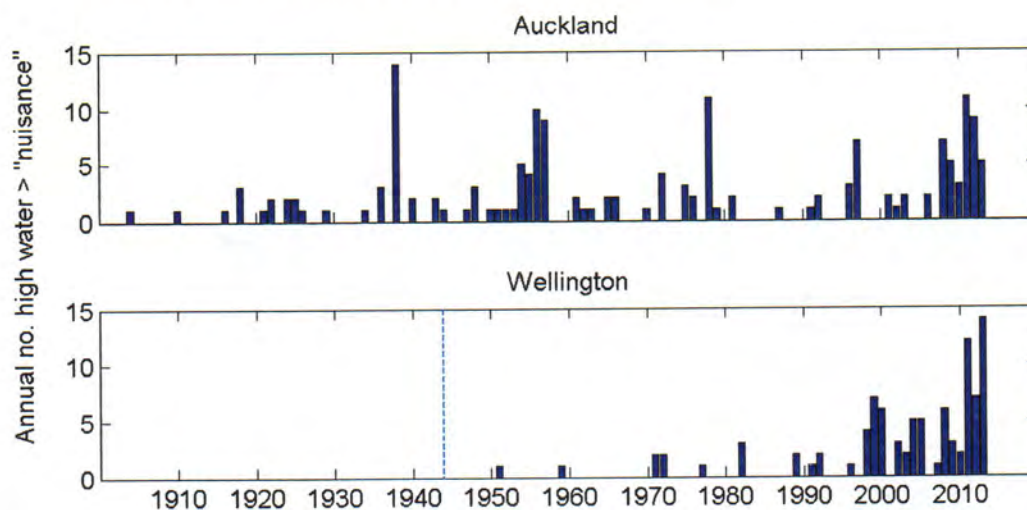
Peaked right on high tide at 9 am



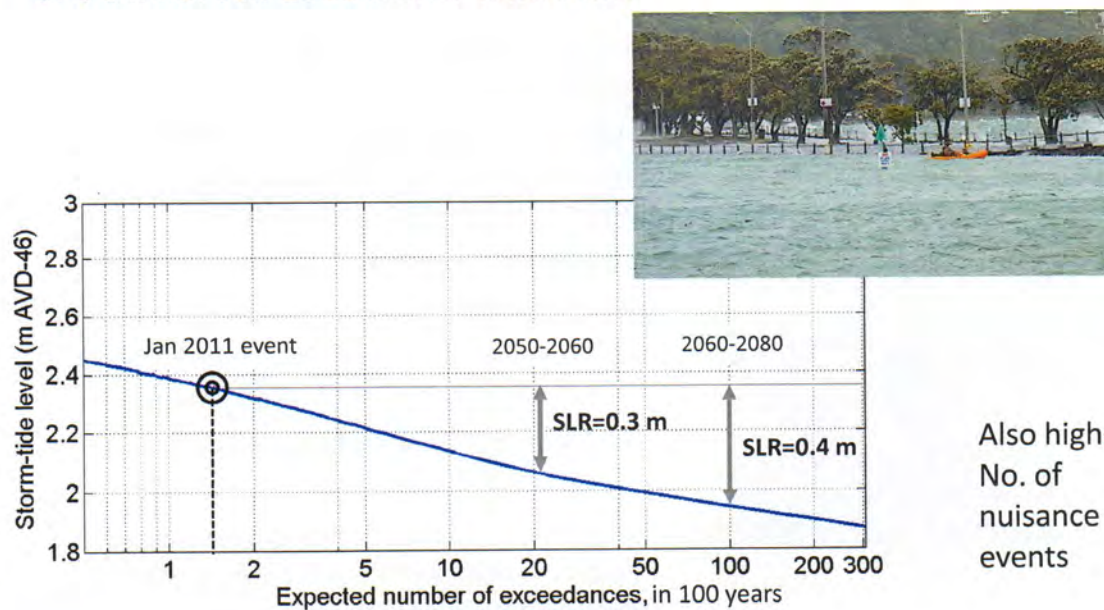


## Annual No. of sea levels > "nuisance"

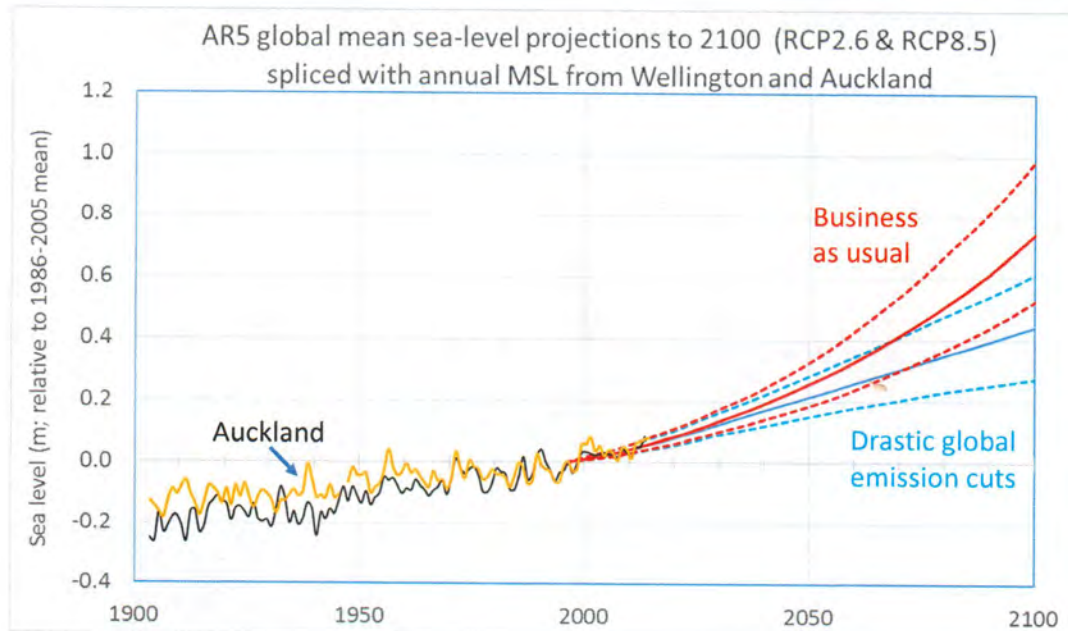
"nuisance" level = MHWS tide + 30 cm = HAT (Auckland)



Expected number of exceedances in a **100-year planning timeframe** of a similar Jan 2011 storm-tide event



Also higher  
No. of  
nuisance  
events



The global-mean sea-level rise projections from the IPCC 5<sup>th</sup> Assessment Report

## Take-aways (1)



- Historic evidence that coastal flooding has affected Tamaki Drive (so not new)
- 1<sup>st</sup> sign of sea-level rise already showing it's hand in Auckland: by more frequent coastal inundation (or higher storm-tides)
- Frequency of Tamaki Drive coastal flooding will increase further as sea level continues to rise:
  - 0.3 m rise: Twenty Jan 2011-type events in 100 year period (or 10 in 50 yrs) [2050-2060]
  - 0.4 m rise: Annual affair of Jan-2011 type events [2060-80]
- Reduction in global emissions will ultimately affect how high sea-level rise tracks – but still need to adapt in any case



## Take-aways (2)



- Effects & issues will vary across NZ: therefore a LOCAL adaptation solution is needed to address the local risks
- Start by putting in place personal contingency plans
- Get involved in King Tide Auckland initiative
- Document events as they happen (photos, water levels) to compile an evidence base
- Engage with Auckland Council and AT about how to plan for increasing flooding – short term and long-term



NIWA - tide resources