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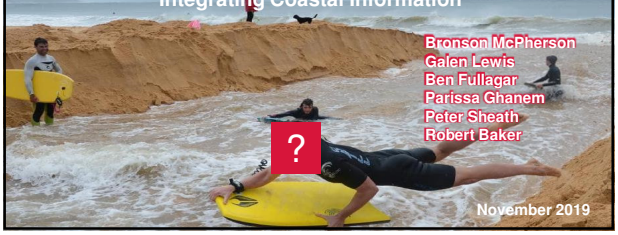
Central Coast Lagoons Flood and Coastal Intelligence Tools
Integrating Coastal Information



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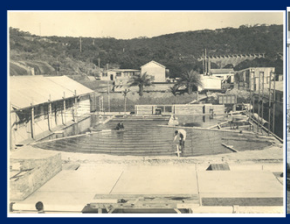
November 2019

Overview

- What are ICOLLS
- What influences ICOLLS
- ICOLL entrance behaviour

Case Study
- Central Coastal Lagoons
  MHL Flood and coastal Intelligence Tool (MHLFIT)

Water modelling and monitoring since 1944 (75 years!)



Port Kembla harbour model circa 1953

Circa 1955

What are ICOLLS

Intermittently Closed and Open Lakes and Lagoons
- Dynamic entrance conditions
- Periodic opening and closing to ocean
- Interface of catchment and coastal processes

ICOLLs – What influences them

Influenced by
- Catchment inflows (upstream)
- Entrance and Lake/Lagoon dynamics (in the middle)
- Ocean water levels and waves (downstream)

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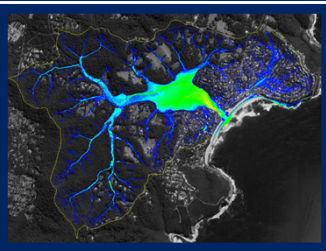
ICOLLS – Catchment inflows (upstream)

Dependent on
- Rainfall
- Catchment wetness
- Impervious areas
- Infrastructure
- Urbanisation



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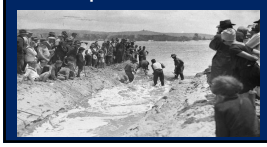
ICOLLS – Entrance dynamics (in the middle)

Dependent on
- Local characteristics
- Entrance management policy
- Manual intervention
  - Government sanctioned
  - Local intervention

Coastal processes



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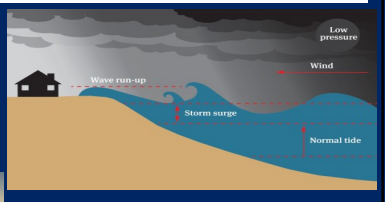
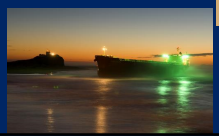
ICOLLS - Ocean Water Levels and Waves (downstream)

Influenced by
- Tides
- Storm surge
- Wave and winds





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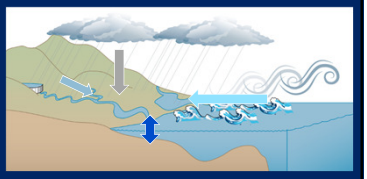
ICOLLs – Real-time Modelling

- Complex interaction between
  - tides
  - waves
  - Rain
  - streamflow
  - entrance dynamics
  - Catchment conditions
- Non-intuitive behaviour



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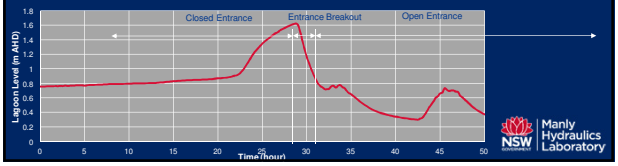
ICOLLS – Entrance Behaviour

1. *Closed Entrance (catchment Inflow):*
   - Focuses on "rising limb" of water level timeseries
   - To obtain reasonable match for time and value of peak water level in lagoon
2. *Entrance Breakout*
   - Focuses on "falling limb" of water level timeseries
   - To obtain reasonable match for entrance opening behaviour and associated drop in water level
3. *Open Entrance - Until the next flood or until it closes*



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ICOLLS – Closed Entrance

- Water Level rise = flow in
- Calibrate catchment inflow model
- Some events have partially open entrance

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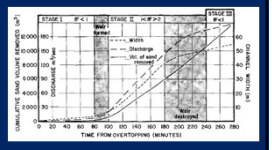
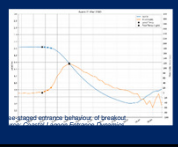
ICOLLS – Entrance Breakout Analysis

- Gordon (1990) presents a three-staged behaviour of entrance opening along NSW Coastline
- Two first stages crucial in entrance breakout modelling
- Statistical analysis of existing water level and hypsometric data allow estimation of typical duration and potential channel area of each of the two stages





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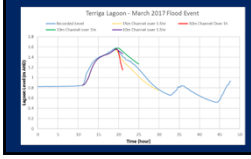
ICOLLS – Entrance Breakout modelling

- Wide range of opening channel dimensions
- Estimating initial berm heights
- Partial opening by manual intervention



Terrigal Aerial Pictures at Various time showing different entrance width
Source: Google Earth

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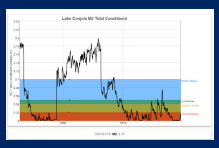
ICOLLs – Open Entrance

- Daily hydraulic calculations of entrance constriction
- Tidal harmonic analysis to calculate M2 – daily amplitude
- Proxy for entrance openness



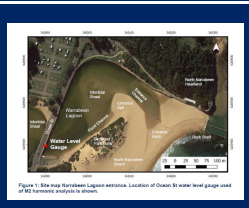


Figure 1: Site map Narrabeen Lagoon entrance. Location of Ocean St water level gauge used of M2 harmonic analysis is shown.

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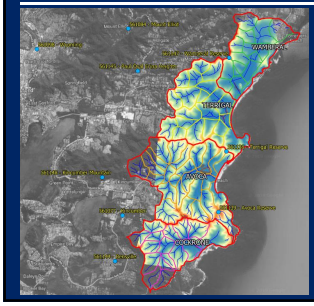
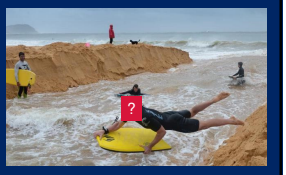
Central Coast Flood and Coastal Intelligence Tool (MHLFIT)





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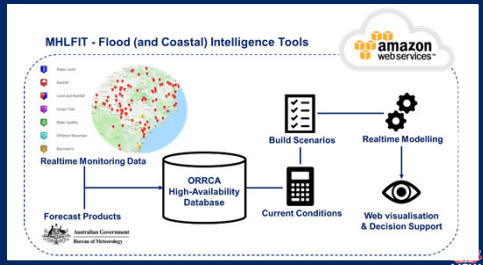
How does MHLFIT work?

MHL FIT



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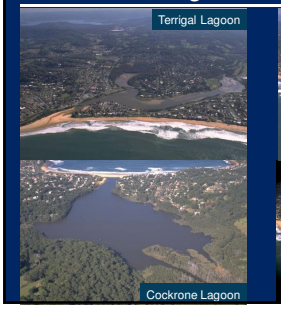
Central Coast Lagoons



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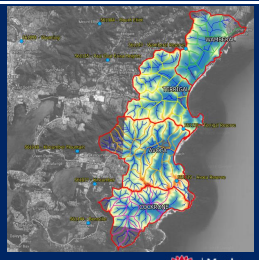
Central Coast Lagoons MHLFIT – Hydrology setup

- Adapted from overland flood study
- Utilises standard routing techniques
- Uses IL-CL loss method
- IL estimated from 10-day antecedent rainfall conditions



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Central Coast Lagoons MHLFIT – Entrance model setup

Wamberal

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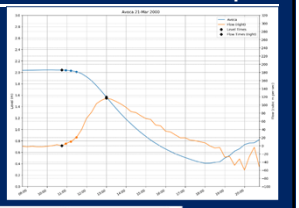
Central Coast Lagoons MHLFIT – Entrance model setup

- Statistical analysis of existing water level
- Entrance management policy
- Local understanding
- Historical information



Lagoon	Adopted Entrance Breakout Width (m)
Wamberal	70
Terrigal	50
Avoca	60
Cockrone	60

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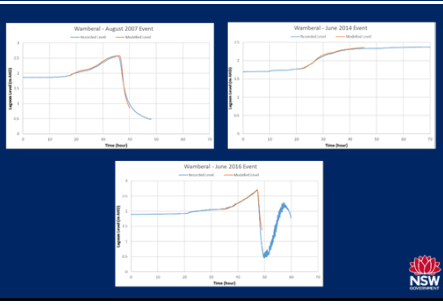
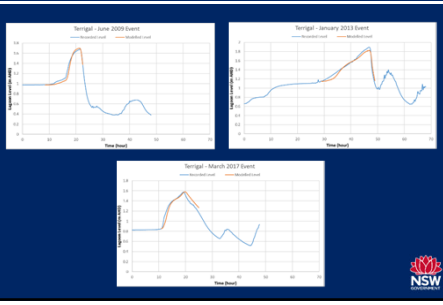
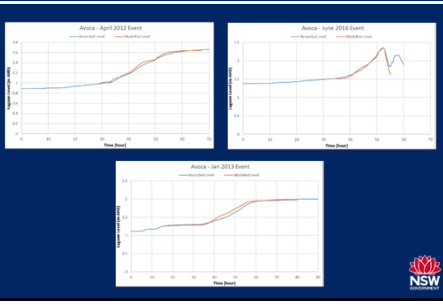
Calibration / Validation Results – Wamberal



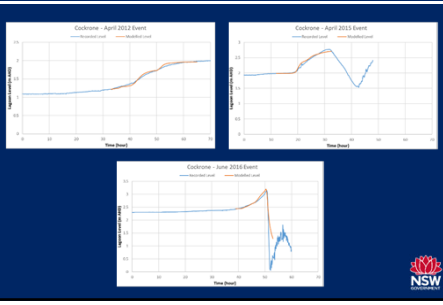
Calibration / Validation Results – Terrigal



Calibration / Validation Results – Avoca

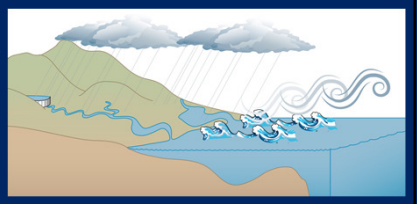


Calibration / Validation Results – Cockrone



Central Coast MHLFIT– Real-time measured data input

Real-time data inputs
- Catchment rainfall
- Entrance conditions
- Ocean tides
- Ocean waves



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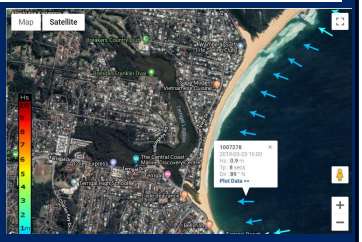
Central Coast MHLFIT – Real-time forecast data input

Forecast input includes:
- Rainfall predictions
- Astronomical tide forecast
- BoM ocean anomaly forecast
- Near Shore Wave data predictions at 10m contour.
- Berm heights
- Wave pumping impacts
- Entrance opening and closing behaviour



Terrigal Lagoon

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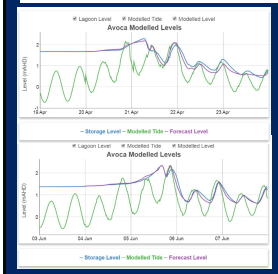
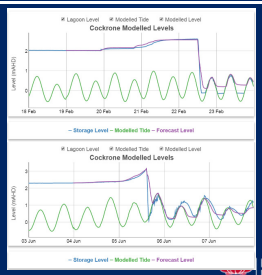
MHLFIT Models – Avoca and Cockrone





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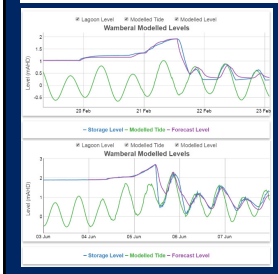
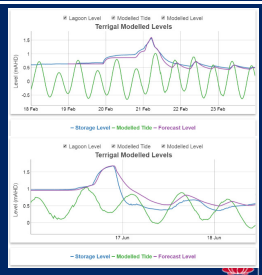
MHLFIT Models – Wamberal and Terrigal





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Central Coast MHLFIT - Dashboard

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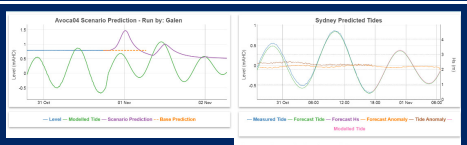
Central Coast MHLFIT – Scenario modelling



Channel Breakout
Tidal Anomaly
Rainfall
Infrastructure management
Berm Height

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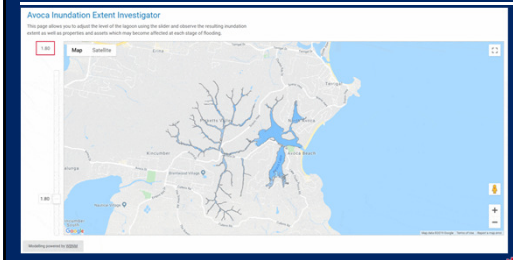
Central Coast MHLFIT - Flood Extent Investigator



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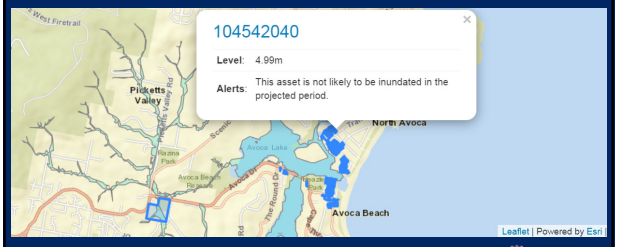
Central Coast MHLFIT - Flooding at key locations



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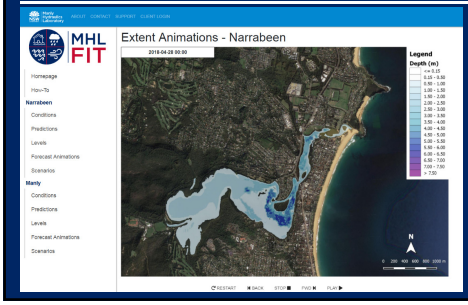
Central Coast MHLFIT - Extent animations



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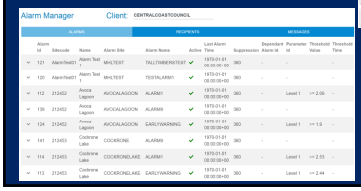
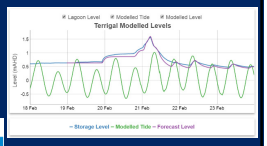
Central Coast MHLFIT - Smart Alerting

Prediction based alarming
Scenario based alarms
Alerting to inform work requests
Web based management system





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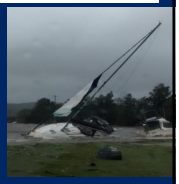
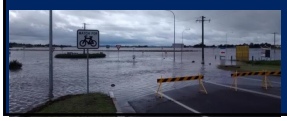
Conclusions

Management of ICOLLs can have a large impact on flooding and coastal inundation of low-lying urbanised developments.

Tools such as MHLFIT provide real-time information to assist ICOLL management

Continuation of the NSW coastal data network program that MHL undertakes on behalf of Environment, Energy and Science (EES) Division of DPIE is essential for the ongoing management of the coastal environment in NSW





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NSW Modelling and Monitoring Hub (MaMH)

The (MaMH) is a knowledge network led by a state-wide representative Working Group

Aim to aid information sharing across government in relation to water modelling and monitoring.

Growing need for water knowledge sharing

There are existing capabilities and tools within some agencies

Lack of overall integration

Testing integration platforms but more to come!

See www.mamh.nsw.gov.au

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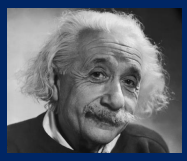
Questions

"Everything should be made as simple as possible, but not simpler"



-Albert Einstein

"Imagination is more important than knowledge"

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