

An aerial photograph of a rugged coastline. The land is brown and rocky, with steep cliffs meeting the blue ocean. The sky is light blue with some clouds. The text is overlaid on the image.

Positioning Tidal Datums for the Purpose of Realising a Marine Cadastre

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The Coastline

- At the intersection of the foreshore and a nominated tidal plane
- Basis for numerous maritime boundaries
- Environment is complex and highly dynamic
- Relatively static boundary definition in comparison

The Coastline

- The dynamic nature of the coastline can be divided into the effects of the environments that encompass it
- Link between the terrestrial environment and marine environment
- Terrestrial environment is effected by erosion and accretion
 - Causes: storm surges, cyclones, cross-shore sand transport, inlet breaching and migration etc..
- Marine environment is effected by tides and meteorological phenomena
 - Causes: winds, temperature, air pressure etc..

The Marine Cadastre

- Seeks to enhance the management and administration of marine boundaries and their associated rights, restrictions and responsibilities
- Some of the differences between marine and land cadastre
 - a wide range of overlapping, but discrete parcels
 - volumetric dimensions, as opposed to planimetric
 - virtual demarcation of boundaries
 - temporal nature of marine boundaries
- Defining jurisdictional boundaries is an irrevocable part of good governance
- The coastline is an important part of realising a marine cadastre

Coastal Definitions

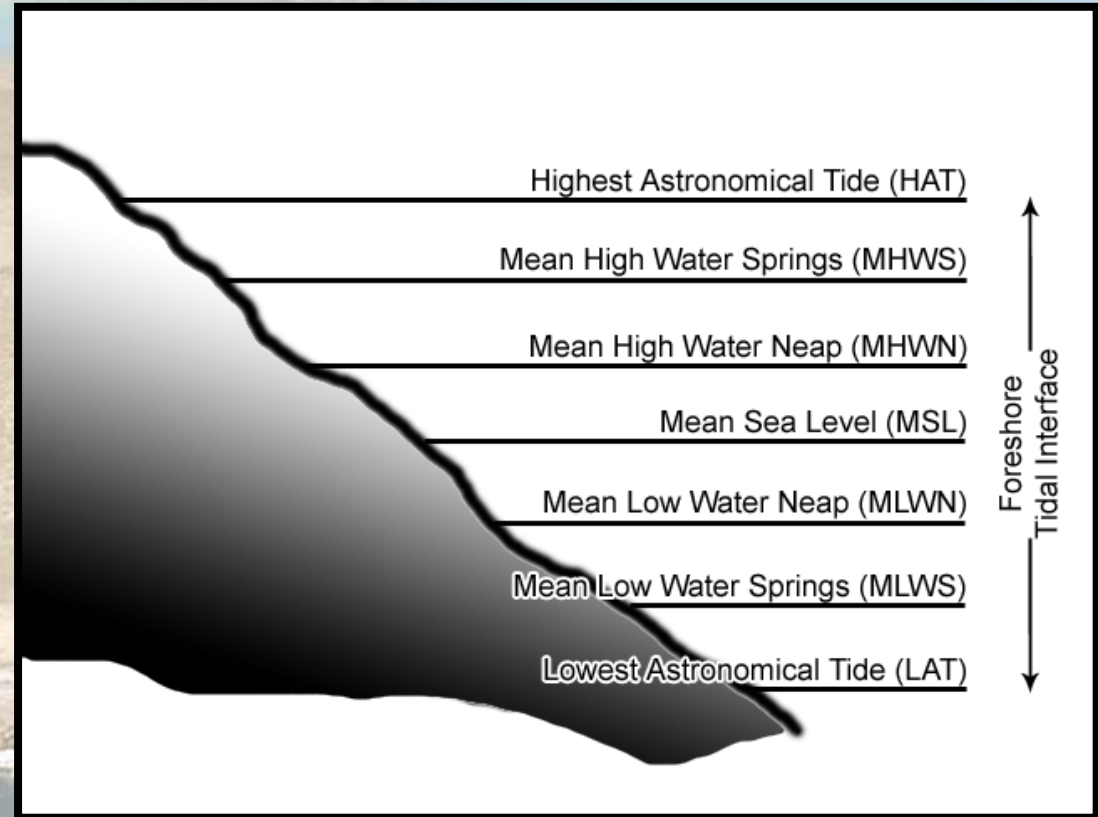
- Coastal terminology is not always clear-cut

Administrative Boundaries Terminology Act 1985 - Sect 5	"foreshore" , "shore" , "coastline" , or other similar term, means the high-water mark along the foreshore, shore, coastline or similar feature;
Coastal Protection And Management Act 1995 - Schedule 2	"foreshore" means the land lying between high water mark and low water mark as is ordinarily covered and uncovered by the flow and ebb of the tide at spring tides.
Fisheries Act 1994 - Sect 4	"foreshore" means parts of the banks, bed, reefs, shoals, shore and other land between high water and low water.
Queensland Consolidated Acts - Volume 1 - Sect 3	"foreshore" means the land lying between high-water mark and low-water mark at ordinary spring tides.

Source: Queensland legislation, Todd 2001

Tidal Datums

- Technical details of tidal plane calculations shall not be covered in this presentation



The Research Problem

- Stems from the requirement for a marine cadastre
 - Stakeholders need clear spatial and legal certainty of their rights, restrictions and responsibilities
- Coastline is a fundamental part of a marine cadastre
 - Boundaries are a fundamental part of a cadastre
 - The coastline is the basis for numerous marine boundaries
- Justification for defining the coastline
 - Currently is ambiguous in the spatial and legal senses
 - Potential for conflict in the coastal zone



Research Aims

This research aims to improve on conventional methods of mapping the coastline by providing a methodology that uses modern technology to increase the accuracy in positioning the coastline in respect to any required tidal plane.

The focus will also be on the adoption of the technical solution into current and future administrative and legal frameworks – including a marine cadastre.

Delineation Requirements

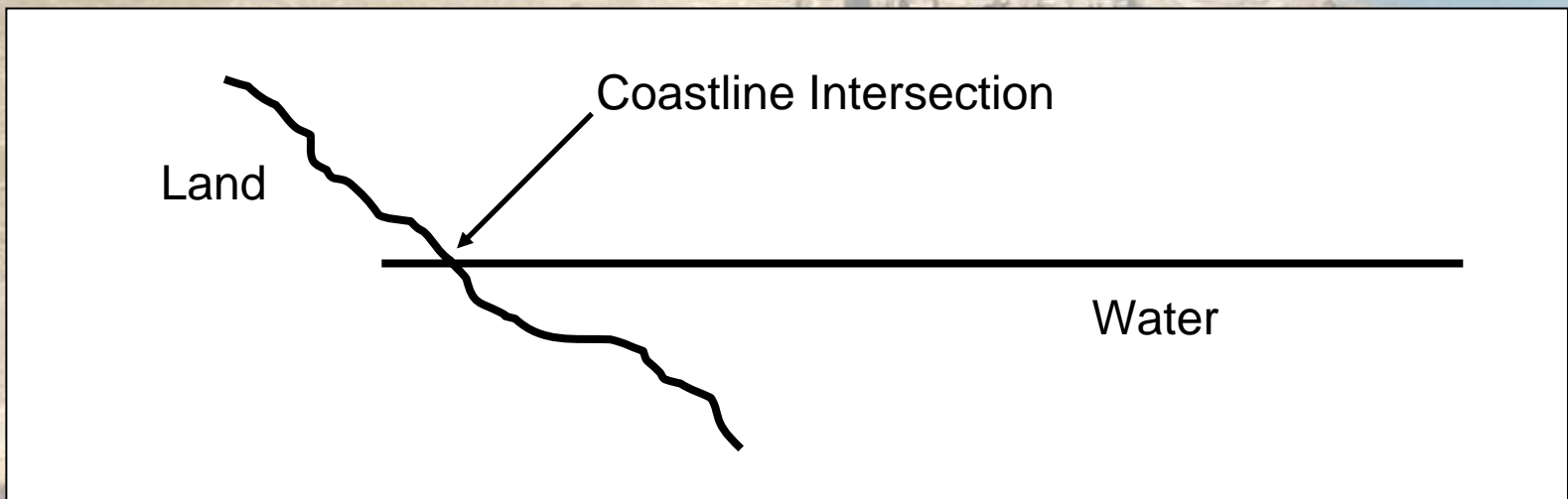
- Three important considerations to optimise solution:
 - Accuracy
 - Consistency
 - Ability to up-date
- Automated process improves consistency and ability to up-date

Aims

→ Delineation

Mathematical Method of Coastline Delineation

- Terrestrial Surface
- Water Surface
- Intersection



Terrestrial Surface Generation

- National Geodetic Survey (NGS) in U.S has investigated different sources of coastal terrain data:
 - Synthetic Aperture Radar (SAR)
 - Light Detection and Ranging (LIDAR)
 - Imaging Spectroscopy (Hyperspectral data)
- SAR has been used for coastline mapping in Alaska
 - Result is inadequate to be included in nautical charts due to ground resolution
- LIDAR has been used by the US Army Corps of Engineers

Water Surface Generation

- Two ways to create a tidal datum surface
 - Interpolate data between tide gauges
 - Generate the surface from a hydrodynamic model
- Interpolation Technique
 - May work along an open coastline
 - Not appropriate for regions of complex terrain that contain bays, rivers, islands etc..
- Hydrodynamic Model Technique
 - Better suited to regions that have complex terrain
 - Requires significantly more time for calibration

Hydrodynamic Model

- Generated from harmonic constituents at the models boundaries
- Contribution of constituents to tidal range heights is calculated for each grid point in relevant region
- Tidal range contribution of each relevant constituent is used to calculate the surface for each tidal datum
- Calculations conducted in customised software

Aims

→ Delineation

Coastline Generation

- Calculated from the intersection of the terrain and water surfaces
- Surfaces can be represented as grids or triangulated irregular networks (TINs)
- Representation and storage of the coastal vector will be investigated
- Smoothing of the coastal vector will be required for views of a differing scale

Procedure

Identified Problems and Limitations

- Hydrodynamic Model
 - The creation of a tidal model would be advantageous to the project as it would give control over a significant portion of the water surface
 - Creation would take a significant amount of time
 - The use, and not creation, is the primary part of the research
- LIDAR Data
 - Confined to regions where LIDAR data has been gathered

