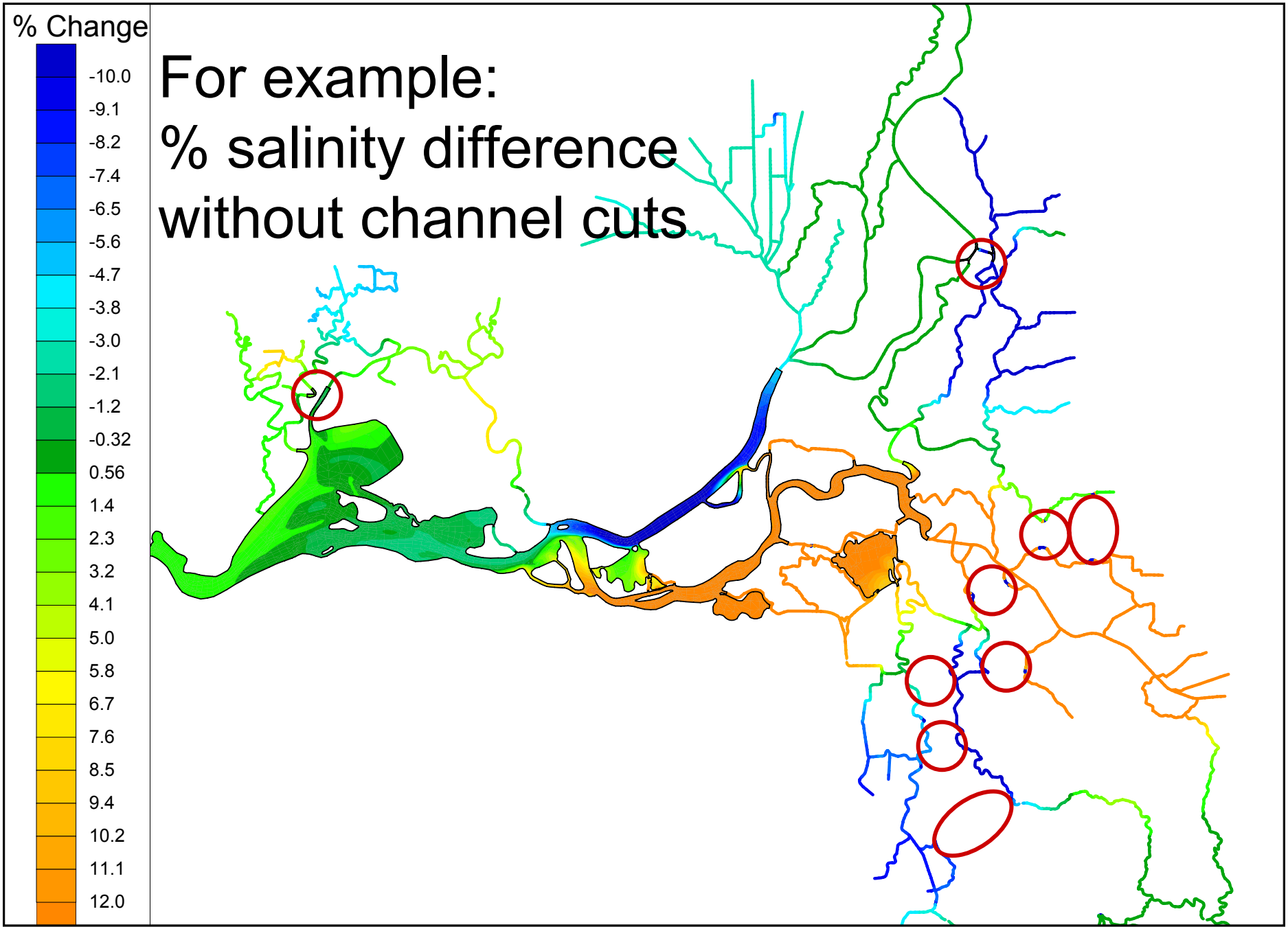
Marsh geometry affects scalar transport: Implications of restoring tidal action to formally diked wetlands

Chris Enright

Suisun Marsh Planning, DWR

Key points

- Suisun Marsh Plan actions will (sooner or later) change the geometry of Suisun Marsh.
- Marsh geometry affects transport of salinity, contaminants, organic matter, and some biota (scalars).


% Change
-10.0
-9.1
-8.2
-7.4
-6.5
-5.6
-4.7
-3.8
-3.0
-2.1
-1.2
-0.32
0.56
1.4
2.3
3.2
4.1
5.0
5.8
6.7
7.6
8.5
9.4
10.2
11.1
12.0
For example:
% salinity difference
without channel cuts

What CE's transport conceptual model is about

1. A primer on scalar transport in tidal estuaries that defines concepts and terms.
2. Implications of geometry modifications for Suisun Marsh charter goals.
3. Discussion of scalar transport tradeoffs that may arise with tidal restoration.
4. Relative importance of other factors affecting scalar transport over time in the San Francisco Estuary.
5. Recommendations for multi-disciplinary process analysis of Marsh.

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Implications of geometry changes for Suisun Marsh charter goals

- Tidal wetland restoration (ES recovery)
- Managed wetland enhancement
- Water quality (salt, contaminants, biota)

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→ Levees and land elevation

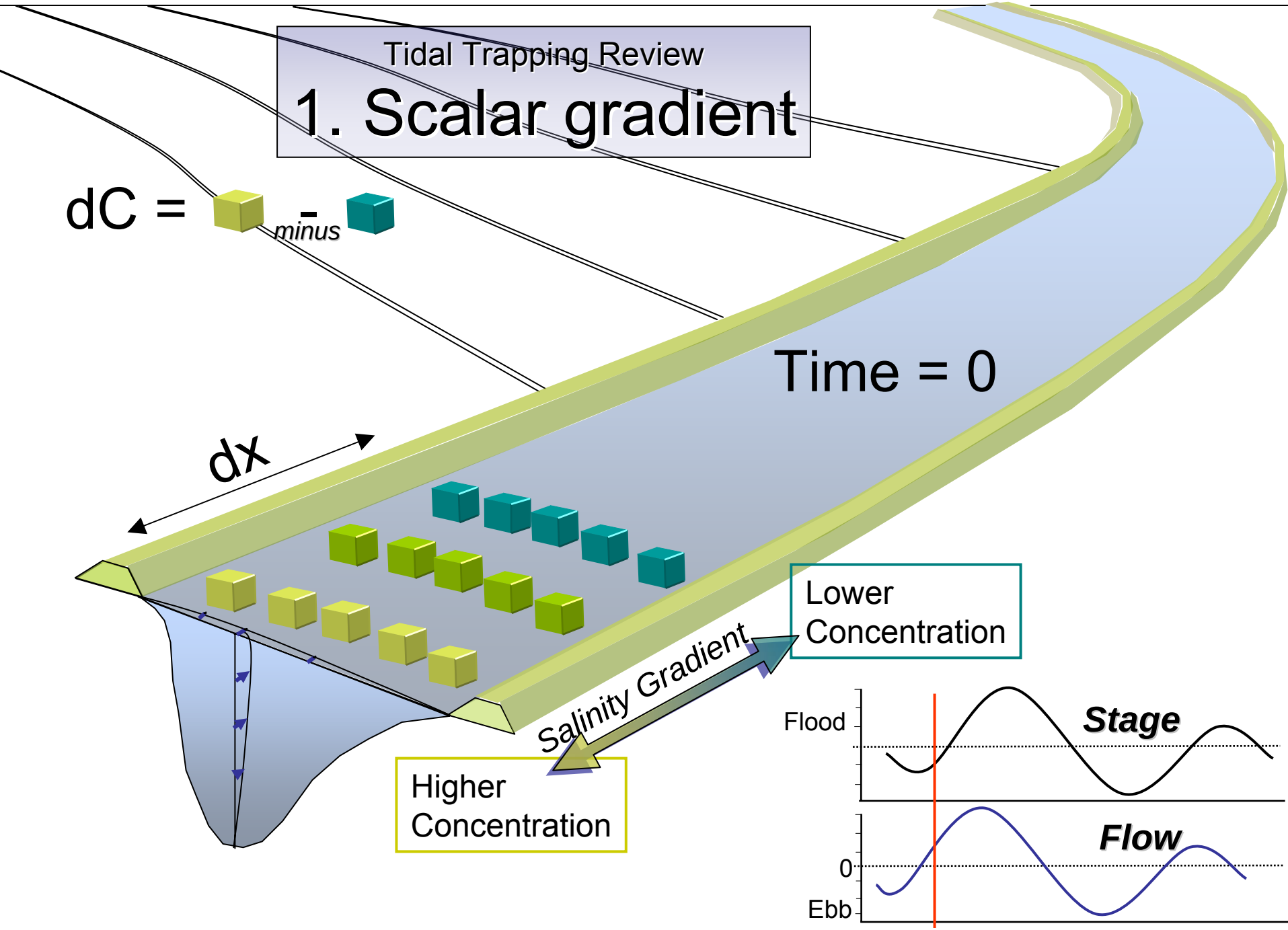
Scalar transport by Tidal Trapping

Two conditions must exist:

1. Scalar gradient (dC/dx, the rate of concentration change with distance)
2. Current asymmetry

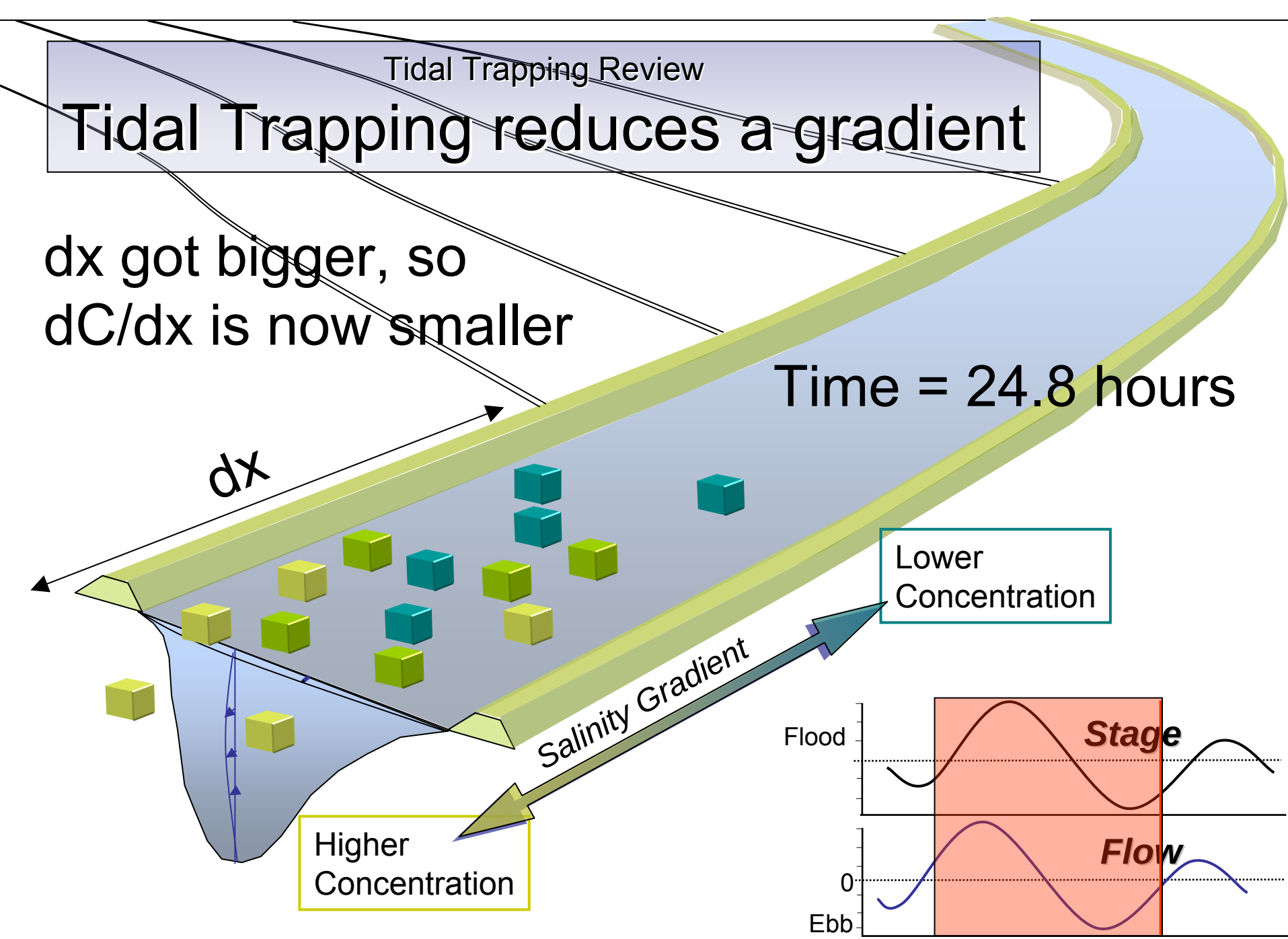
Tidal Trapping Review

1. Scalar gradient

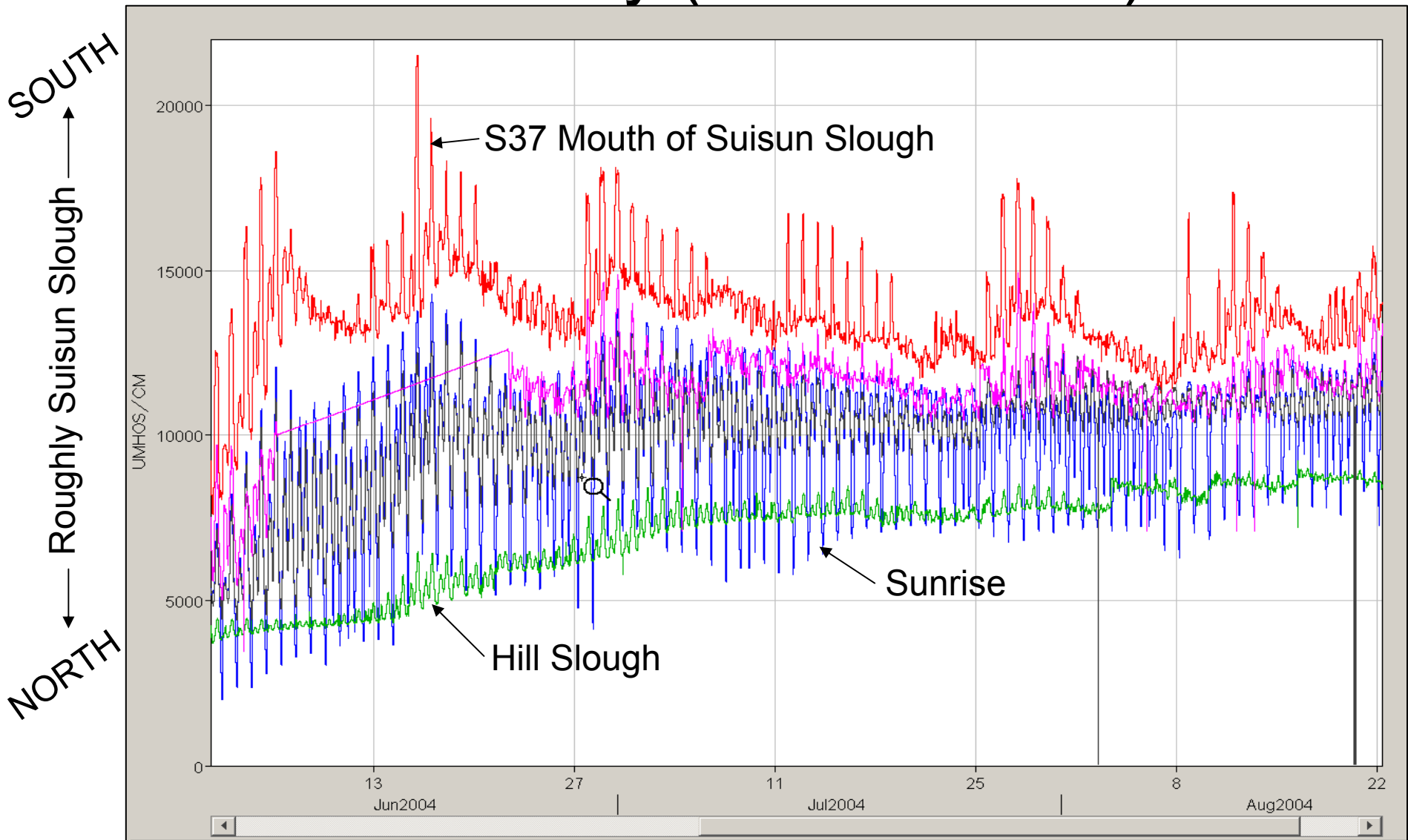


Tidal Trapping reduces a gradient

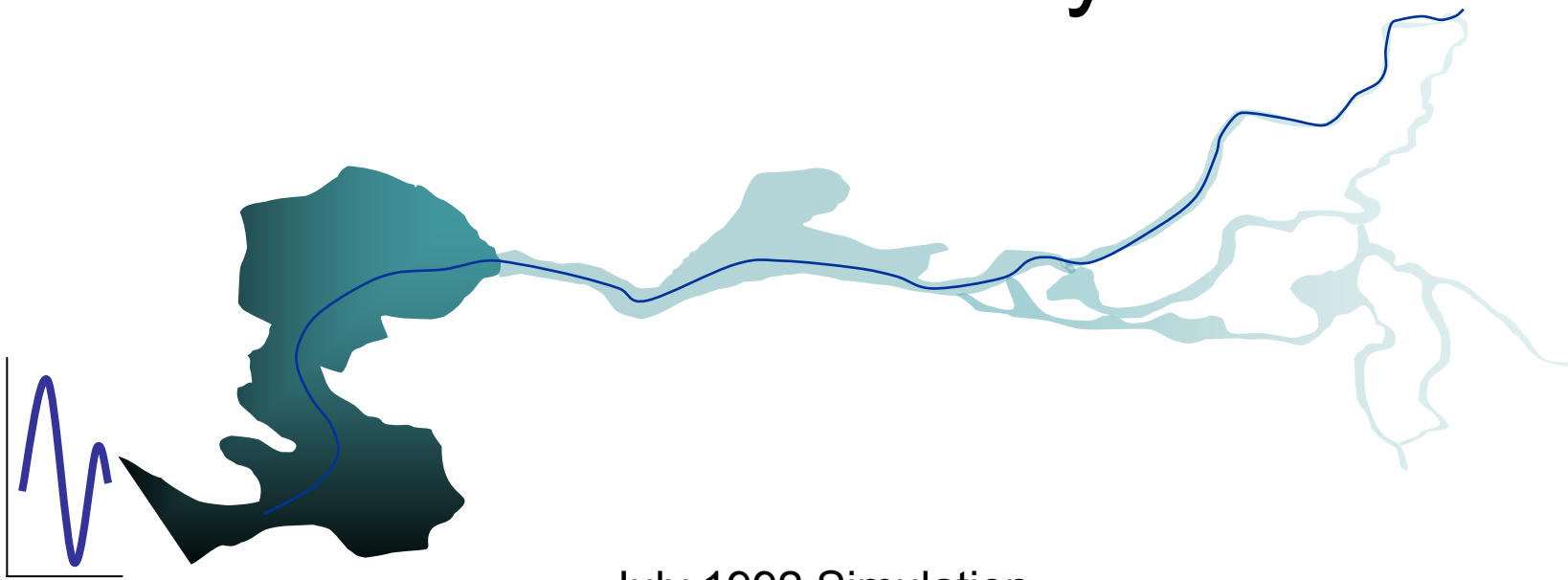
dx got bigger, so
dC/dx is now smaller

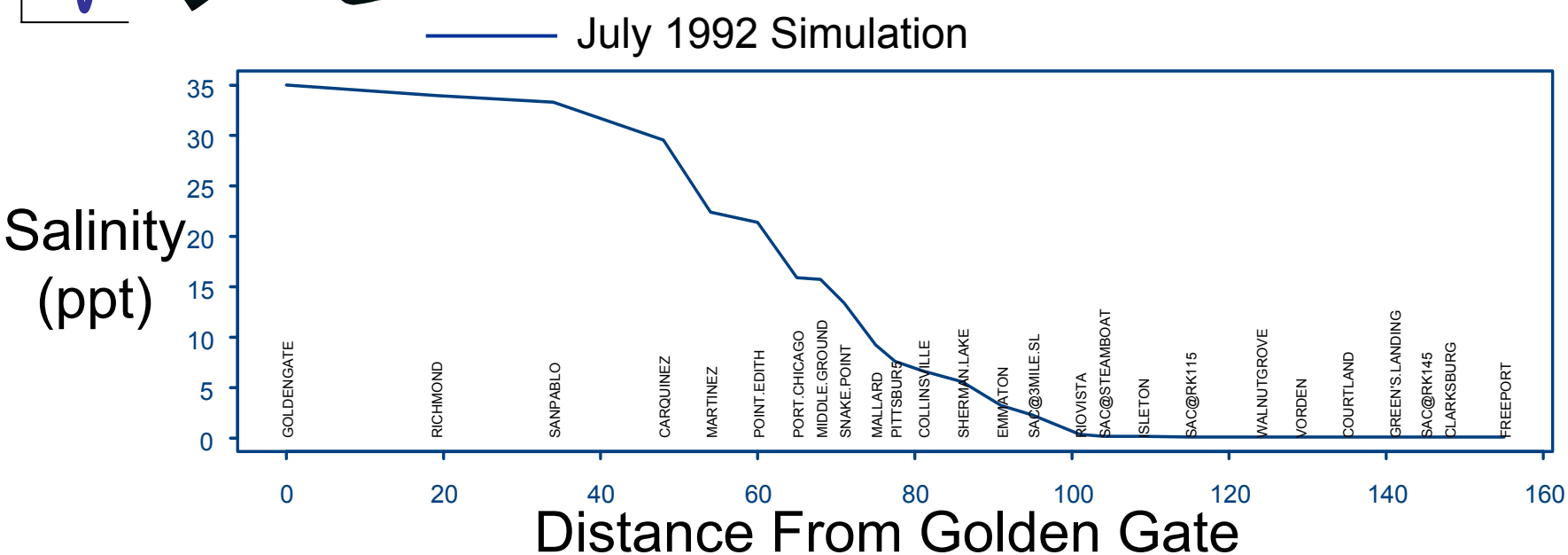


Suisun Marsh has the biggest gradients in the estuary (N-S and E-W)!



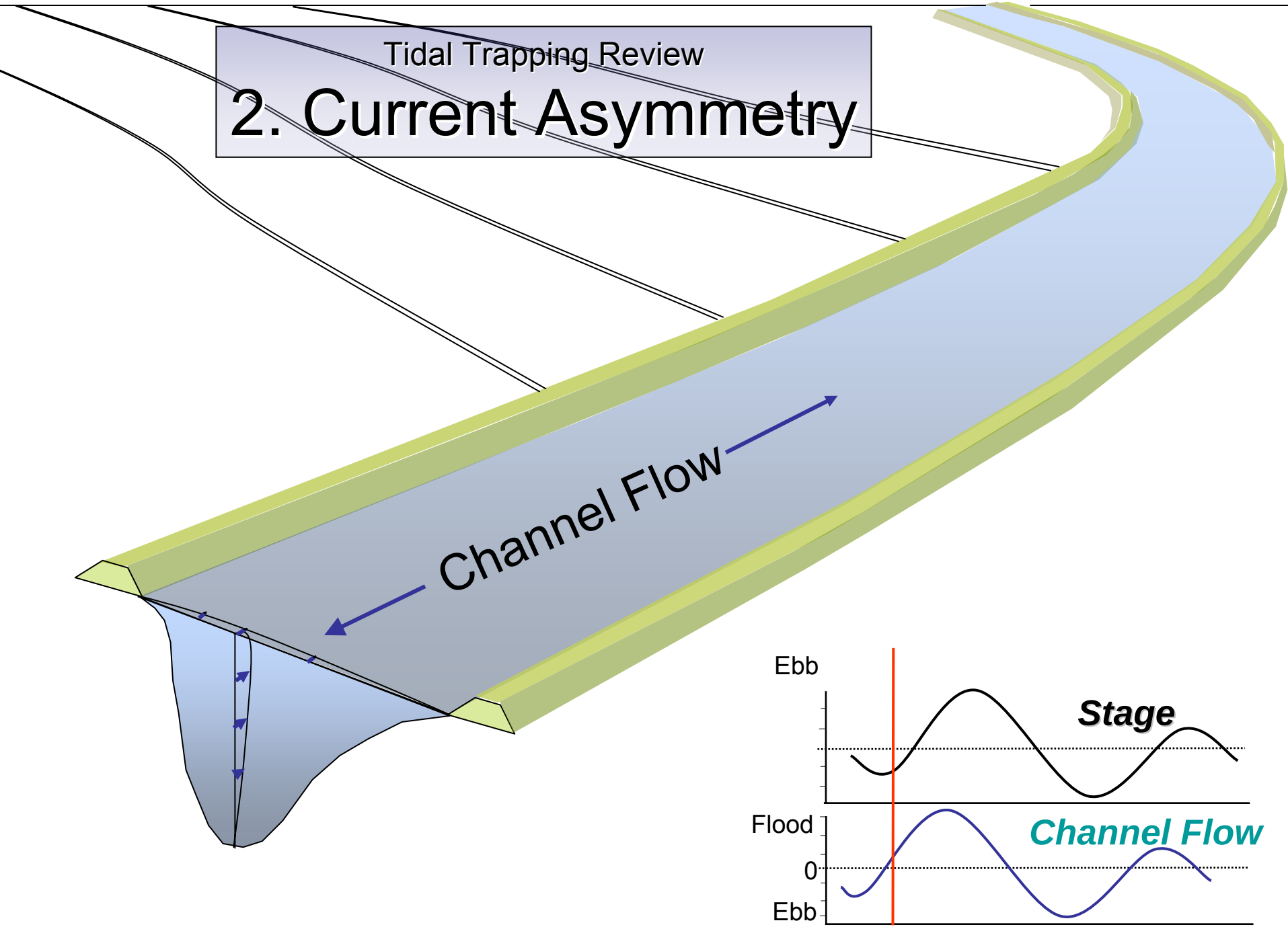
East-West Salinity Gradient





Tidal Trapping Review

2. Current Asymmetry



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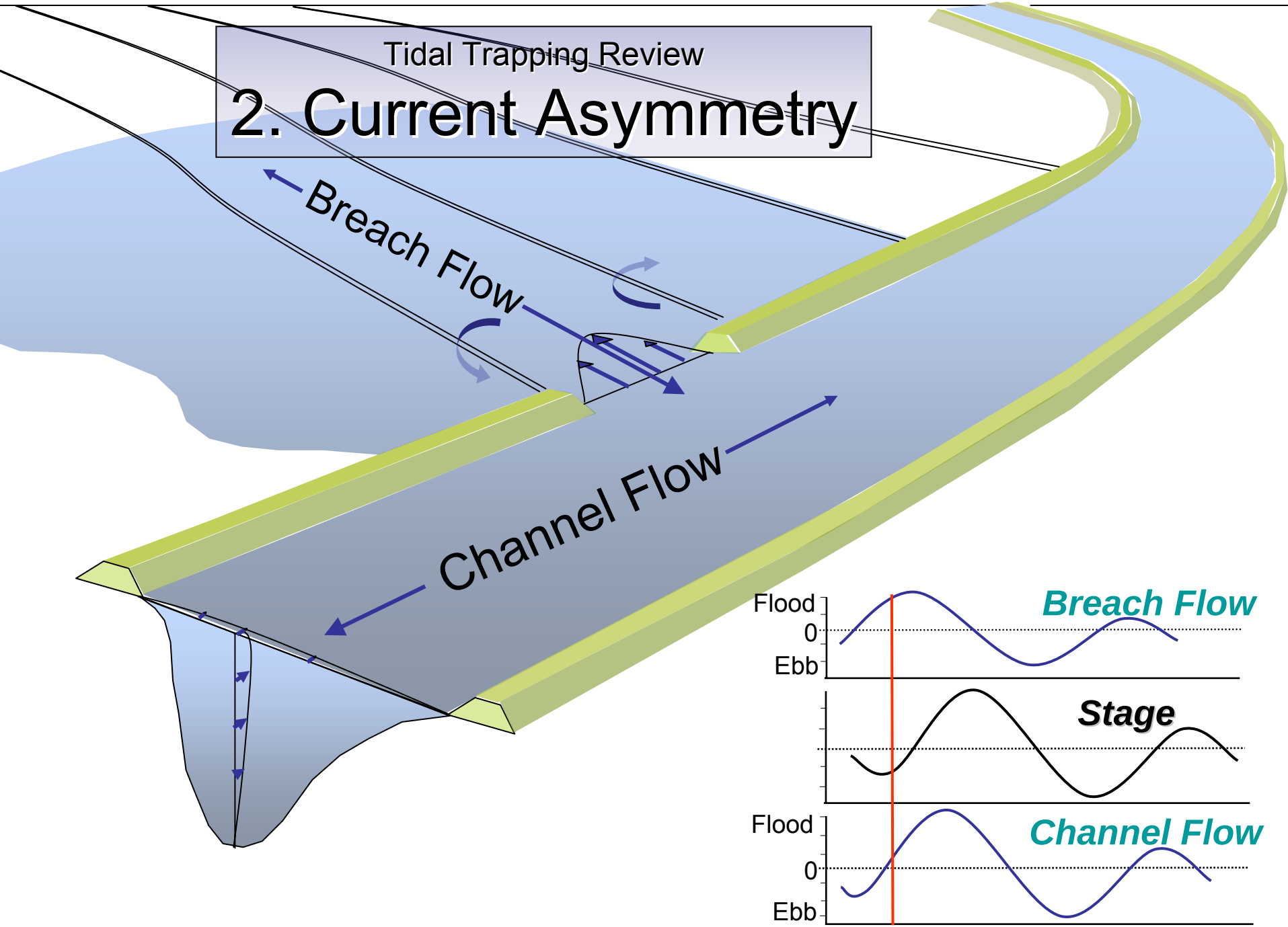

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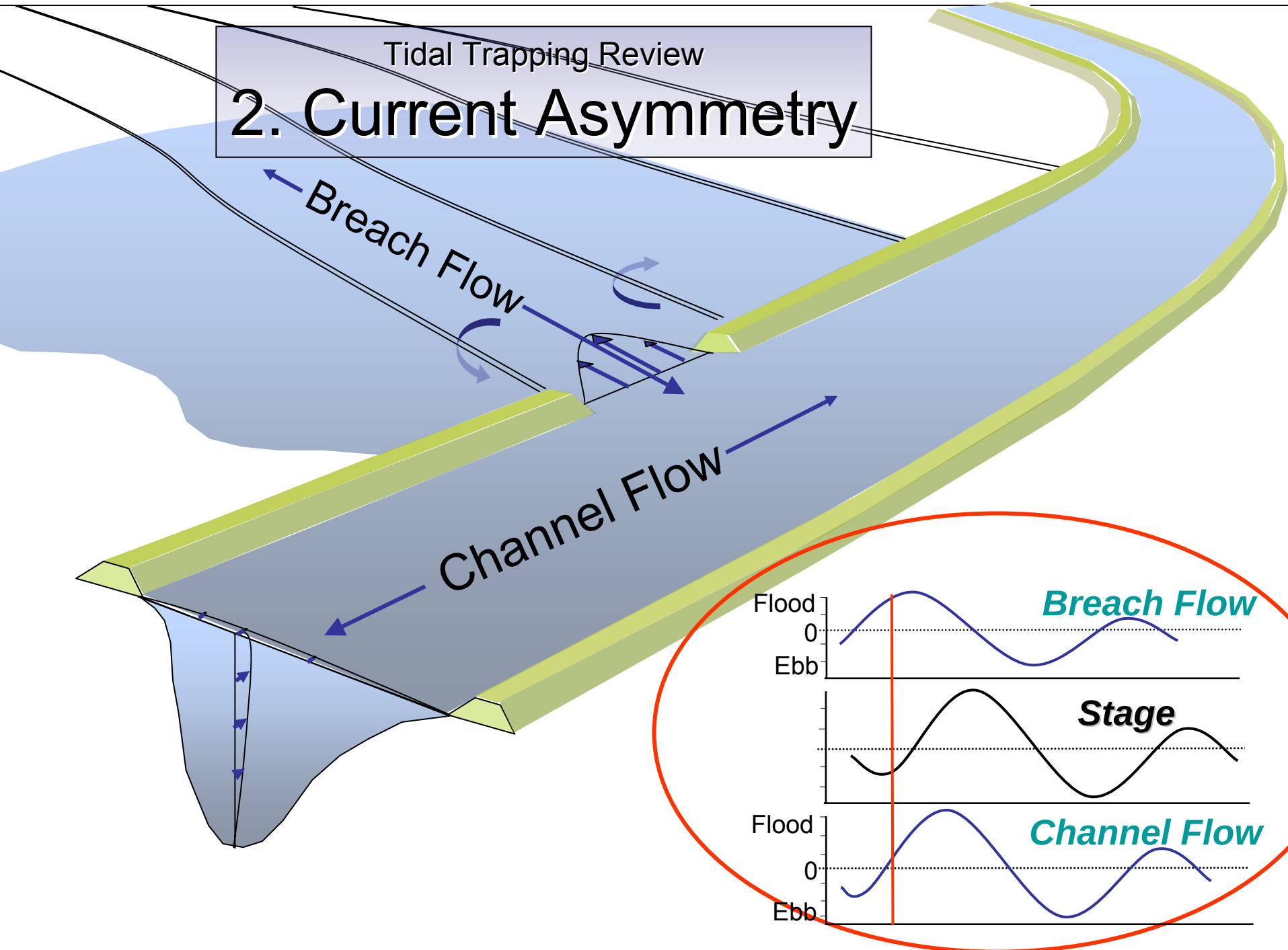
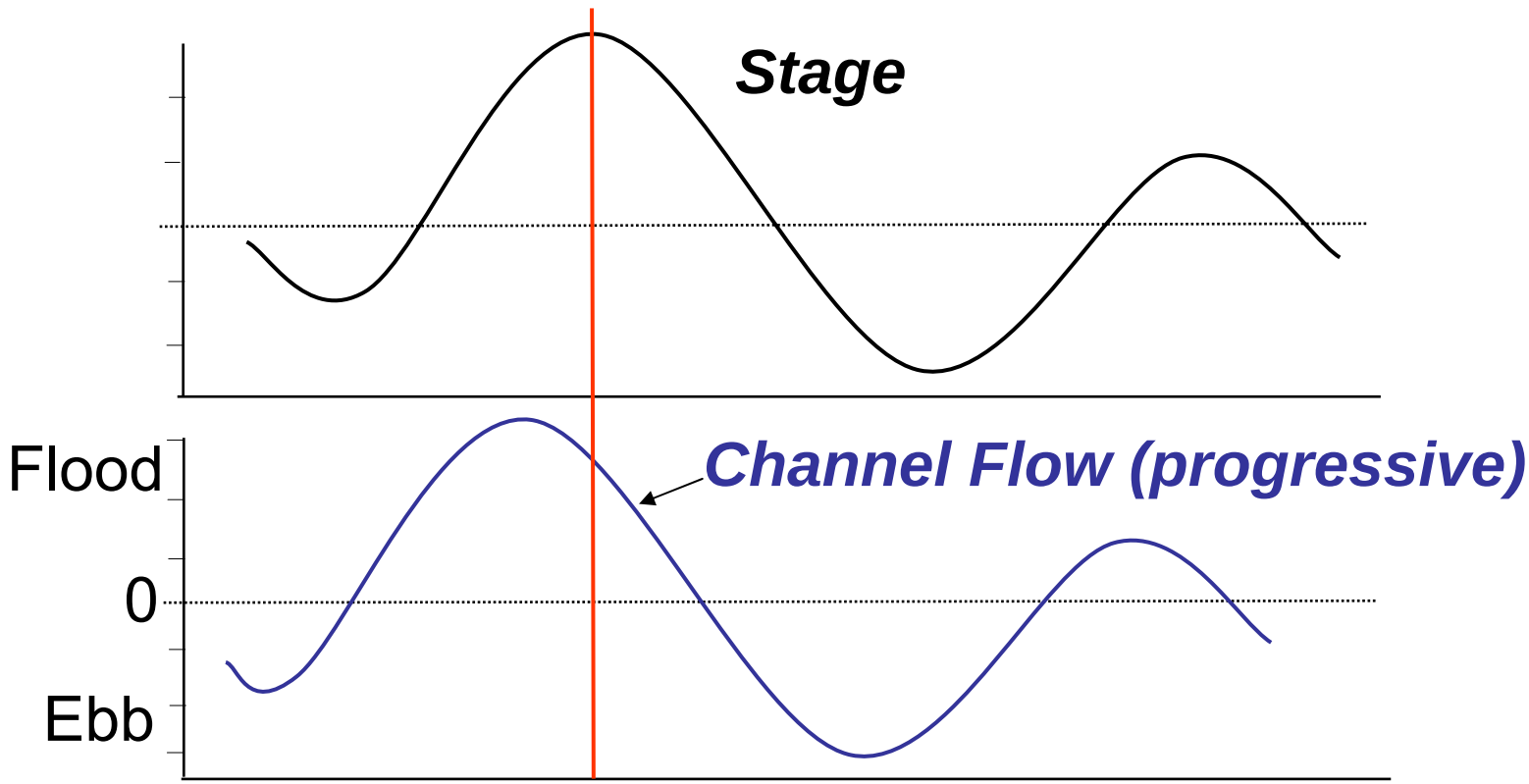


Tidal Trapping

- Timing of tidal stage and tidal flow:



Typical of Suisun Bay

Tidal Trapping

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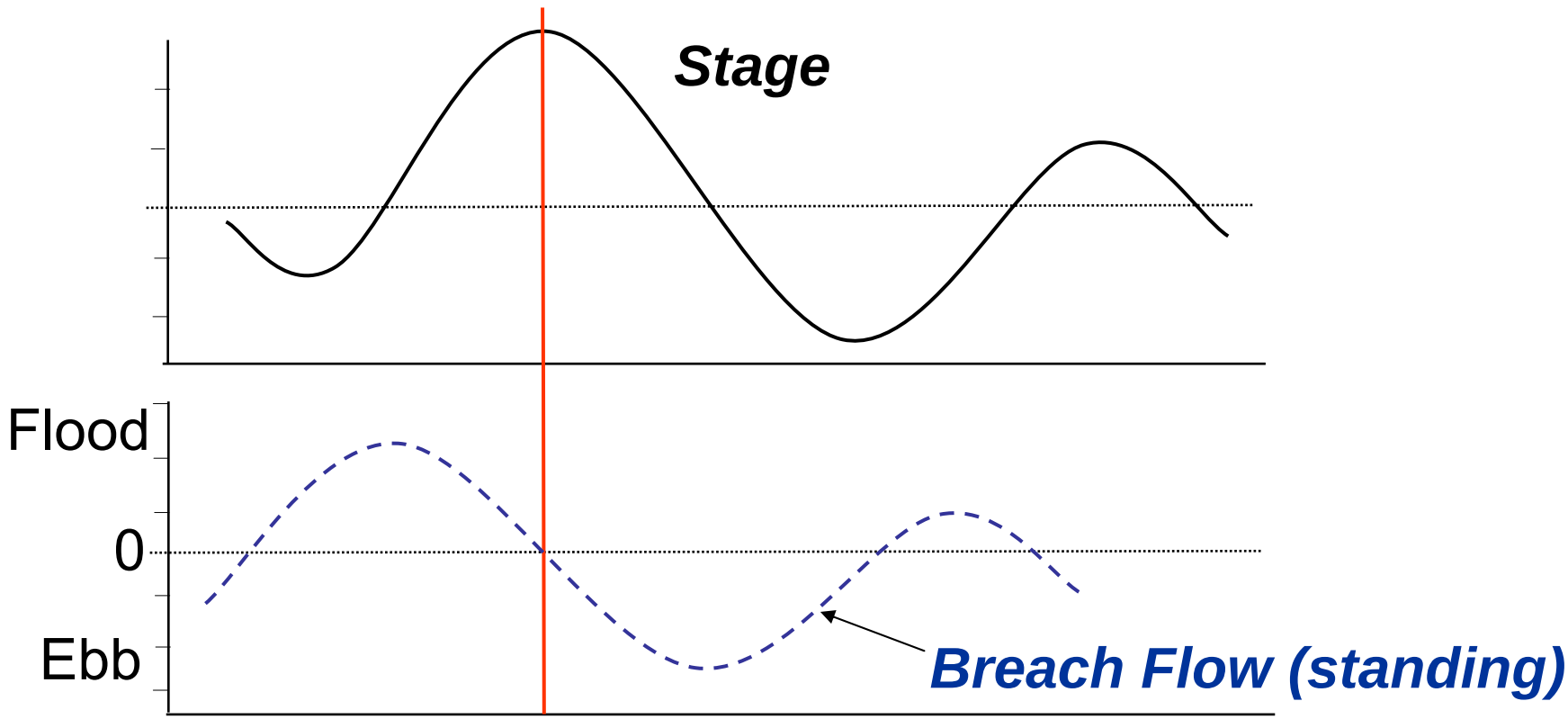

Typical of Suisun Marsh

Tidal Trapping

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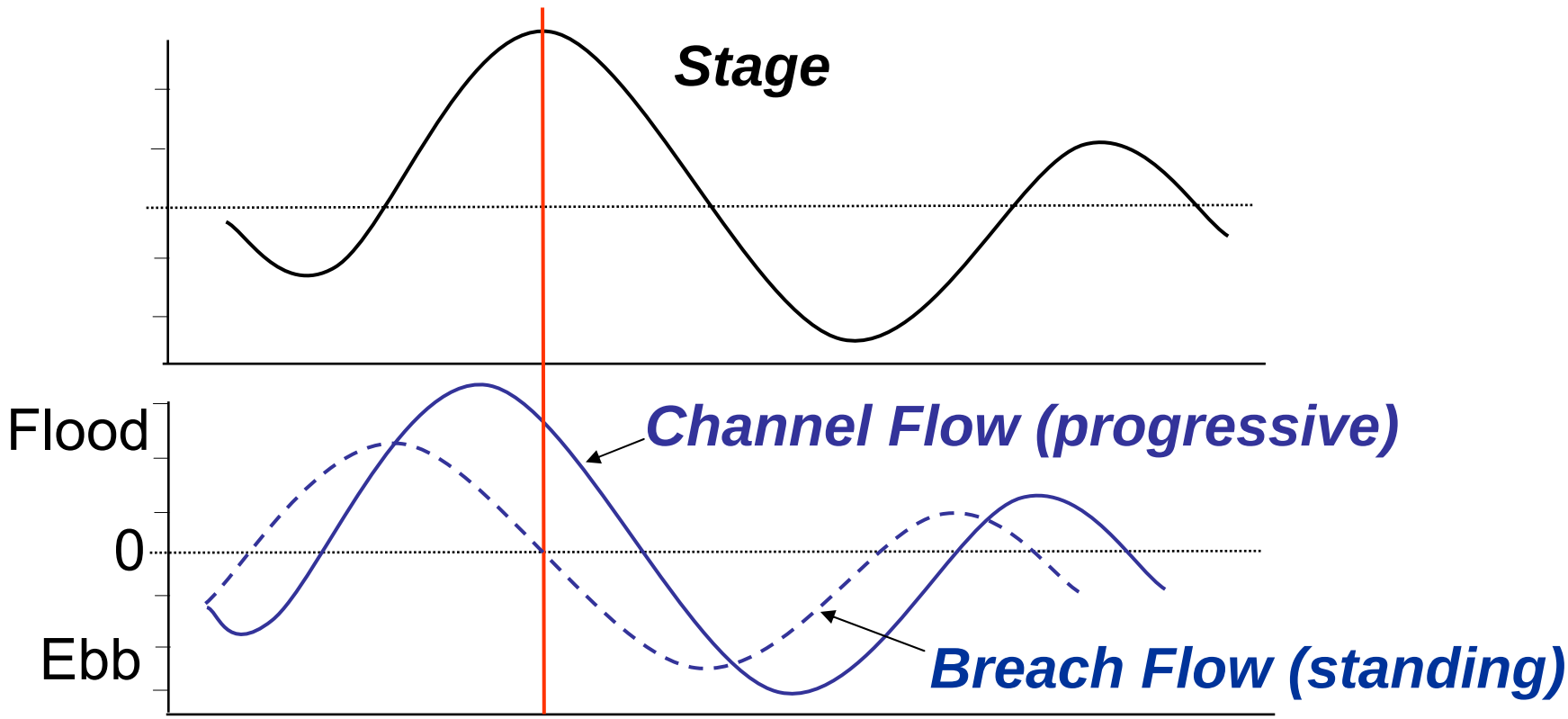

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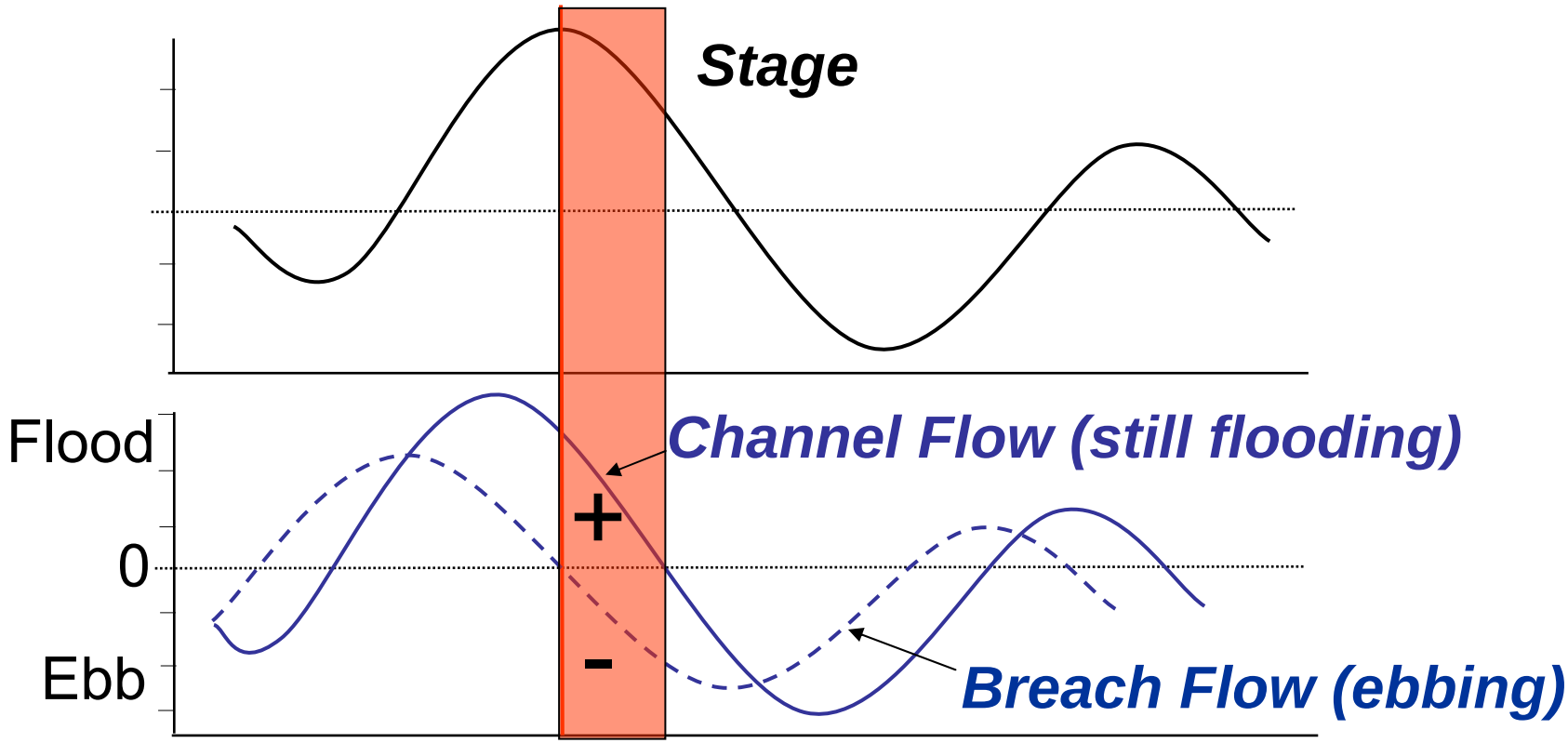
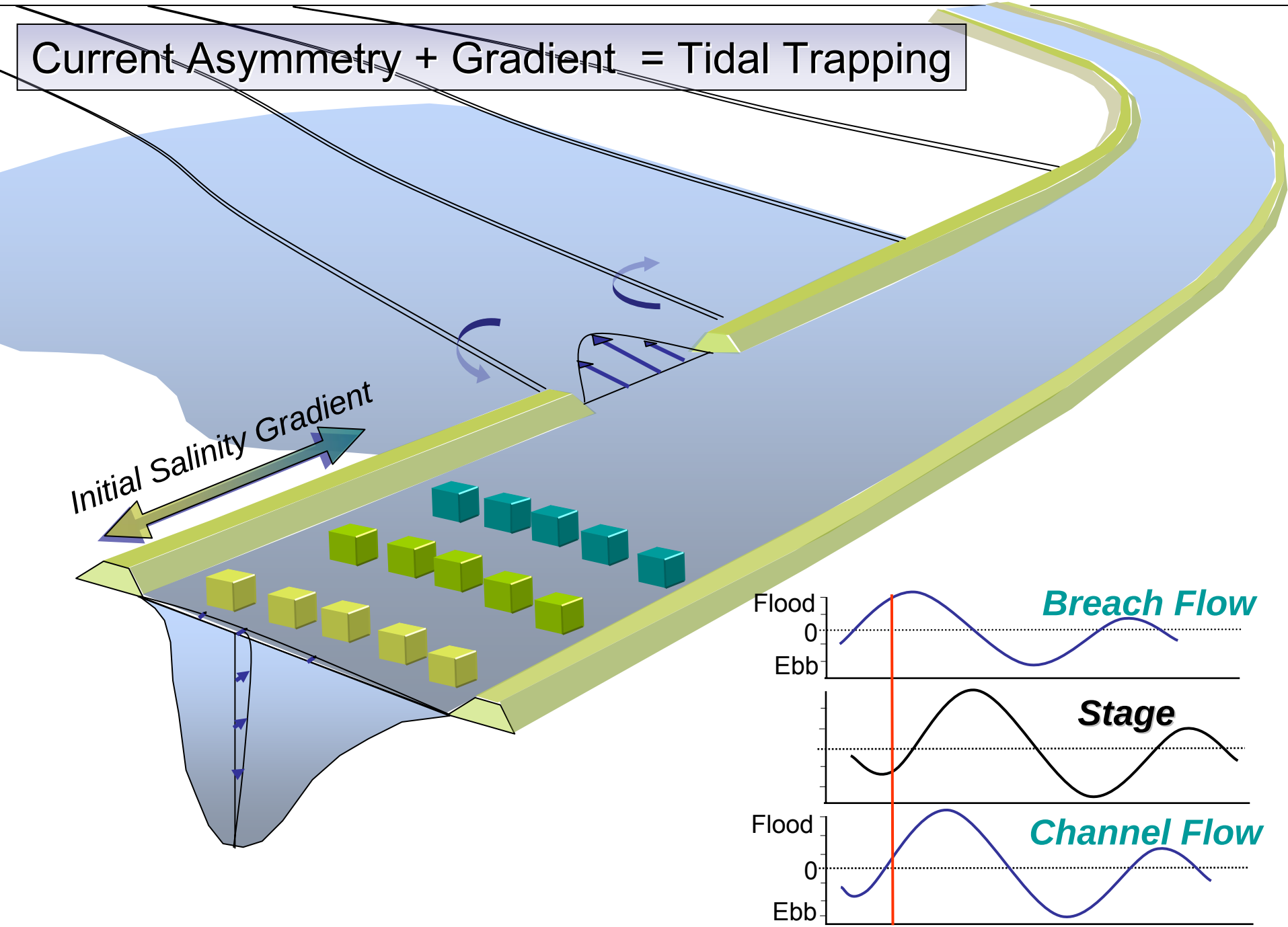


Current Asymmetry + Gradient = Tidal Trapping



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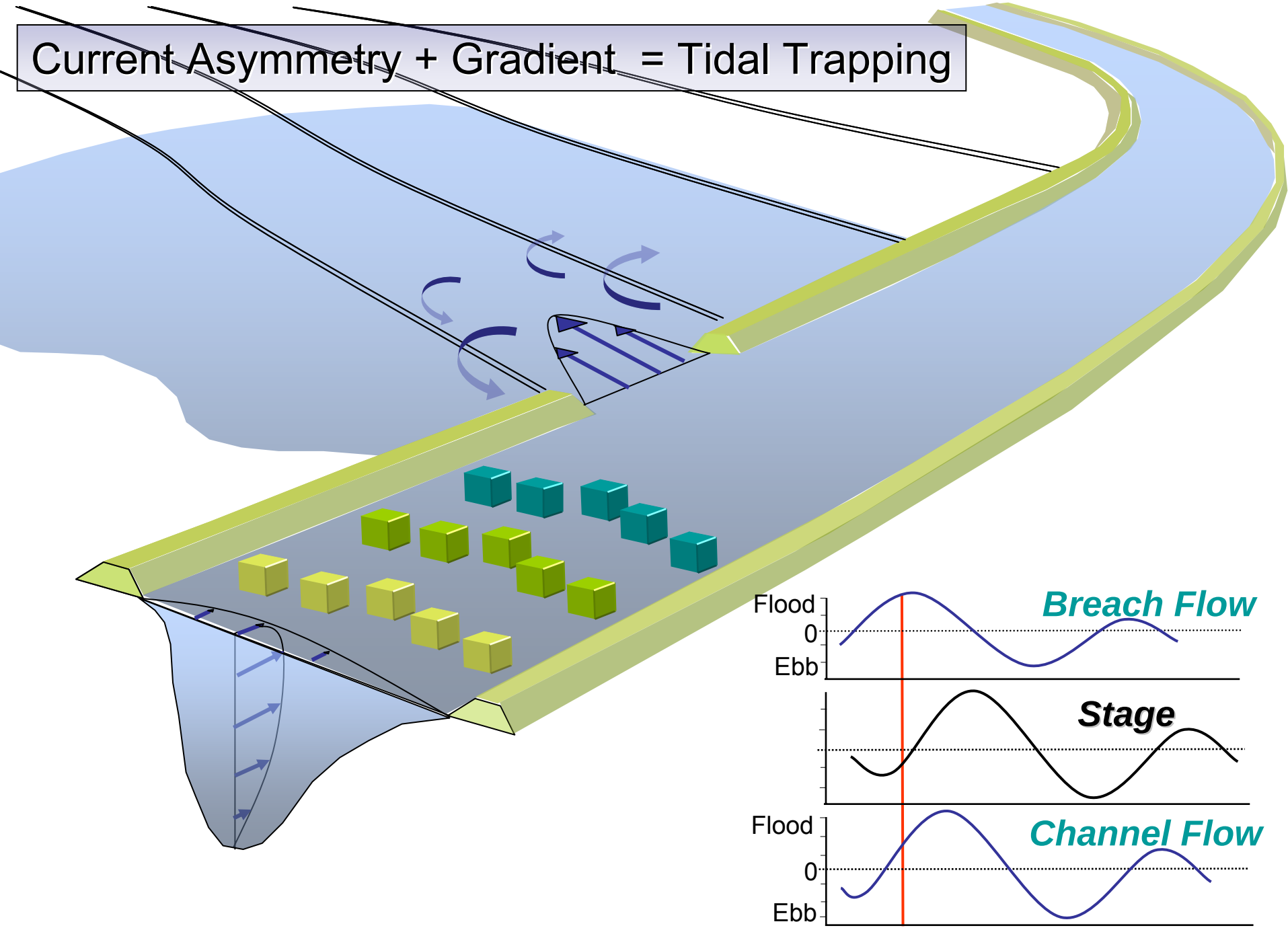

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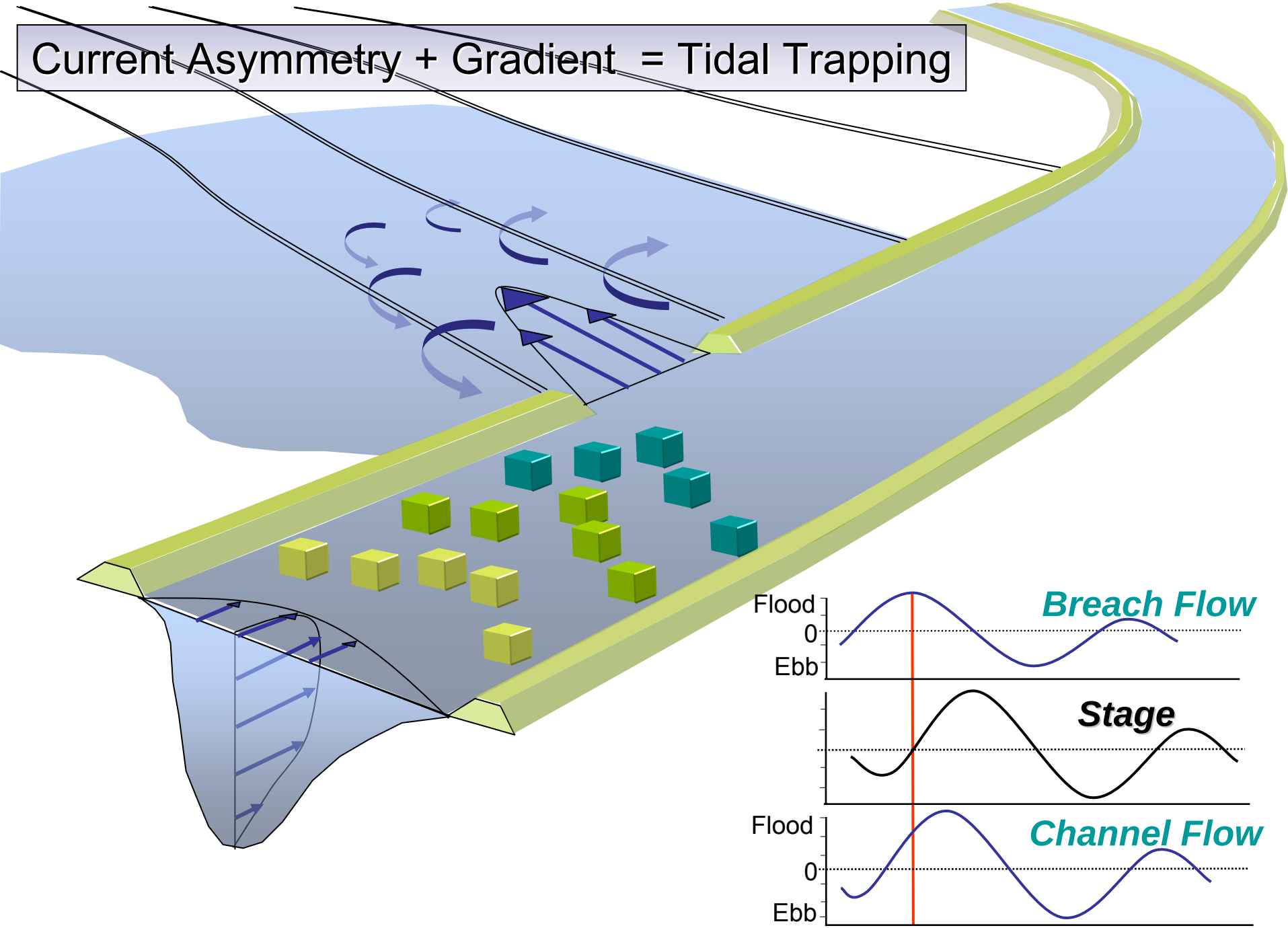

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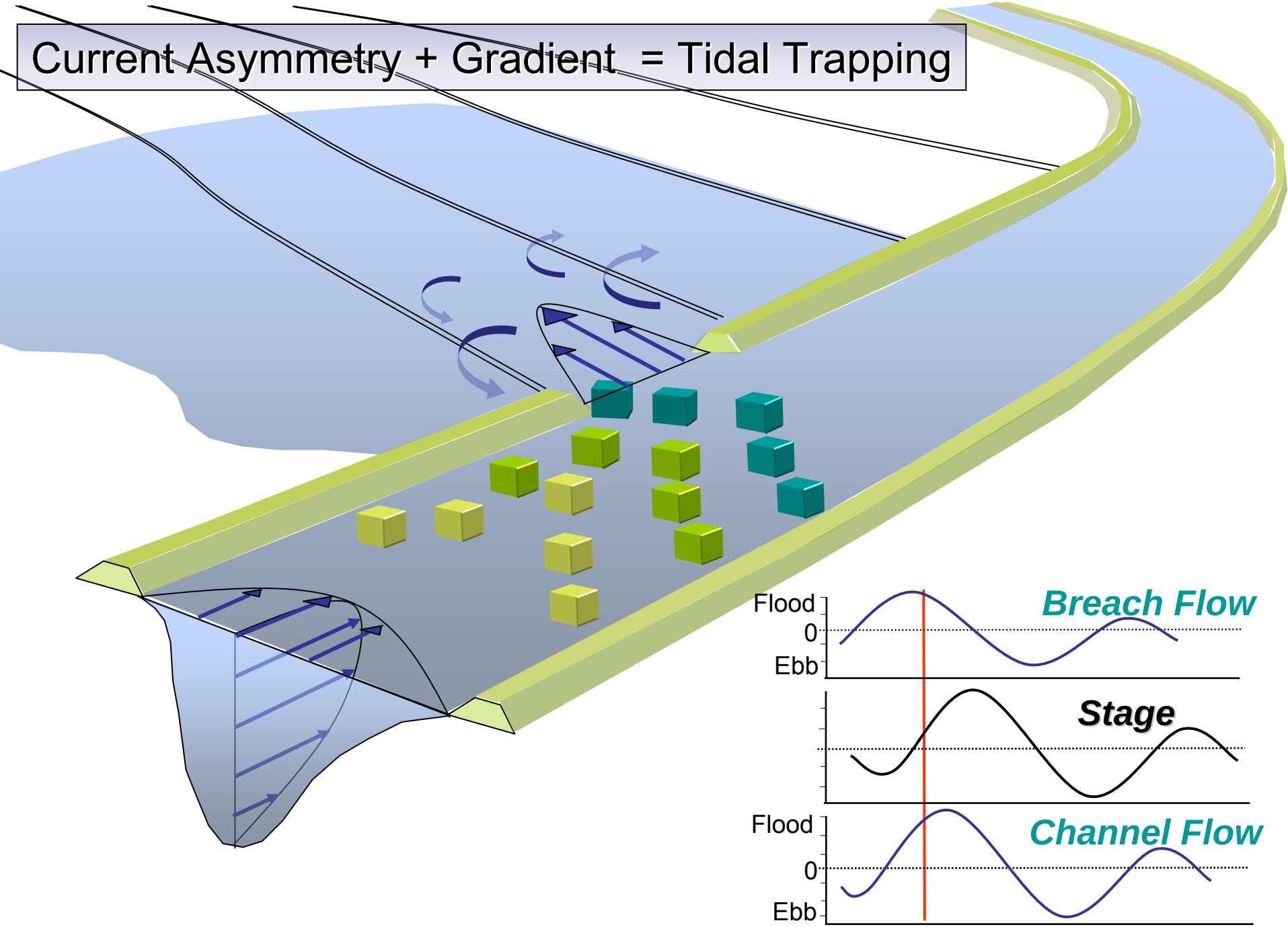

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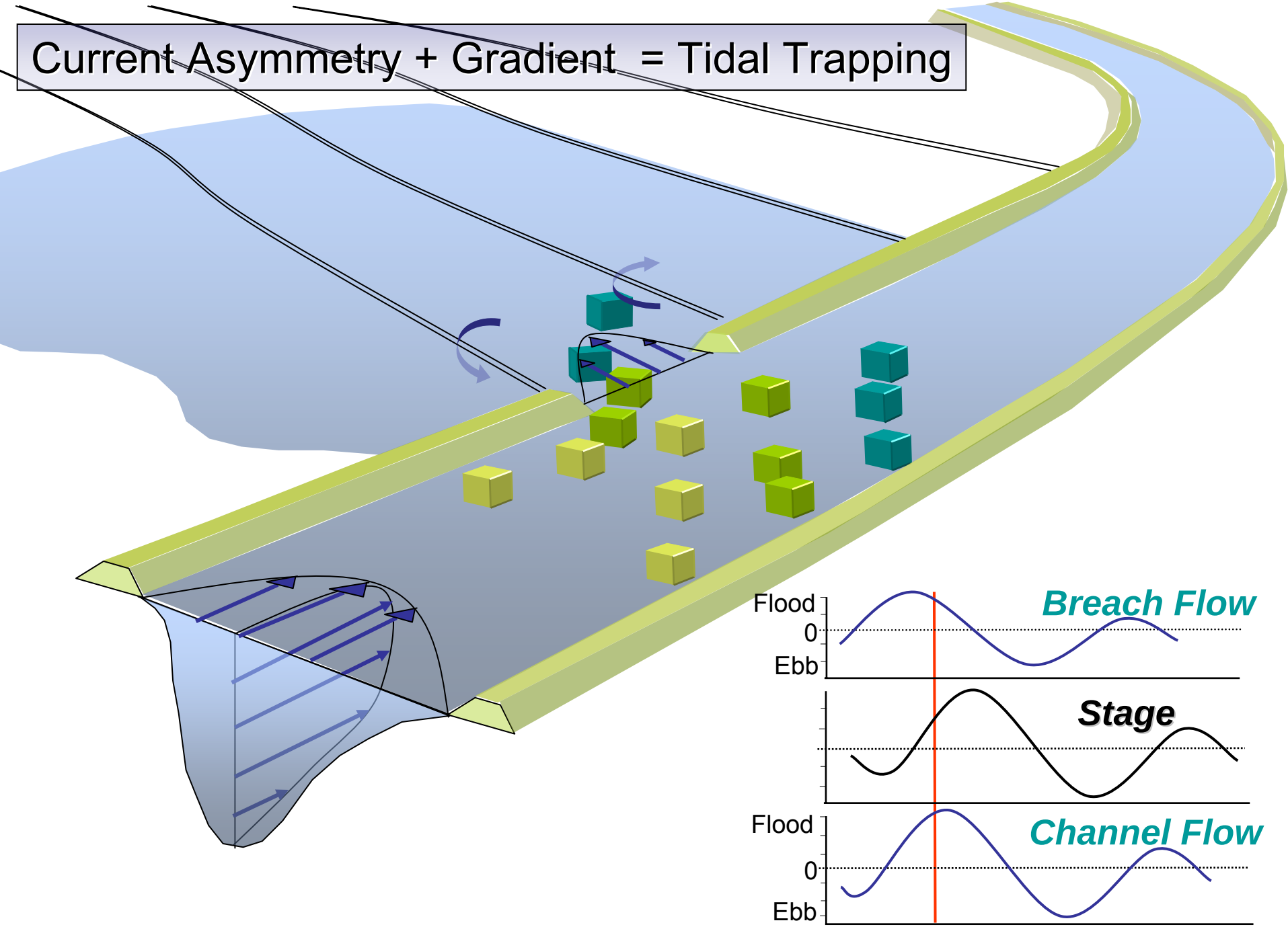

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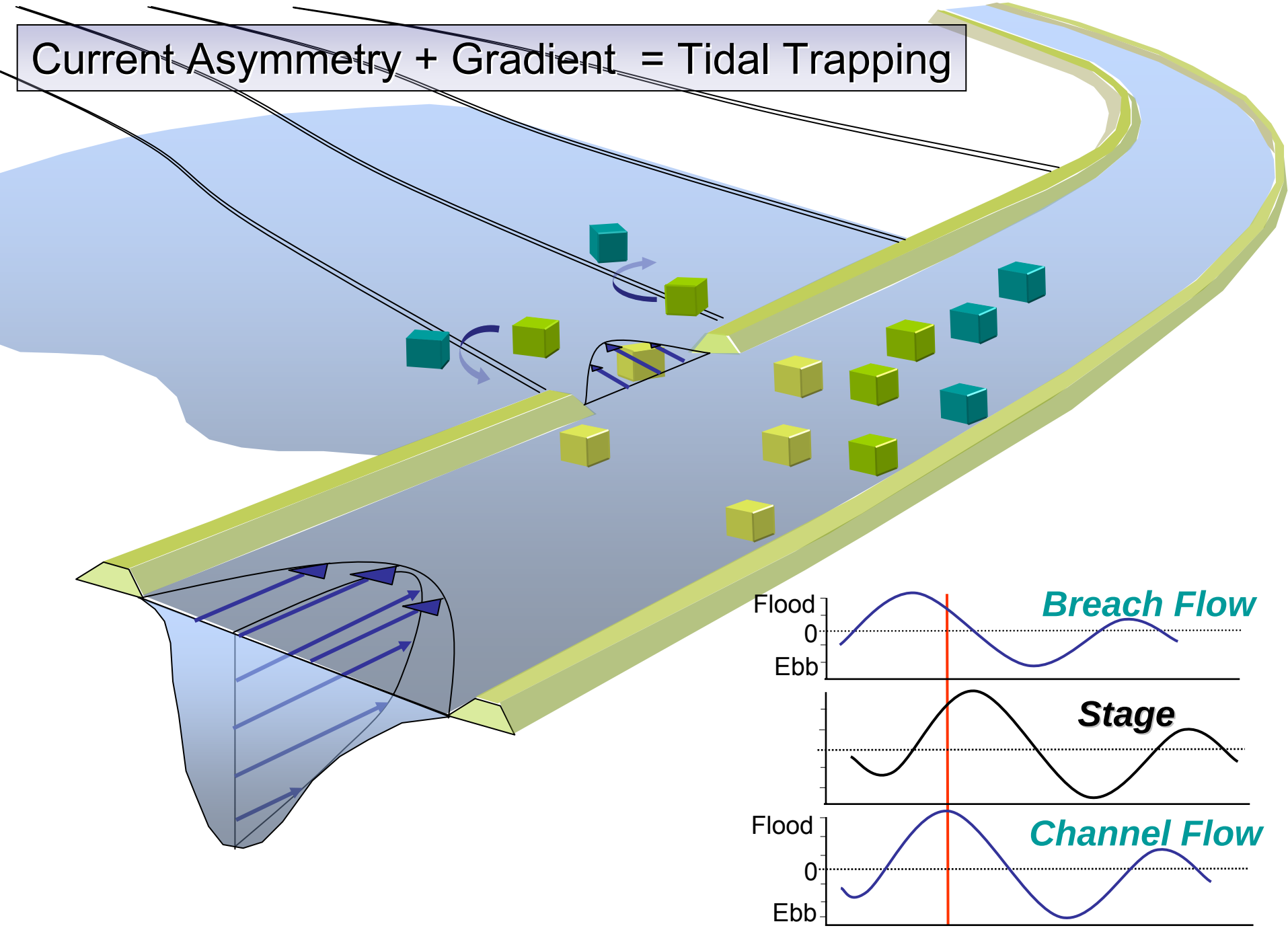

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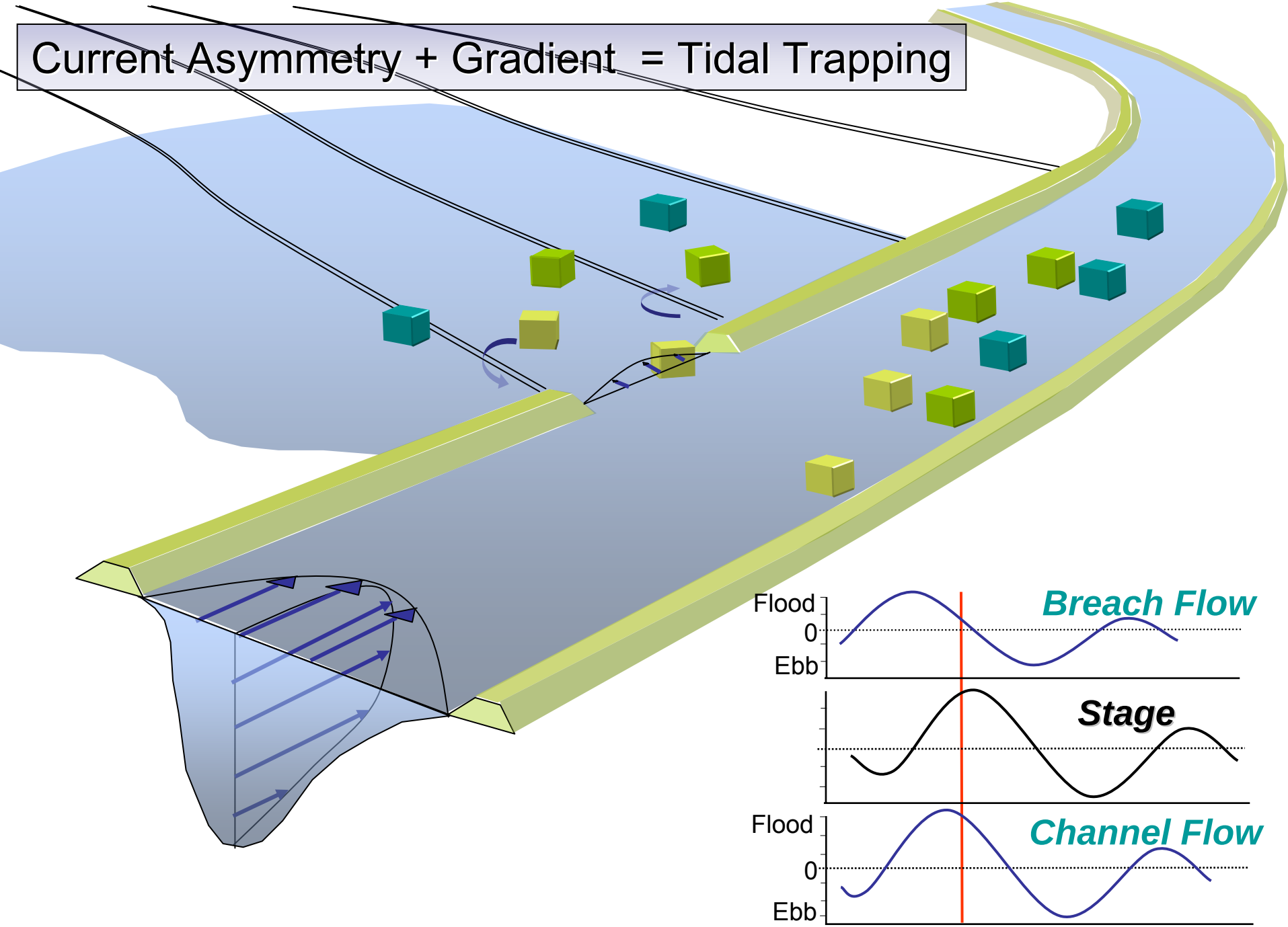

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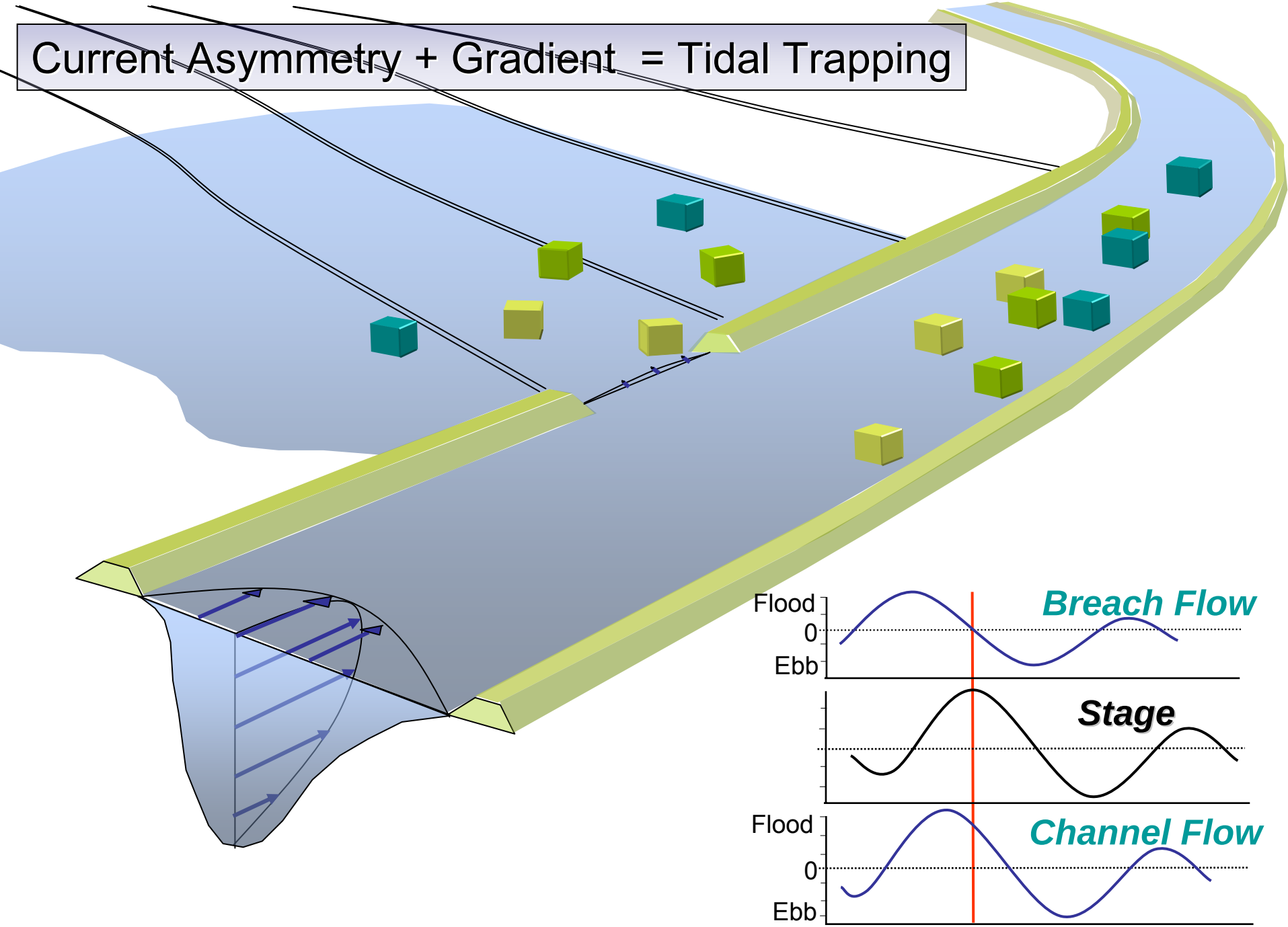

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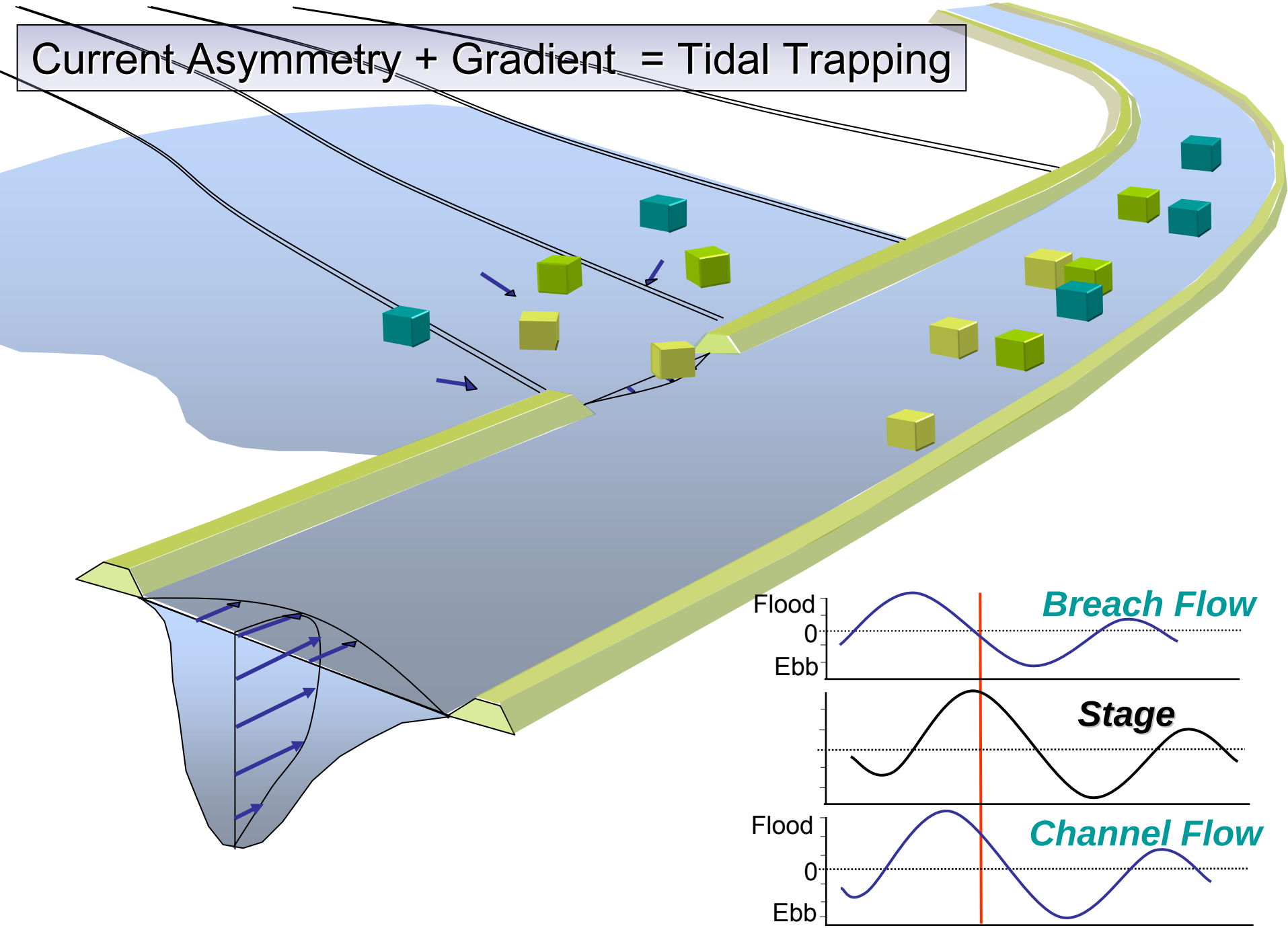

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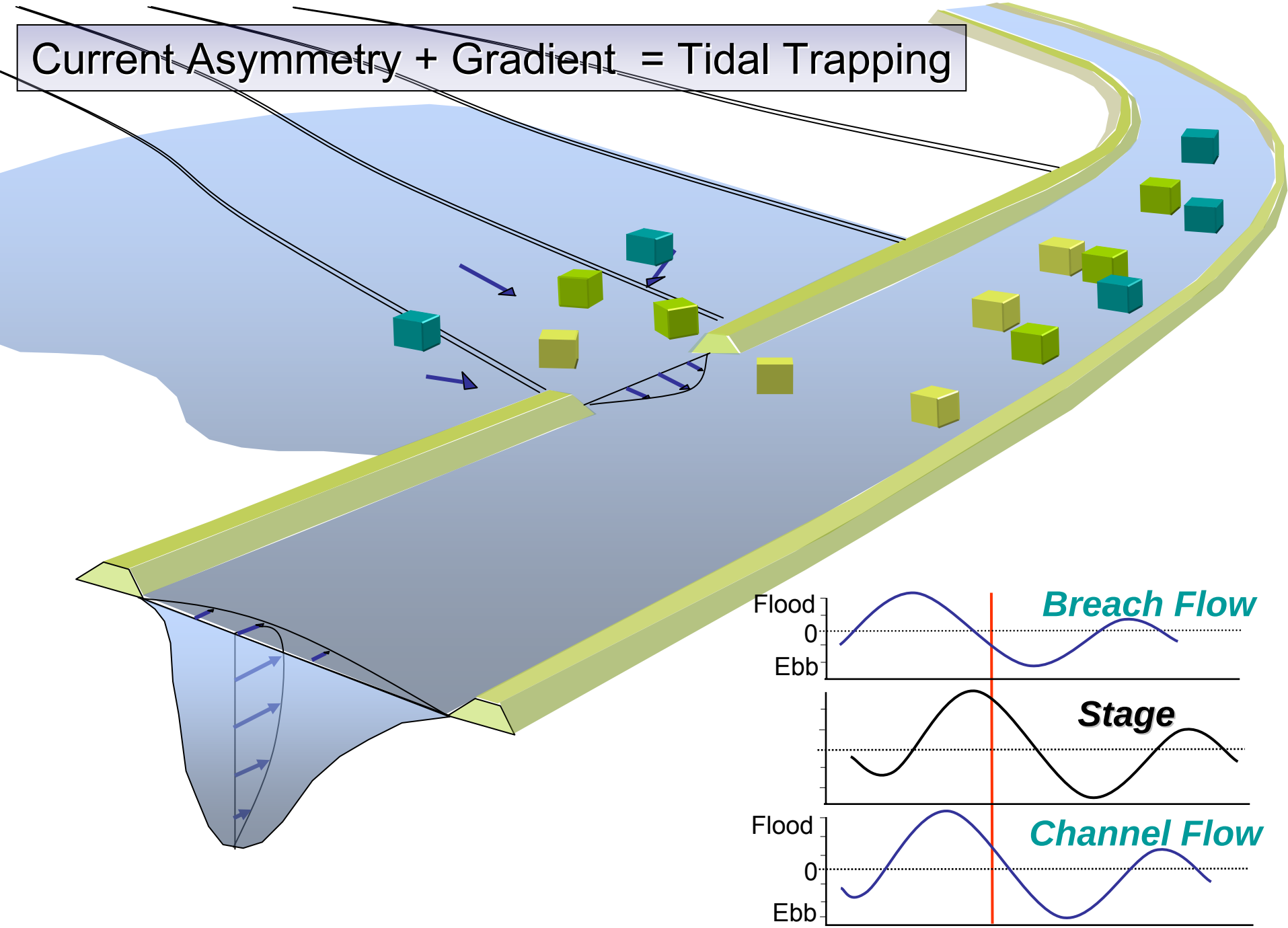

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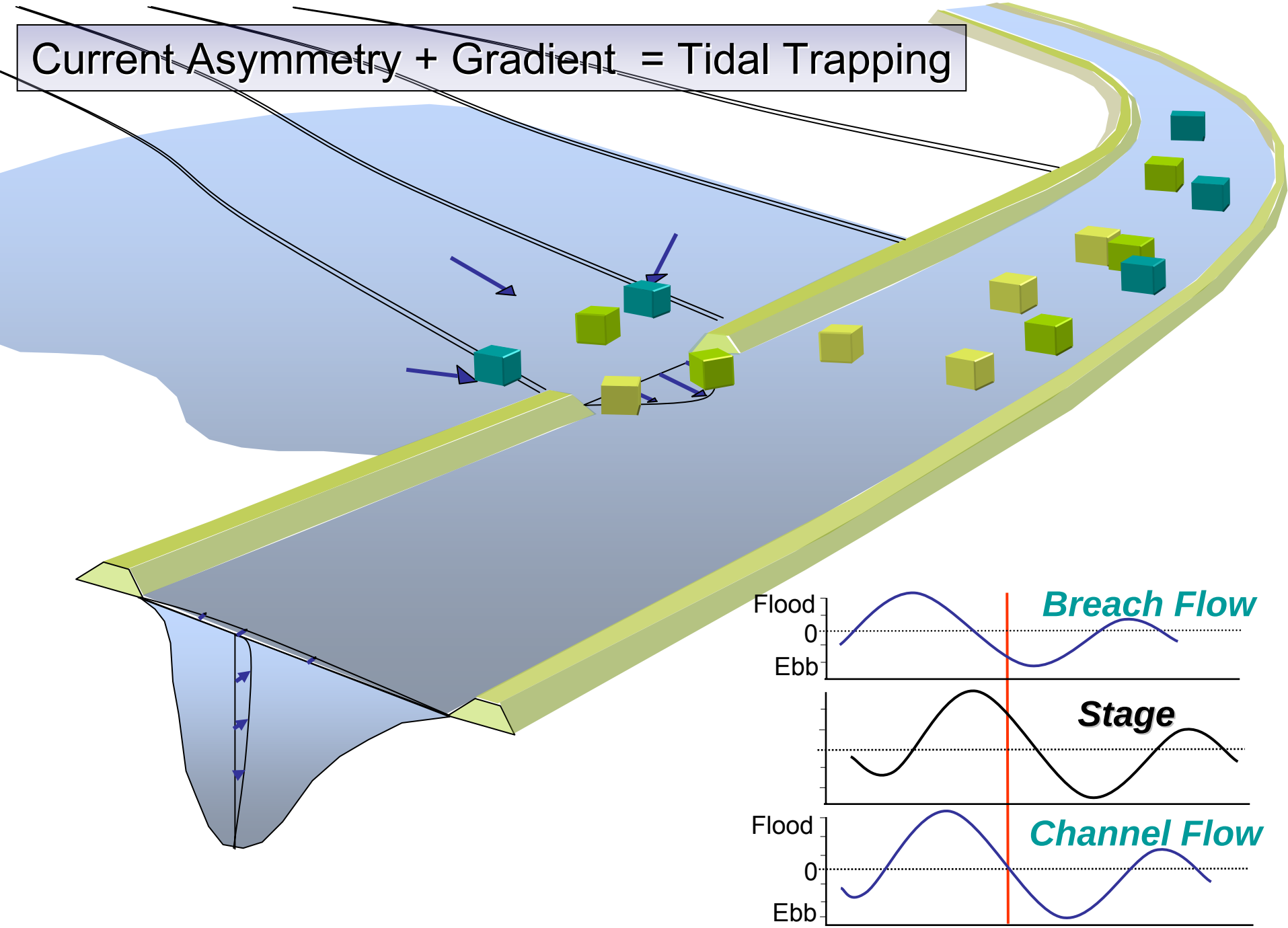

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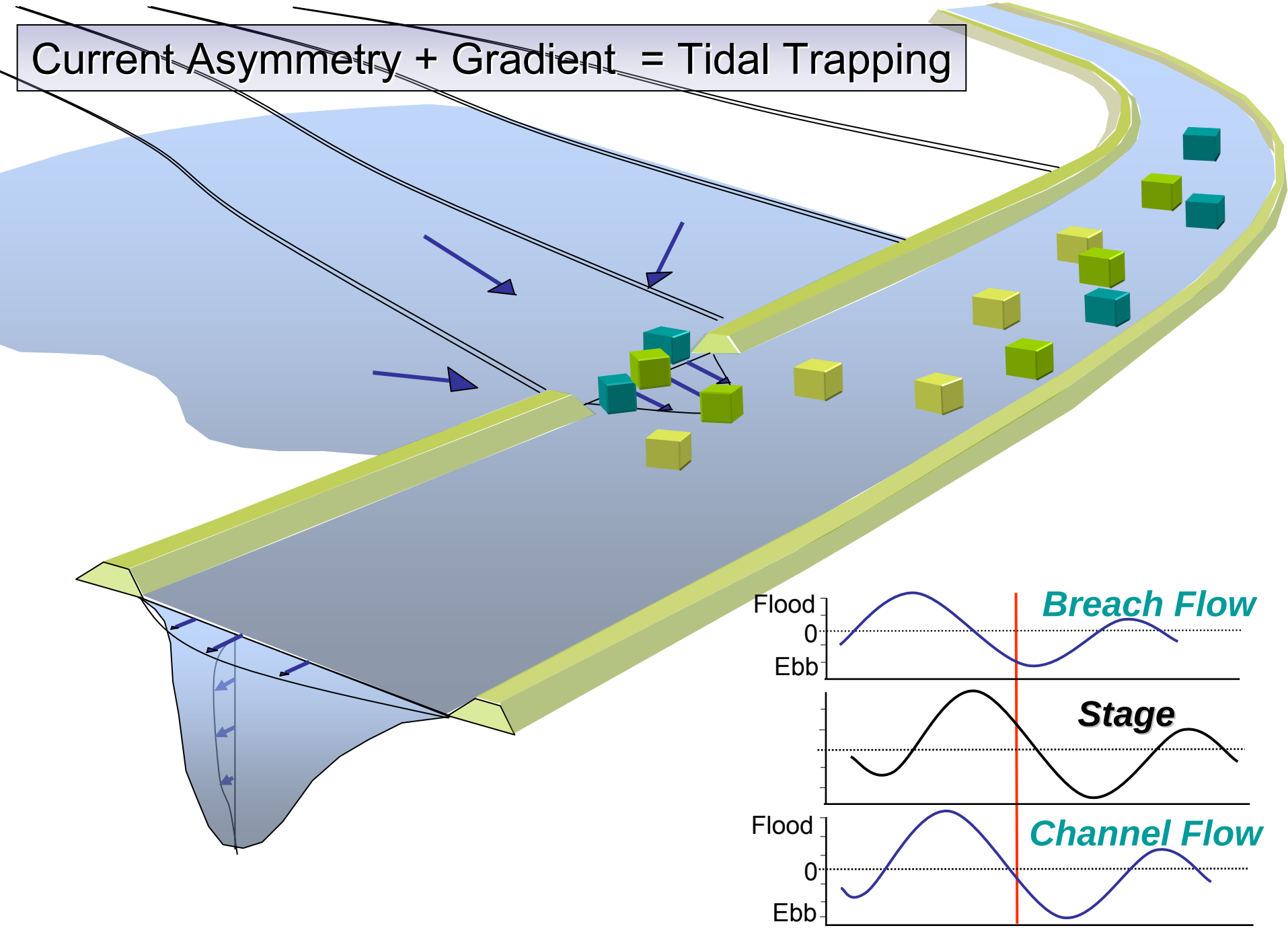

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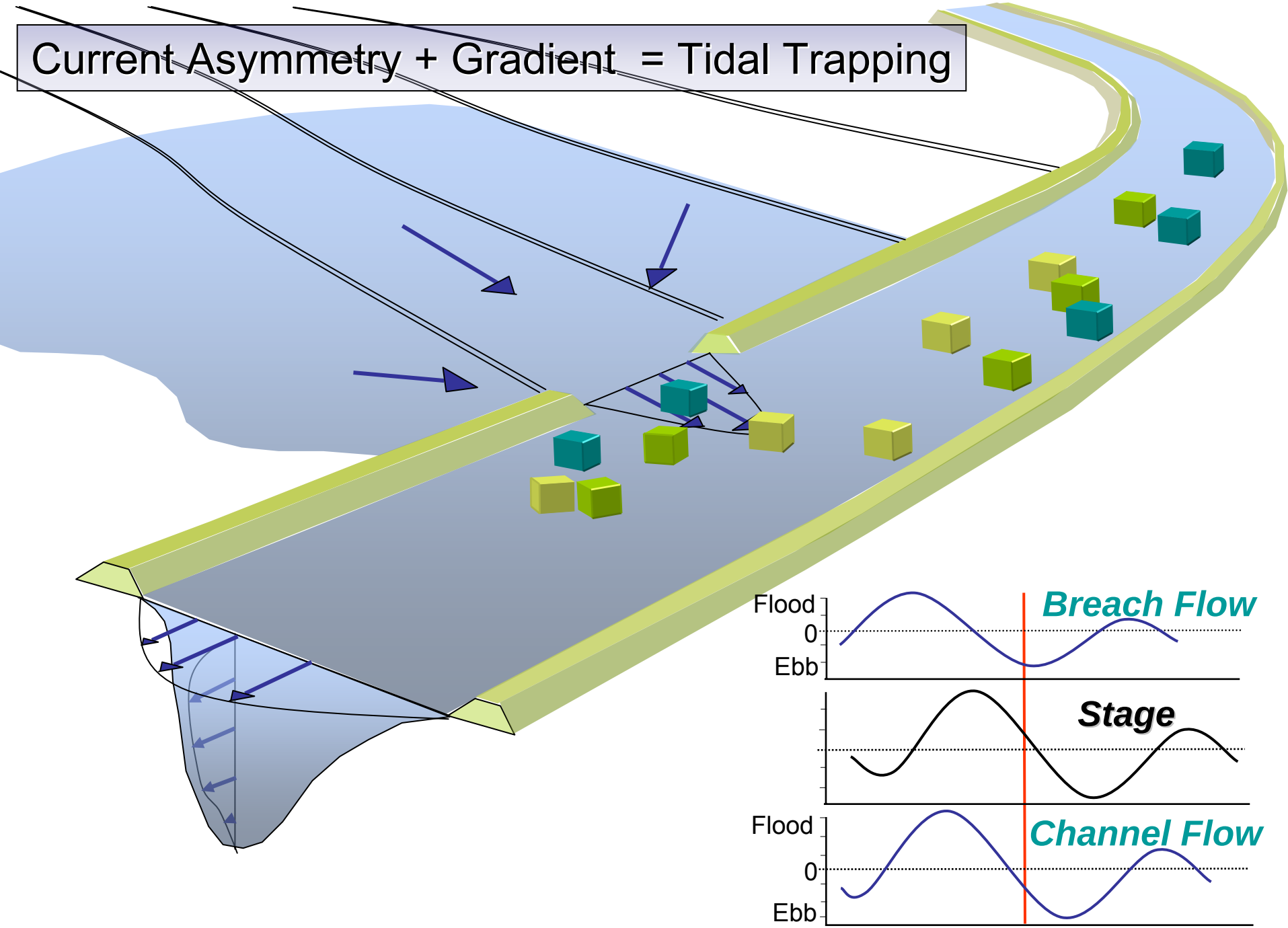

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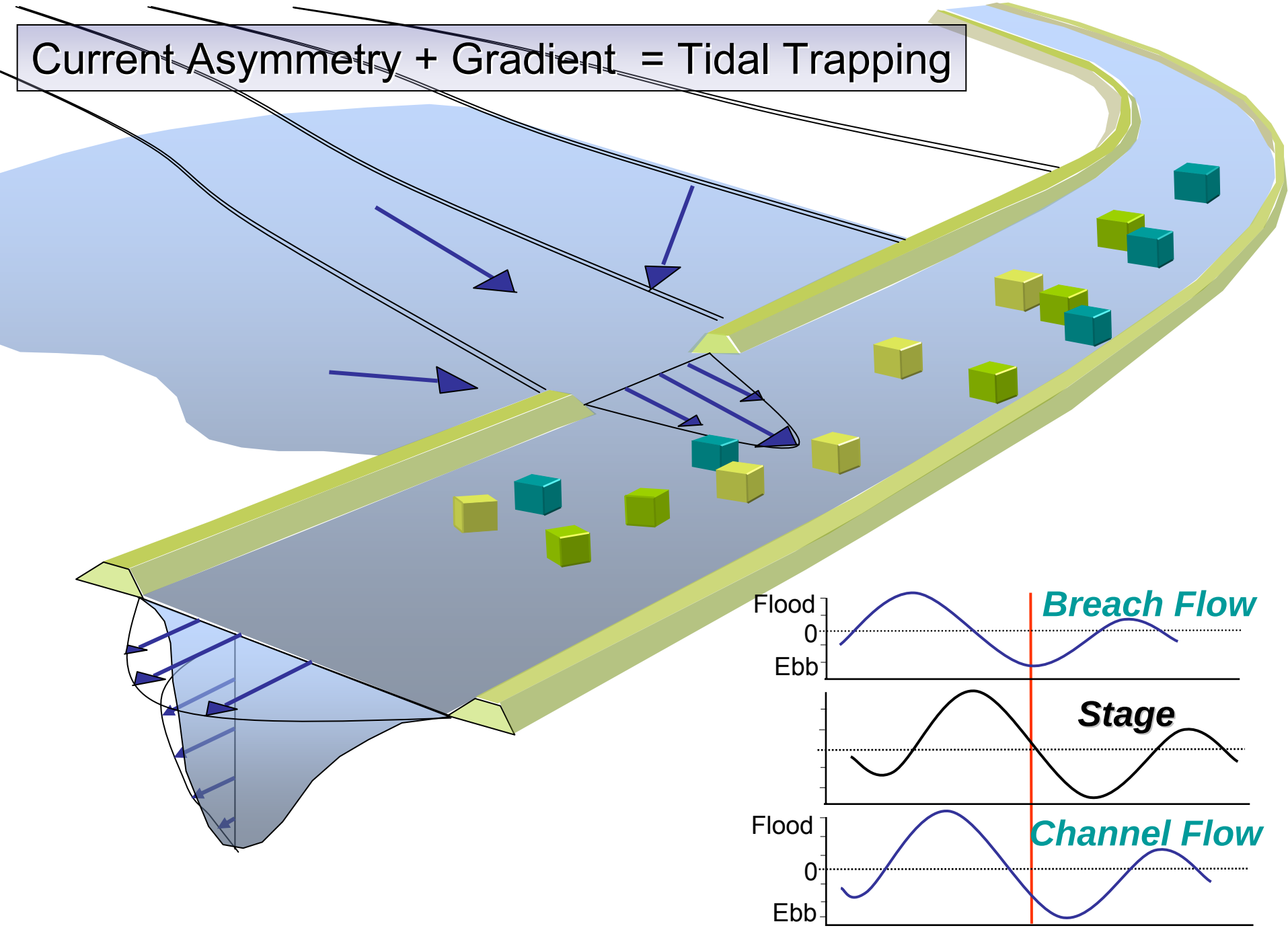

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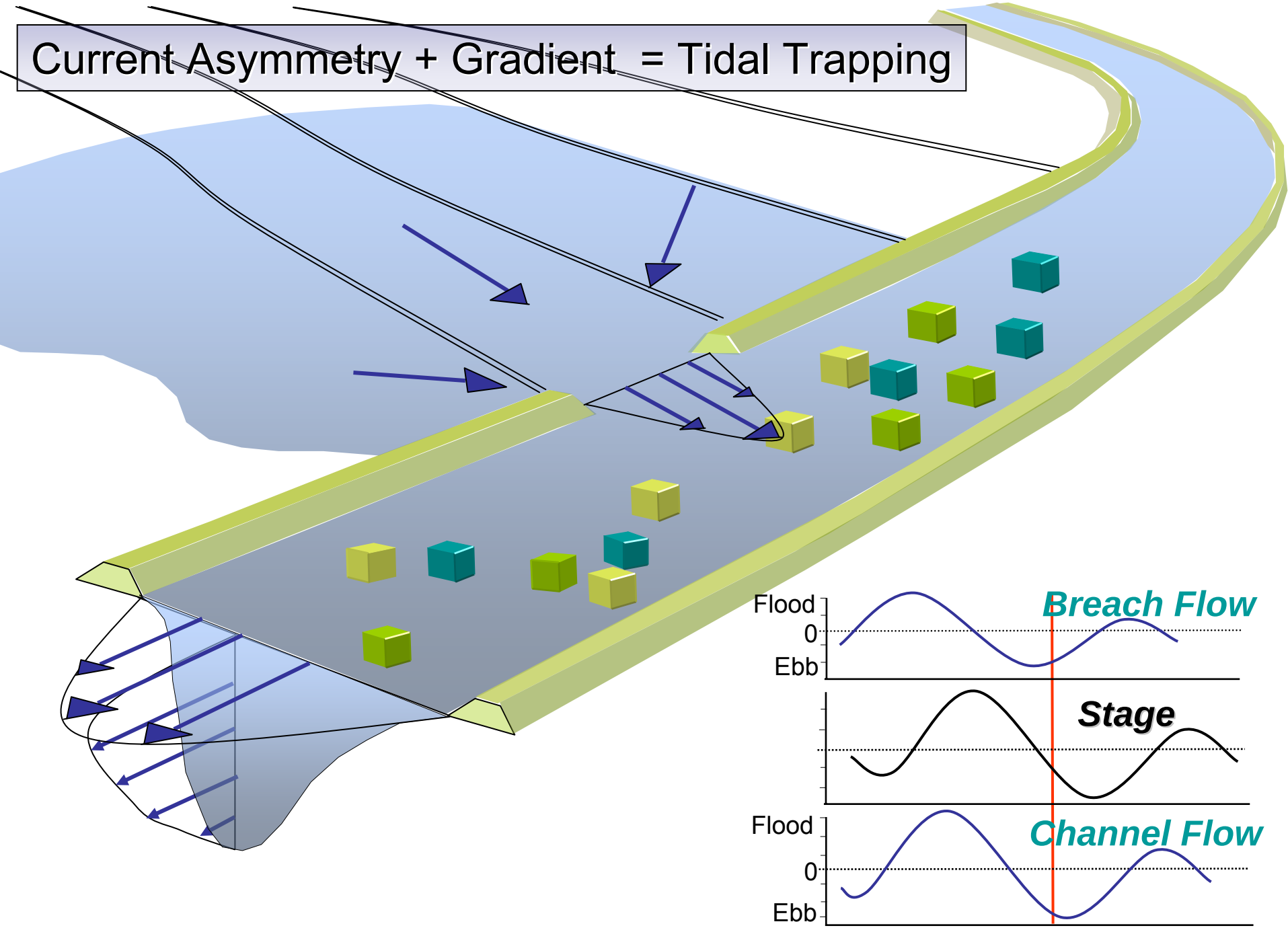

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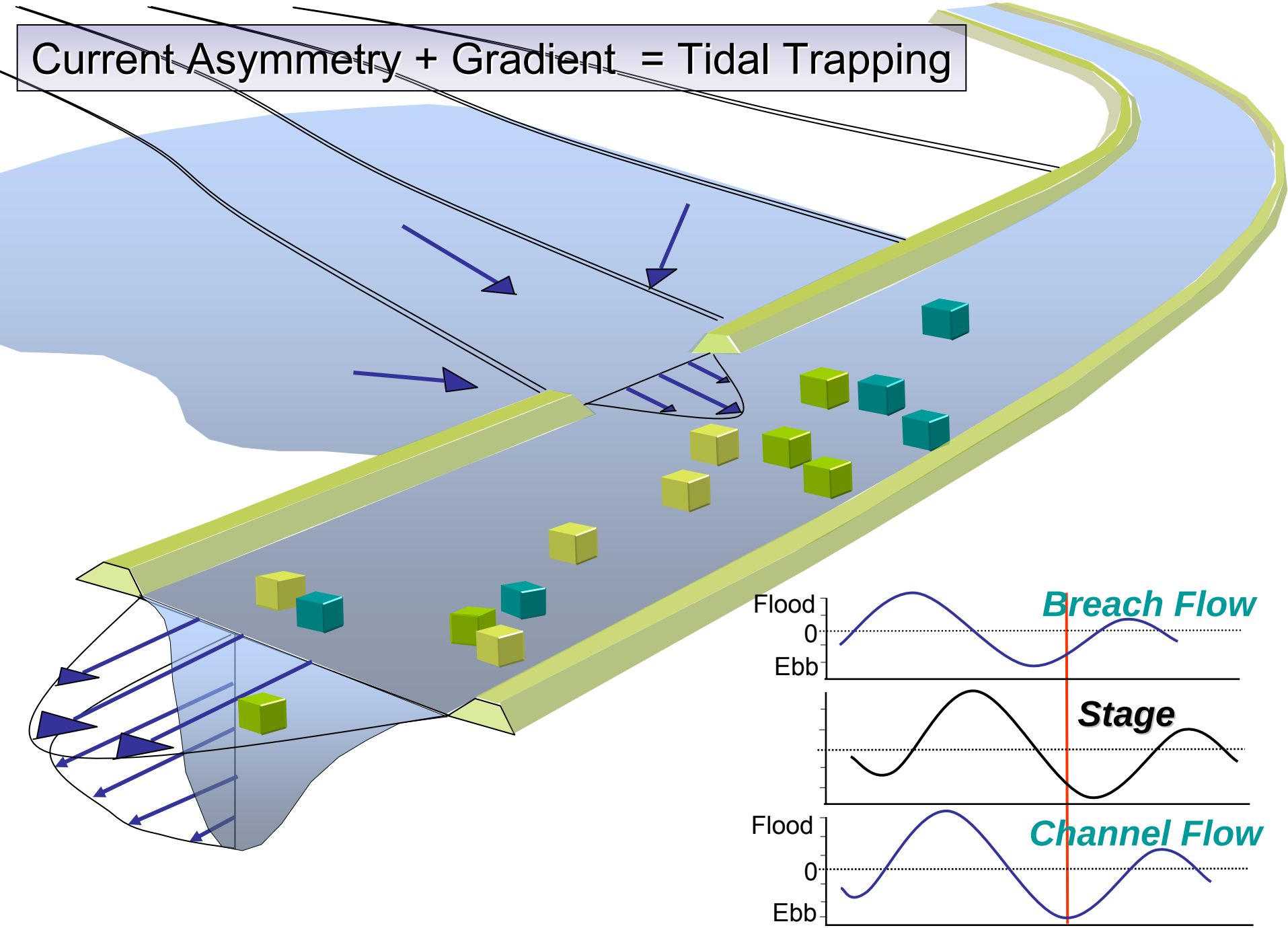

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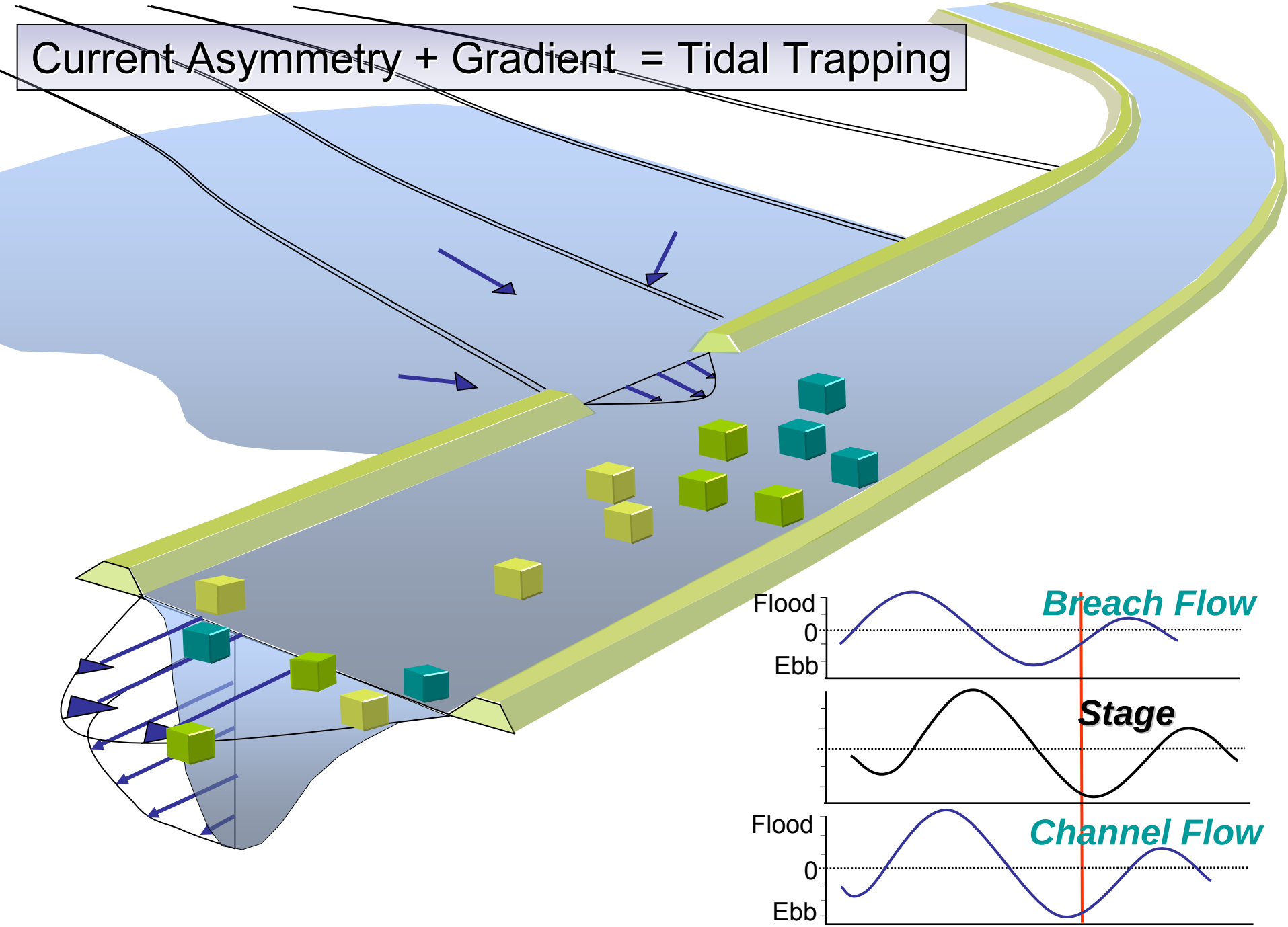

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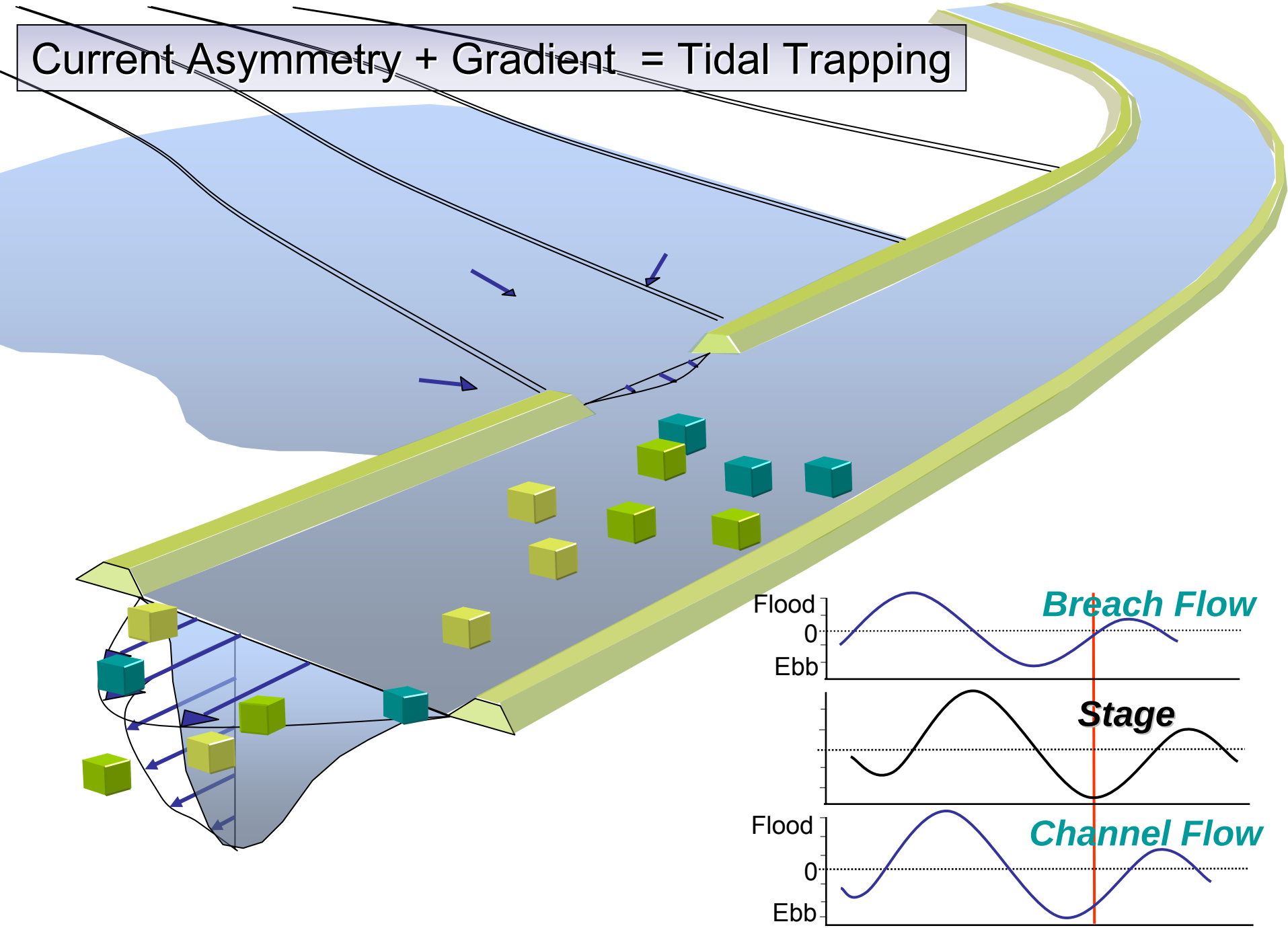

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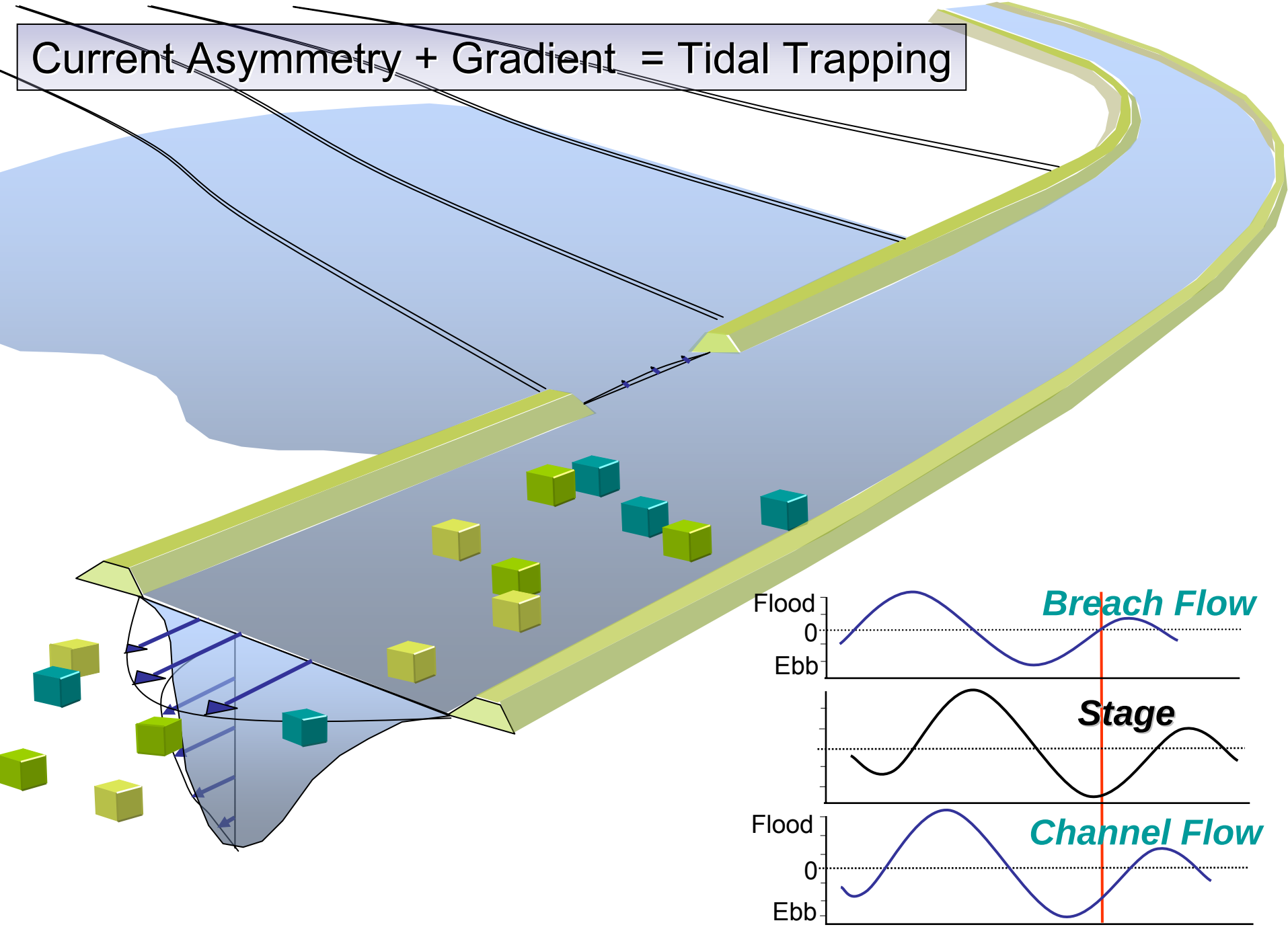

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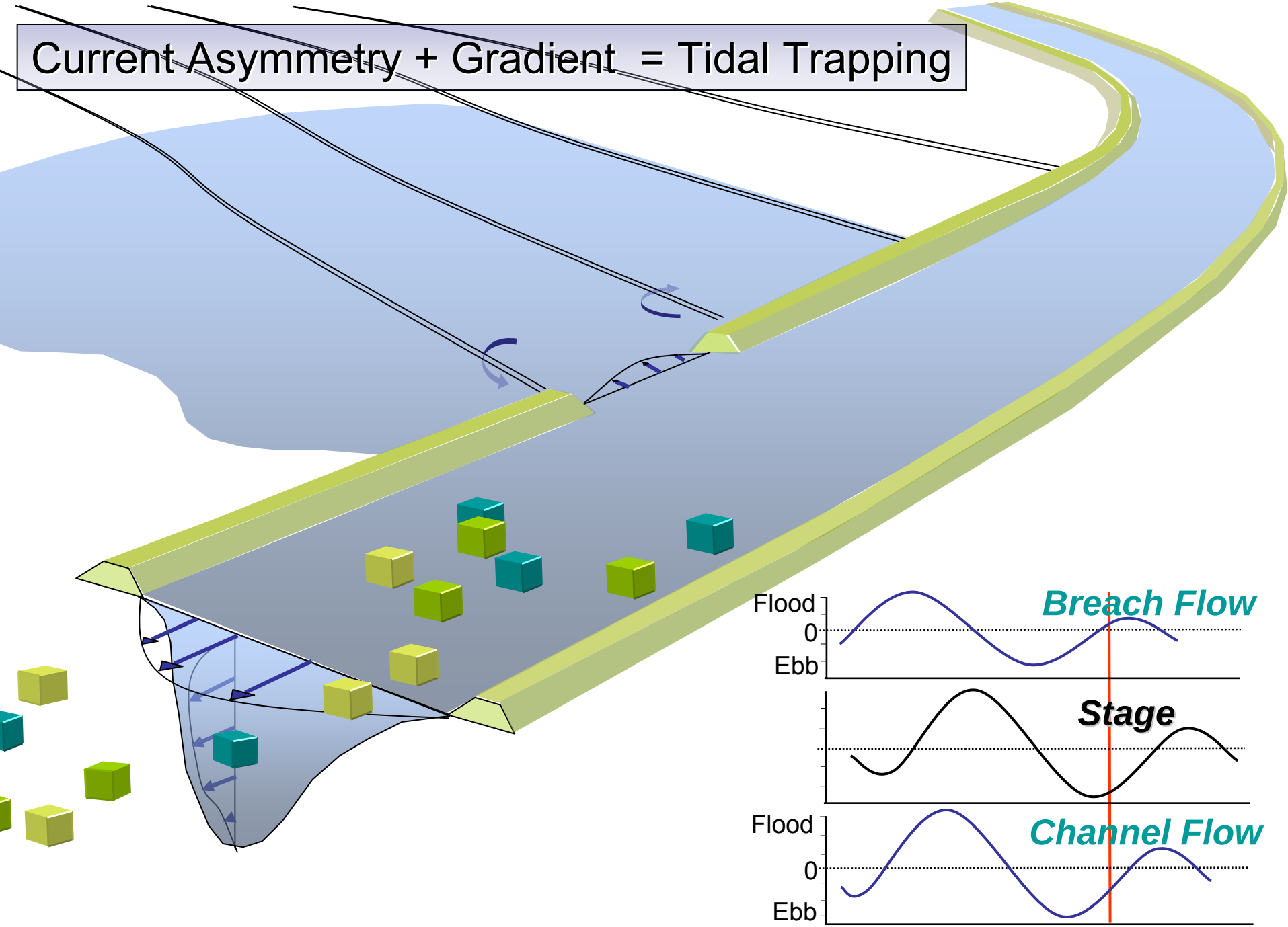

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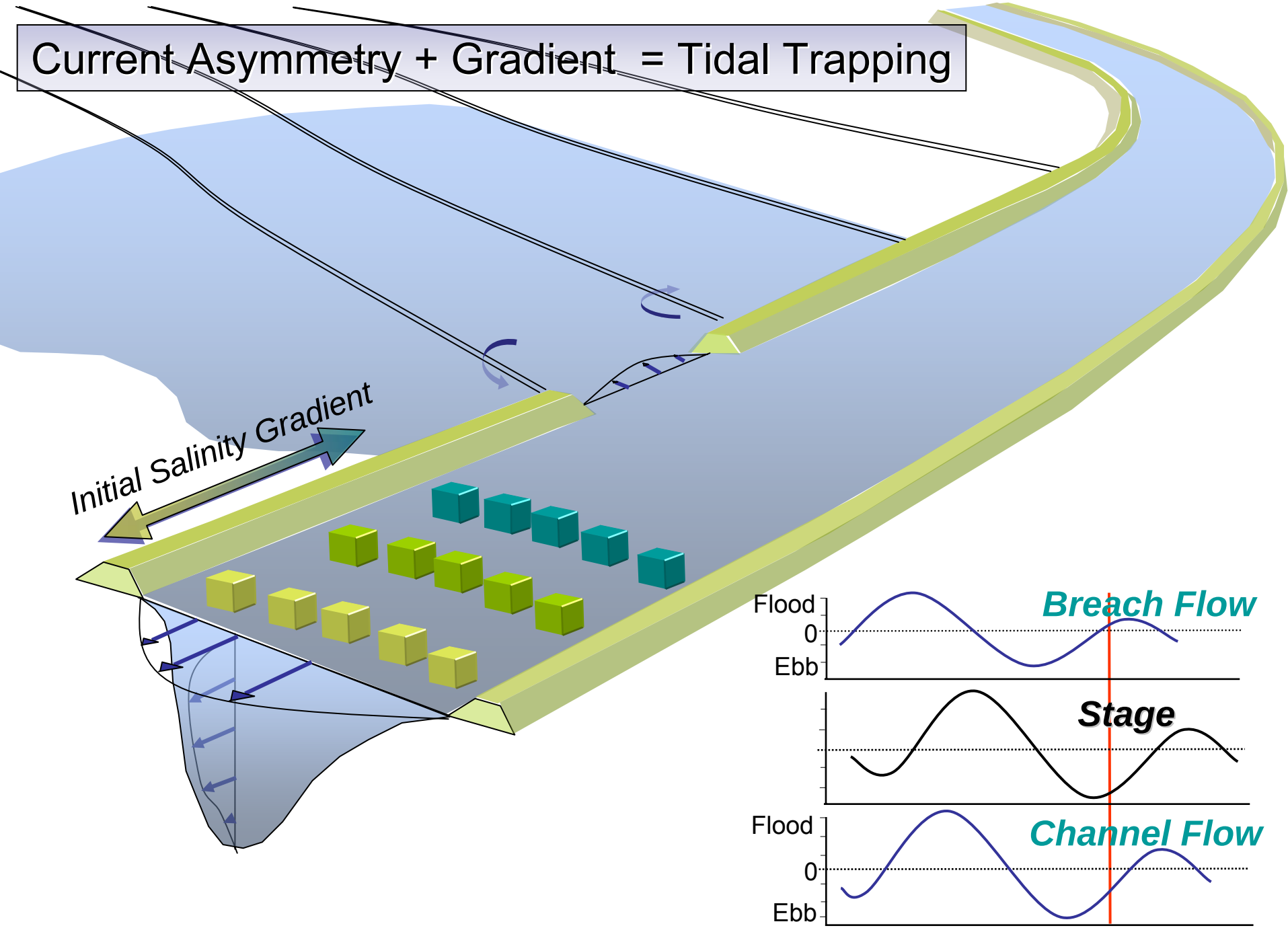

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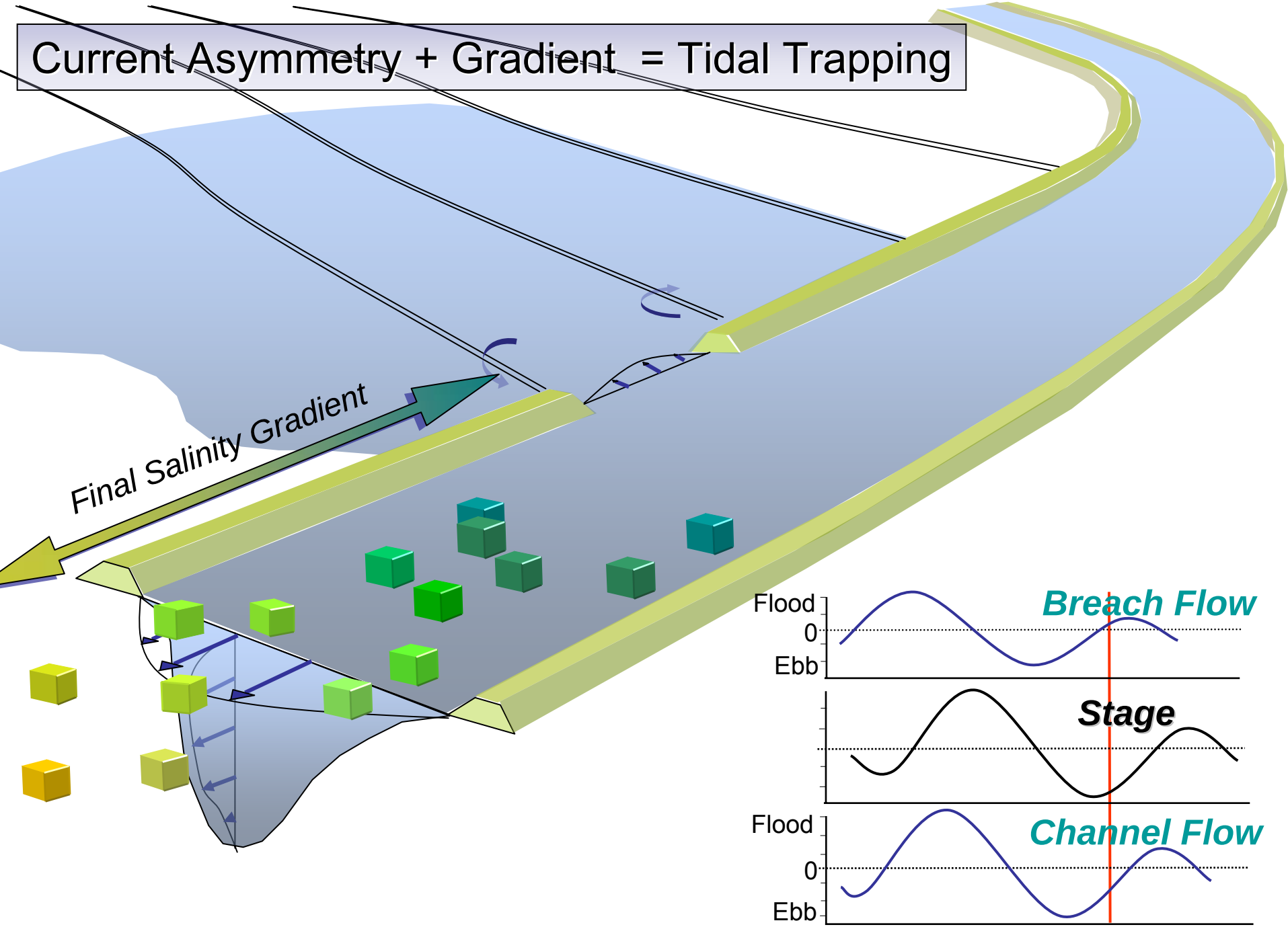
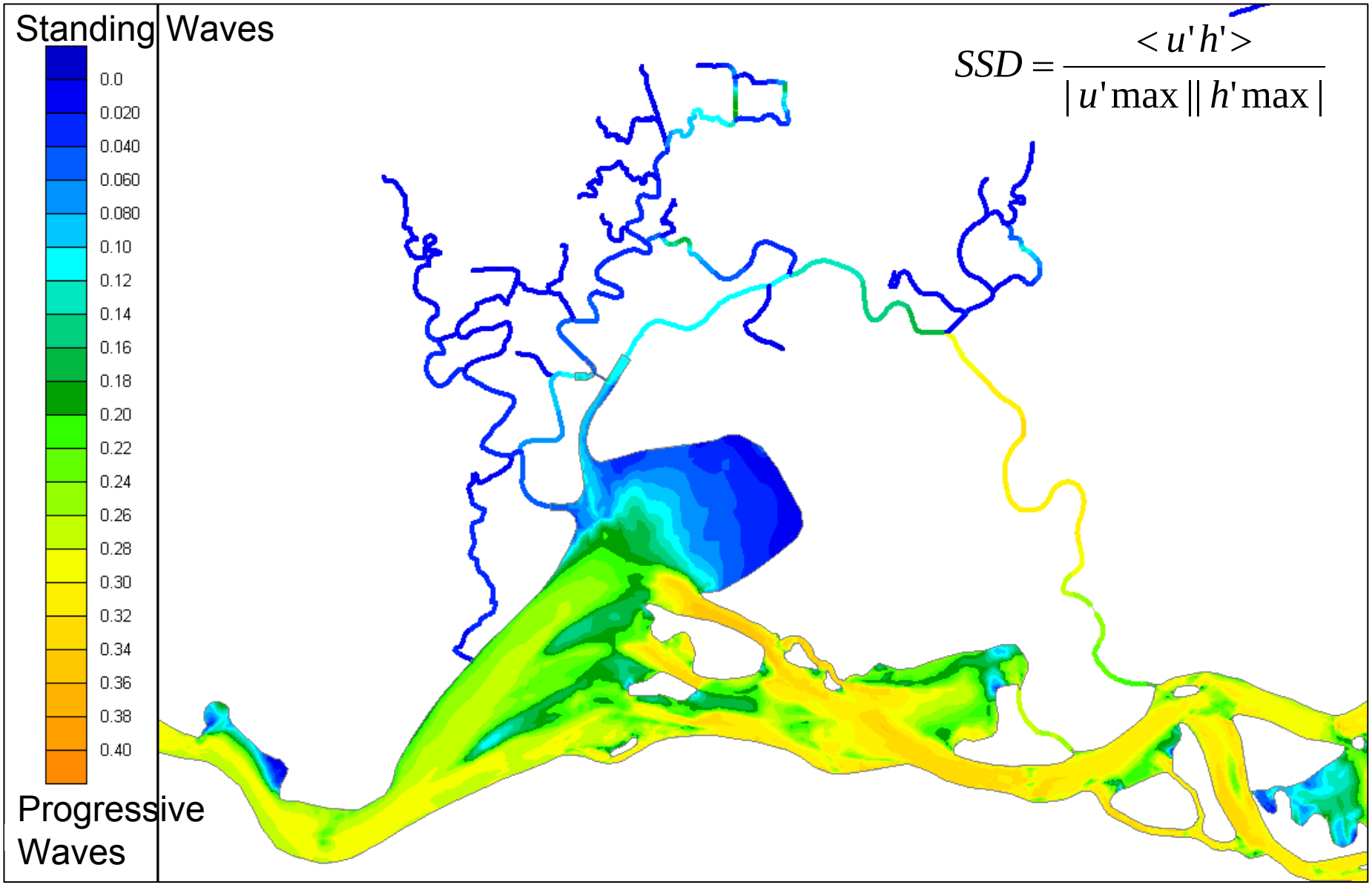


So, we have gradients everywhere.

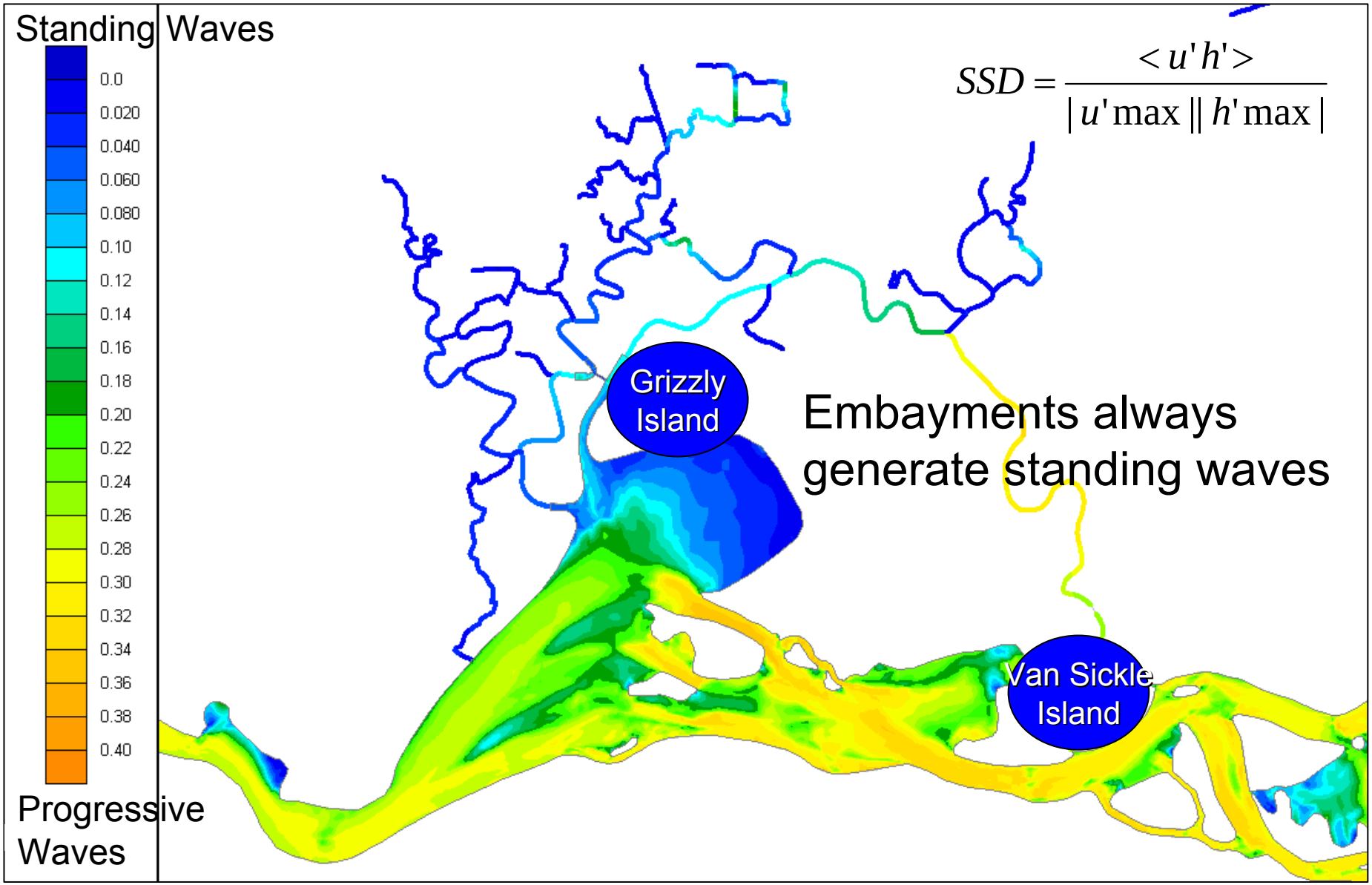
Where are the current asymmetries?

Tidal Trapping may occur wherever standing waves and progressive waves are proximate.



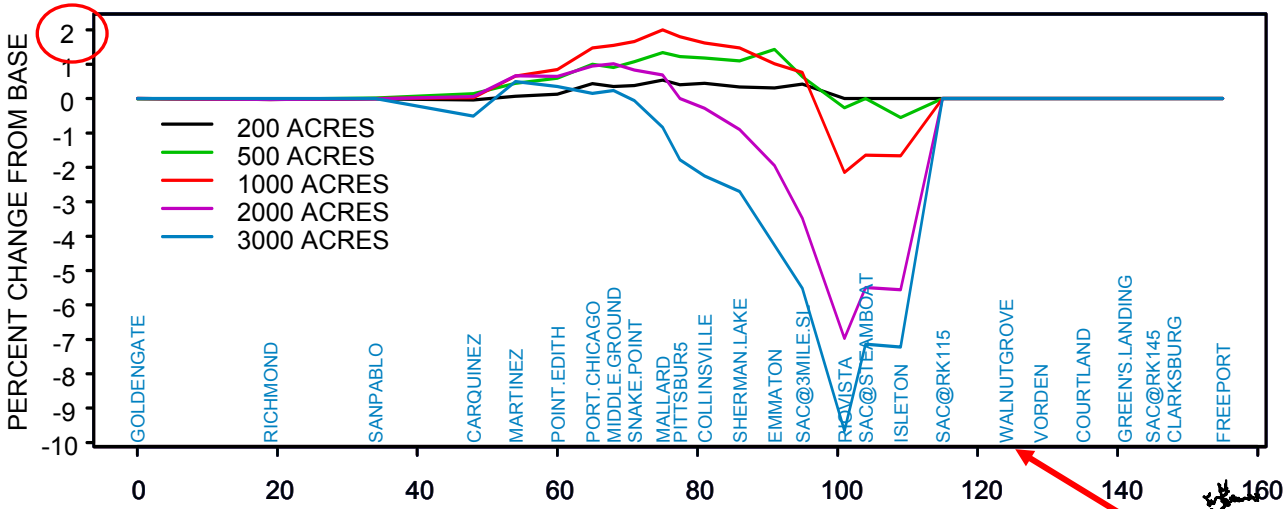
$$SSD = \frac{< u'h' >}{|u'\max||h'\max|}$$

Siting Restoration Projects (levee breaches)

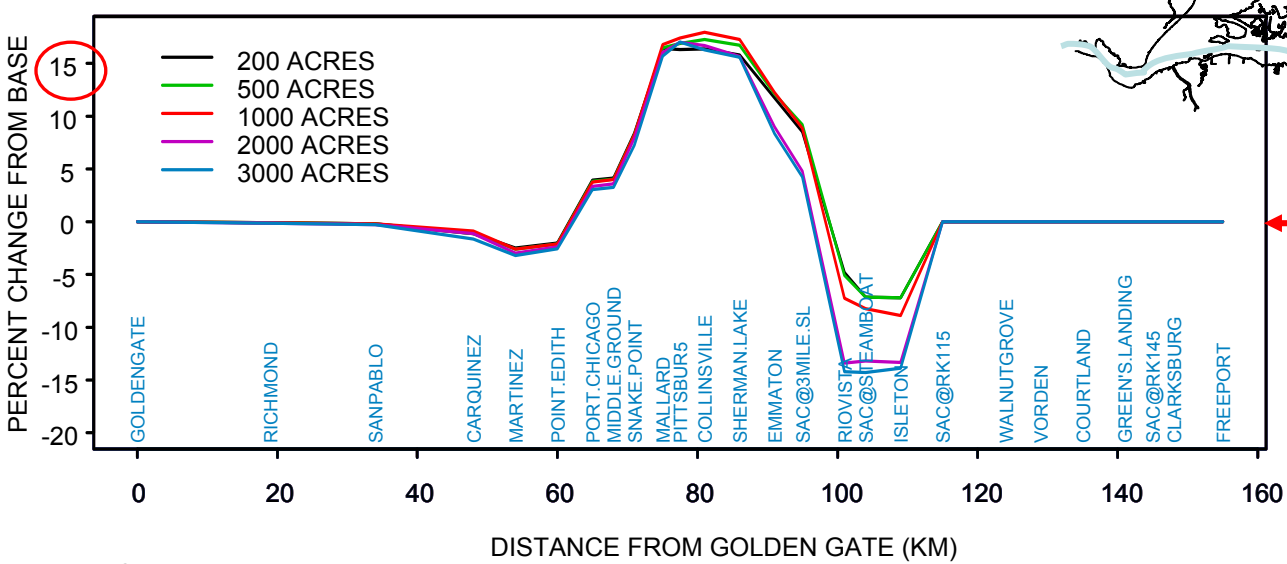


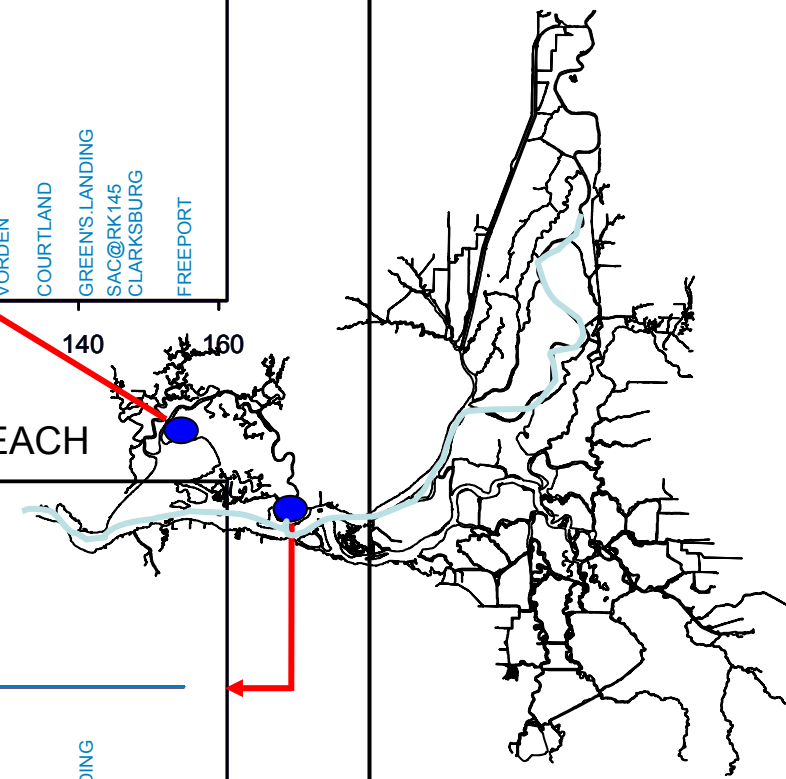
Effect of breach location wrt adjacent channel wave characteristic

GRIZZLY ISLAND 100' LEVEE BREACH



VAN SICKLE ISLAND 100' LEVEE BREACH





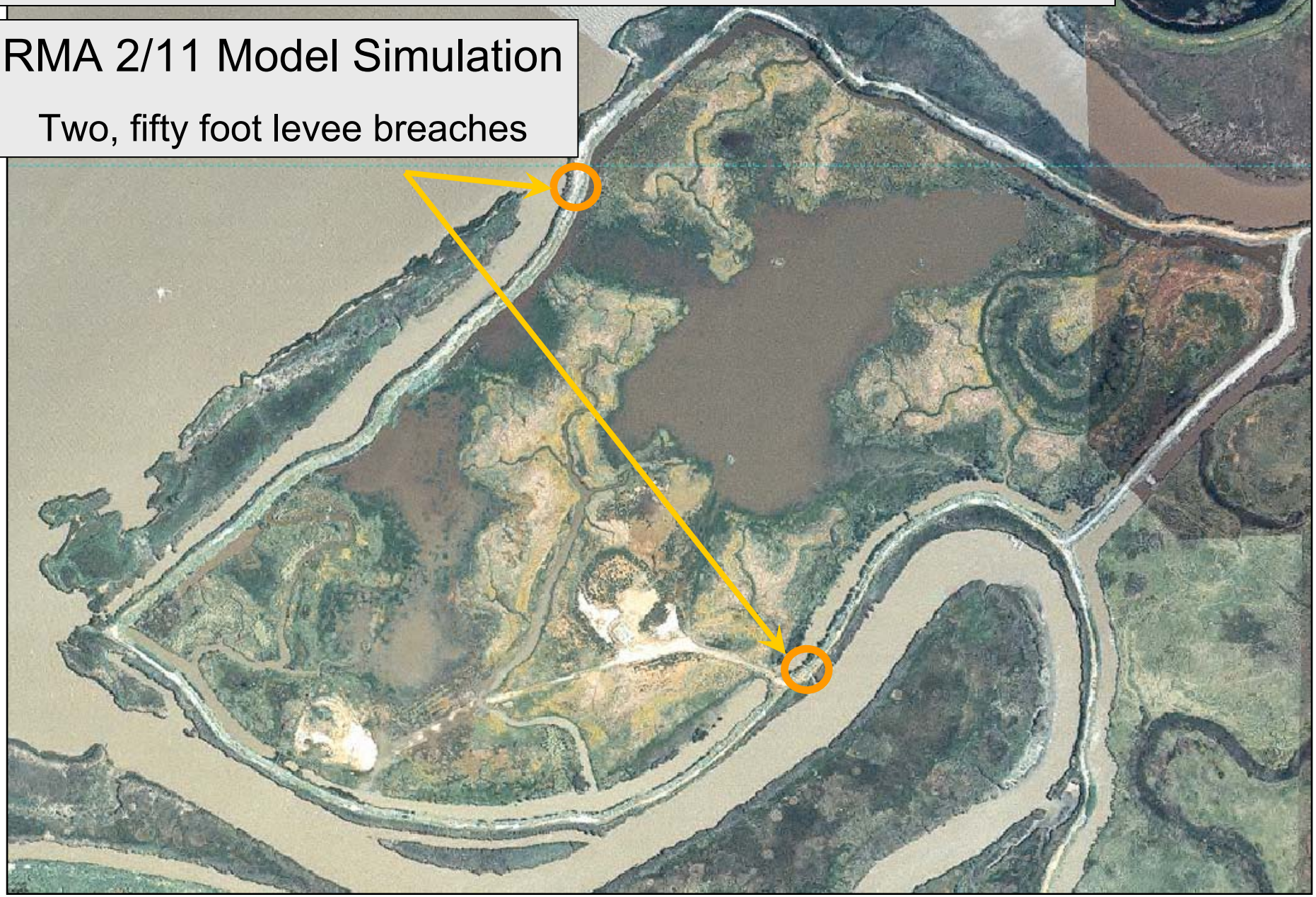
1/ Simulated July 29, 1992
DSM1 Suisun Marsh Version

Blacklock example

Regional Salinity Impact of Blacklock Levee Breaches

RMA 2/11 Model Simulation

Two, fifty foot levee breaches



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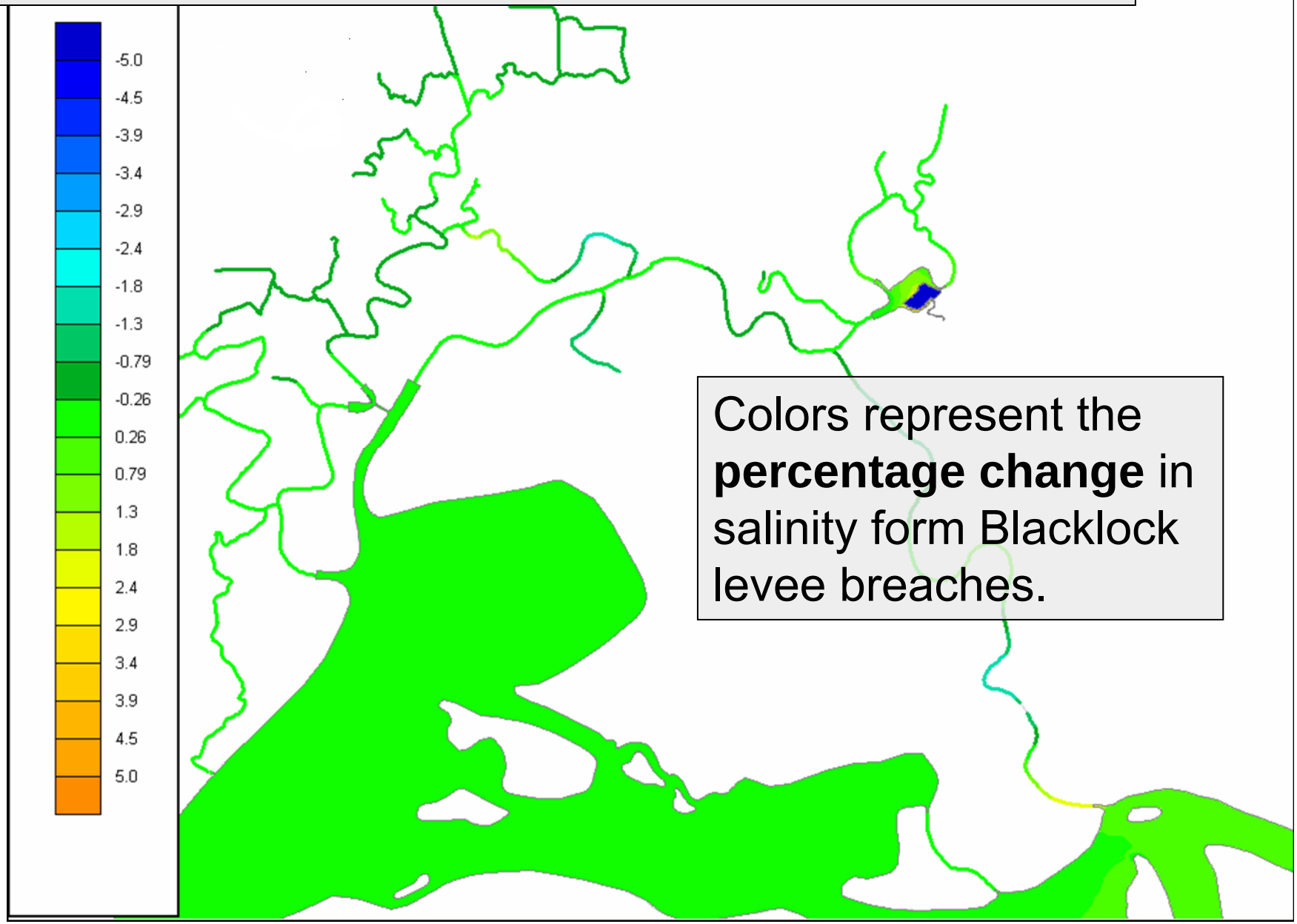
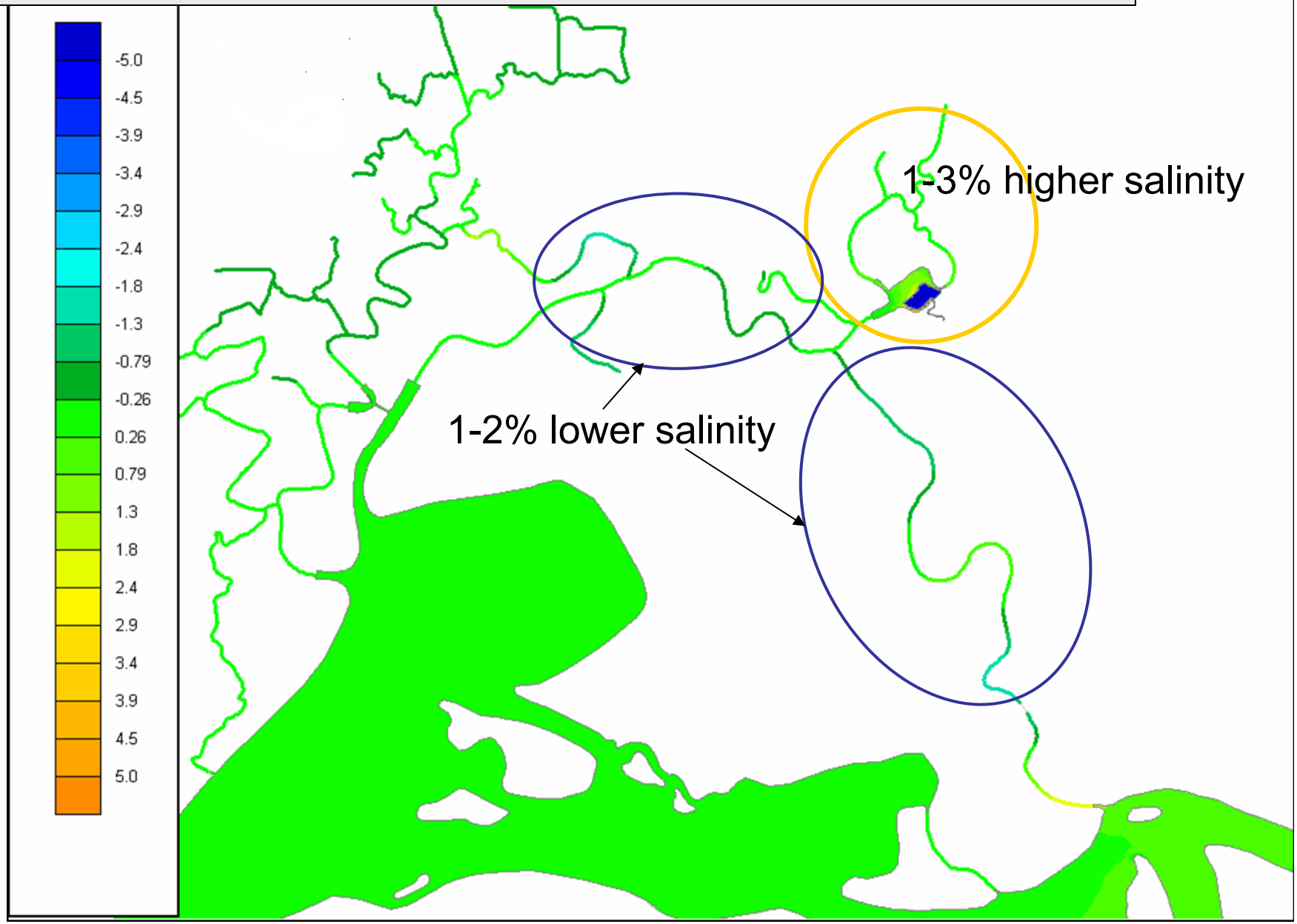


Colors represent the **percentage change** in salinity form Blacklock levee breaches.

Regional Salinity Impact of Blacklock Levee Breaches



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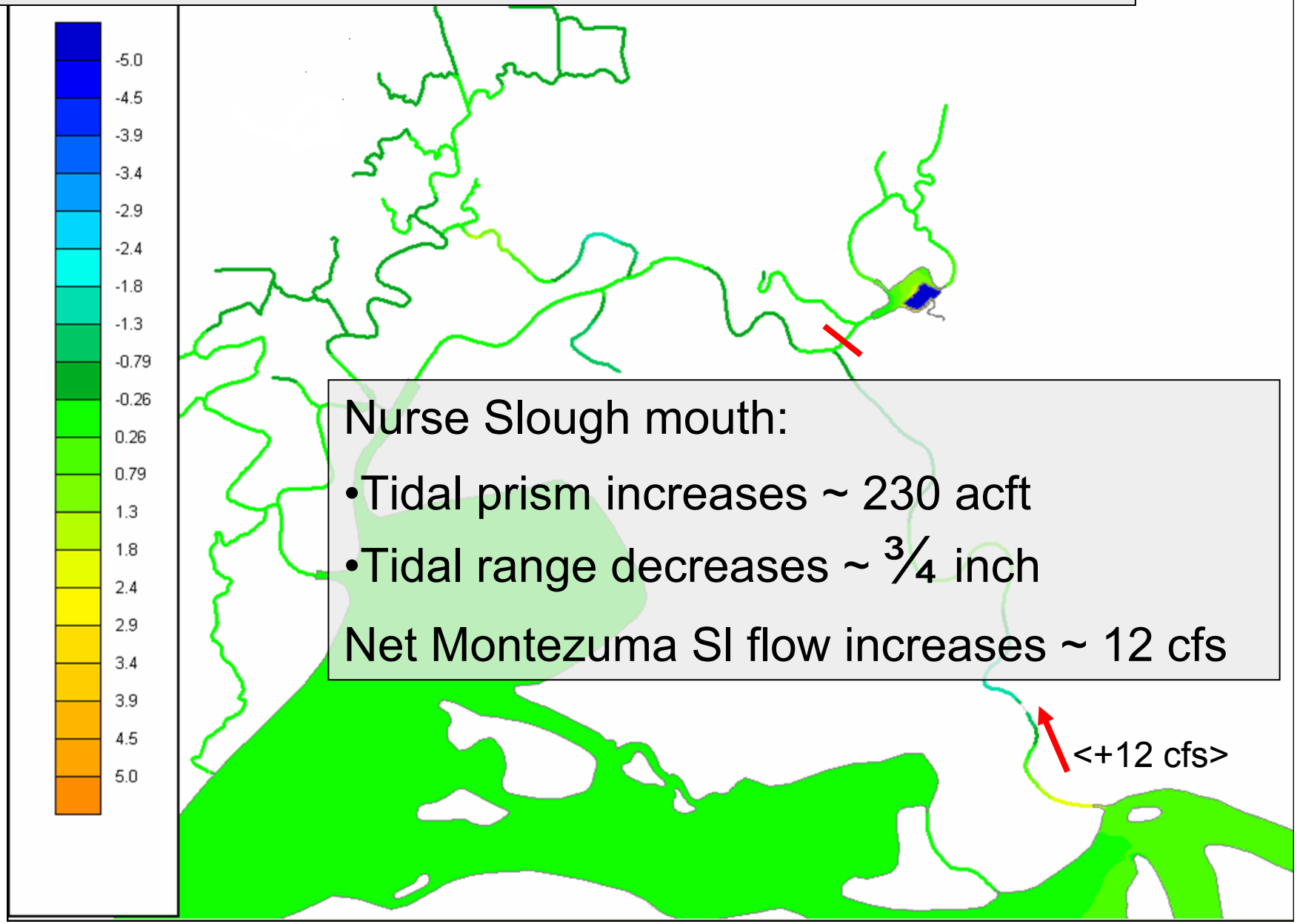

Nurse Slough mouth:

- Tidal prism increases ~ 230 acft
- Tidal range decreases ~ ¾ inch

Net Montezuma Sl flow increases ~ 12 cfs

Uncertainties

- Each site has it’s own transport characteristics depending on location, breach configuration, water exchange volume, and roughness.
- Is incremental addition of tidal restoration parcels additive or geometric?
- What is the impact of more or less mixing on contaminant and biota transport?

Uncertainties

- What levees are more important for Delta salinity protection?