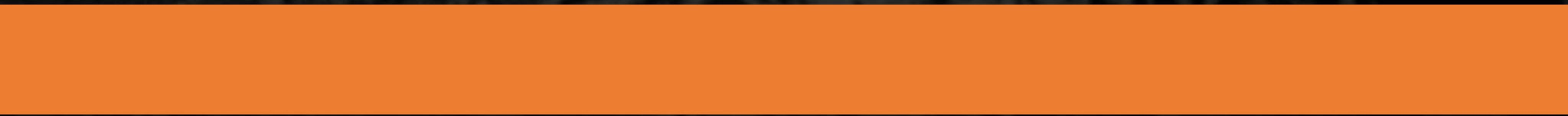




# Geomorphology 101



What is it?

Geomorphology - the study of landforms, the processes that created them, and the history of their development.



# What does it look like? Sand mining example

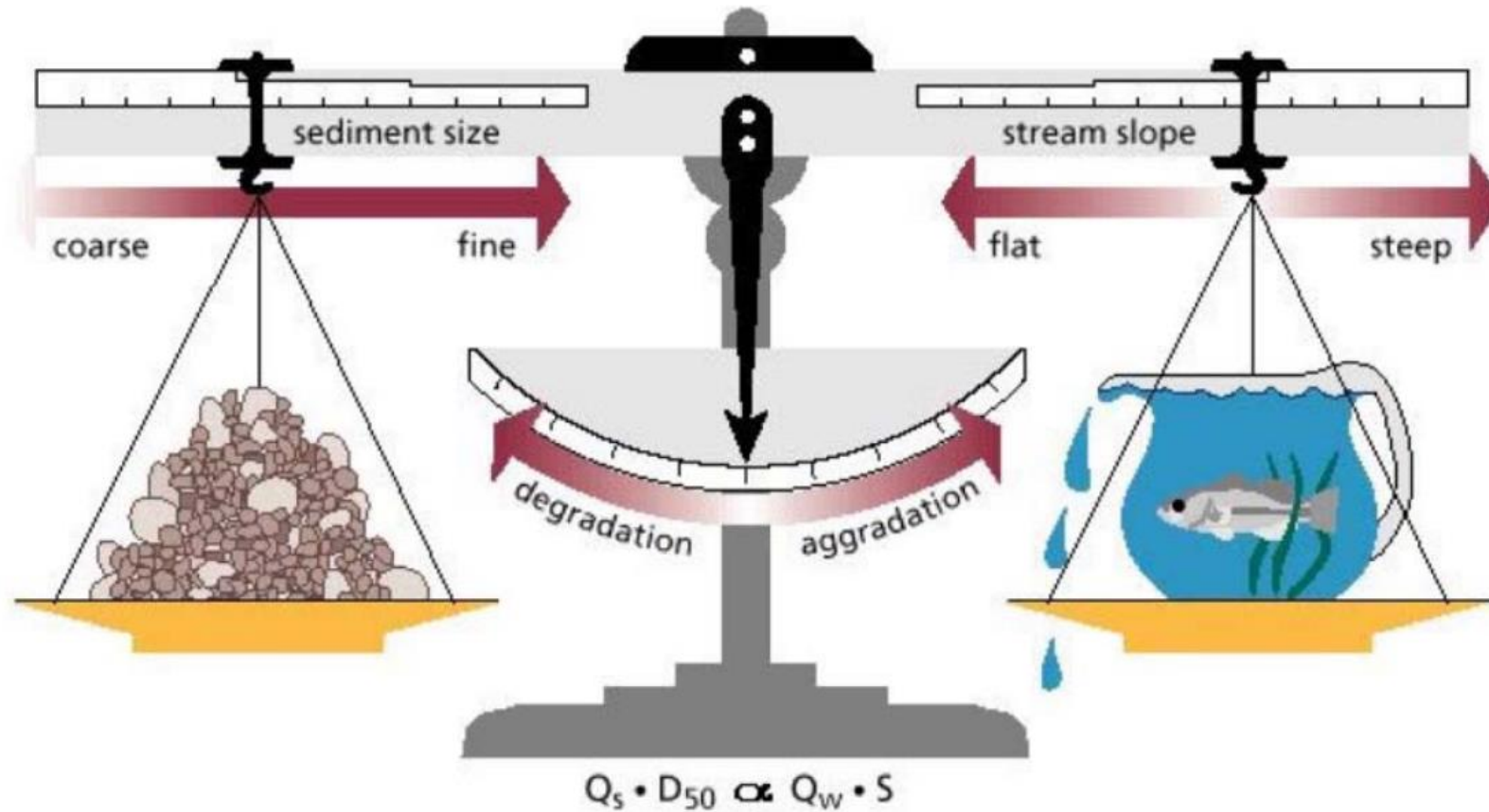


# Takeaways?



- **Complex response**
- A range of possible outcomes –  
**Uncertainty and Randomness**
- **Thresholds & non-linearity**
- Rapid initial response diminishing over  
**Time**
- Response trajectory towards new dynamic  
**equilibrium**

# Conceptual model – landscape in balance



**FIG 1** - Lane's (1955) geomorphic balance diagram (from ACARP, 2002).



## Uncertainty

- Rieger and Olive (1988) comment on the “**present, sorry state**” of sediment yield research, where load computations are “**similar to that generated by random numbers**” and there have been no major advances during the last 10 years.

# Geomorphic value proposition



To predict how natural systems may evolve and respond to impact and thereby manage risk and promote sustainable outcomes

*Holes not drills..*



## Tools of the trade

- Multiple lines of evidence ('forensics')
- Physical models
- Empirical models
- Deterministic models
- Stochastic models
- Conceptual models
- Classification models
  
- Past behaviour
- Case histories/anecdotes
- Expert opinion
- Investigations/monitoring
- ..and lots more



# Case Study

## Instream sand mining

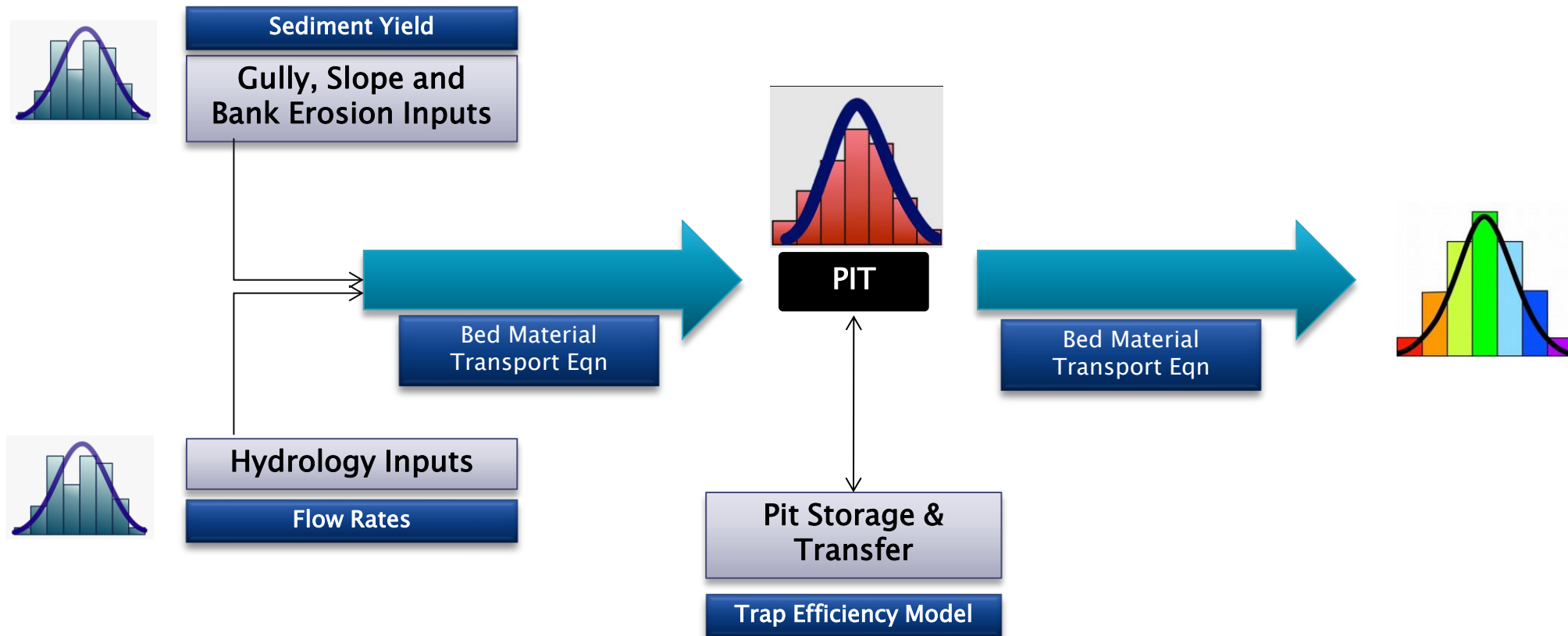
- Sustainable yield
- How will the river respond?
- Landform risk management



# Case Study

## Instream Sand Mining

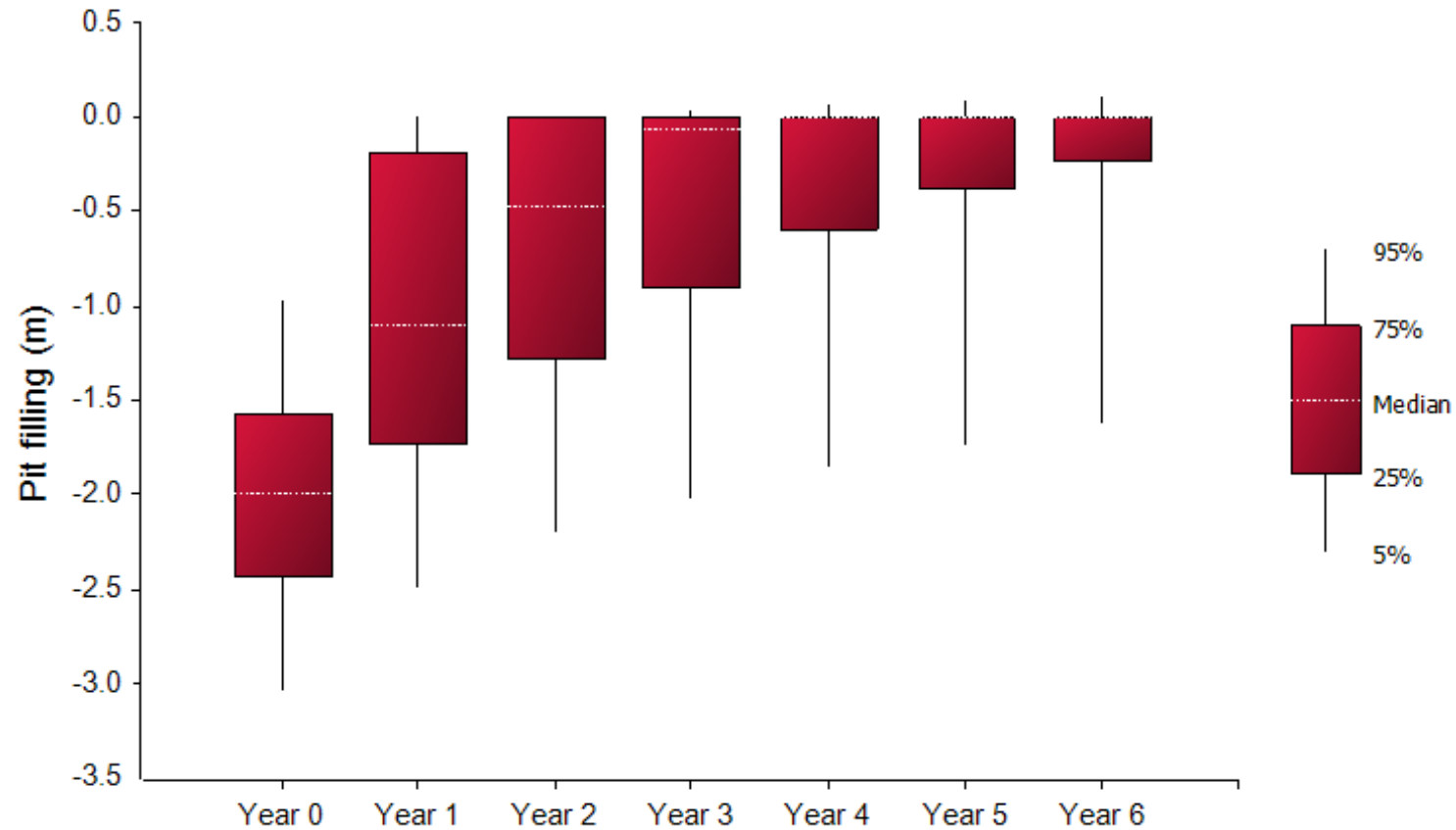
Monte Carlo Modelling



# Case Study

## Instream Sand Mining

Monte Carlo Modelling





# Case Study

## Adjacent Infrastructure





# Case Study

## Adjacent Infrastructure

- How close?
- In-perpetuity solution?



Service Layer Credits: World Imagery:  
Source: Esri, DigitalGlobe, GeoEye, Earthstar  
Geographics, CNES/Airbus DS, USDA,  
USGS, AeroGRID, IGN, and the GIS User  
Community



# Case Study

## Catastrophic sediment event – stabilization and recovery



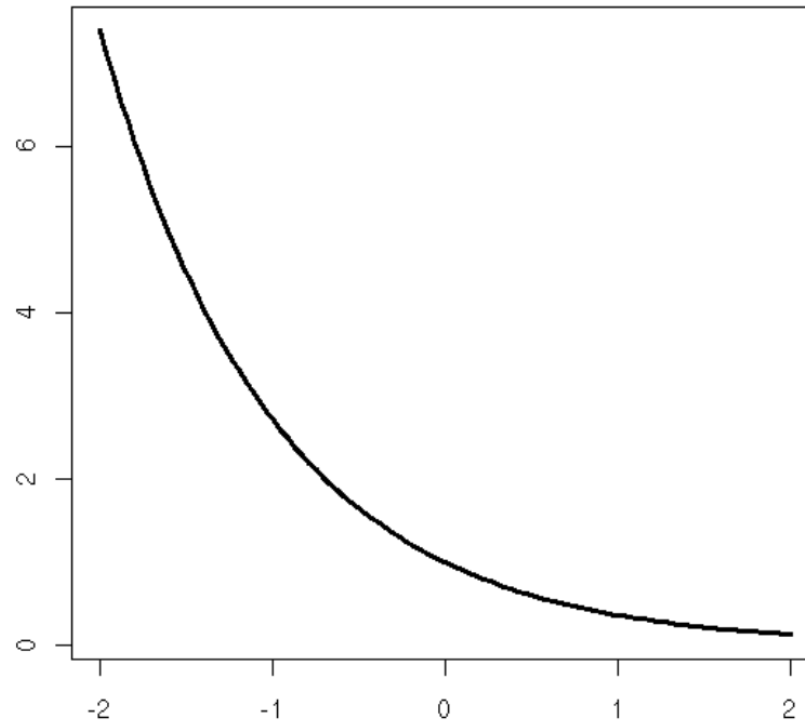
- How to stabilise
- Sediment Balance
- How long?
- How to make functional



# Case Study

## Recovery Trajectory – Samarco Tailings Dam Failure

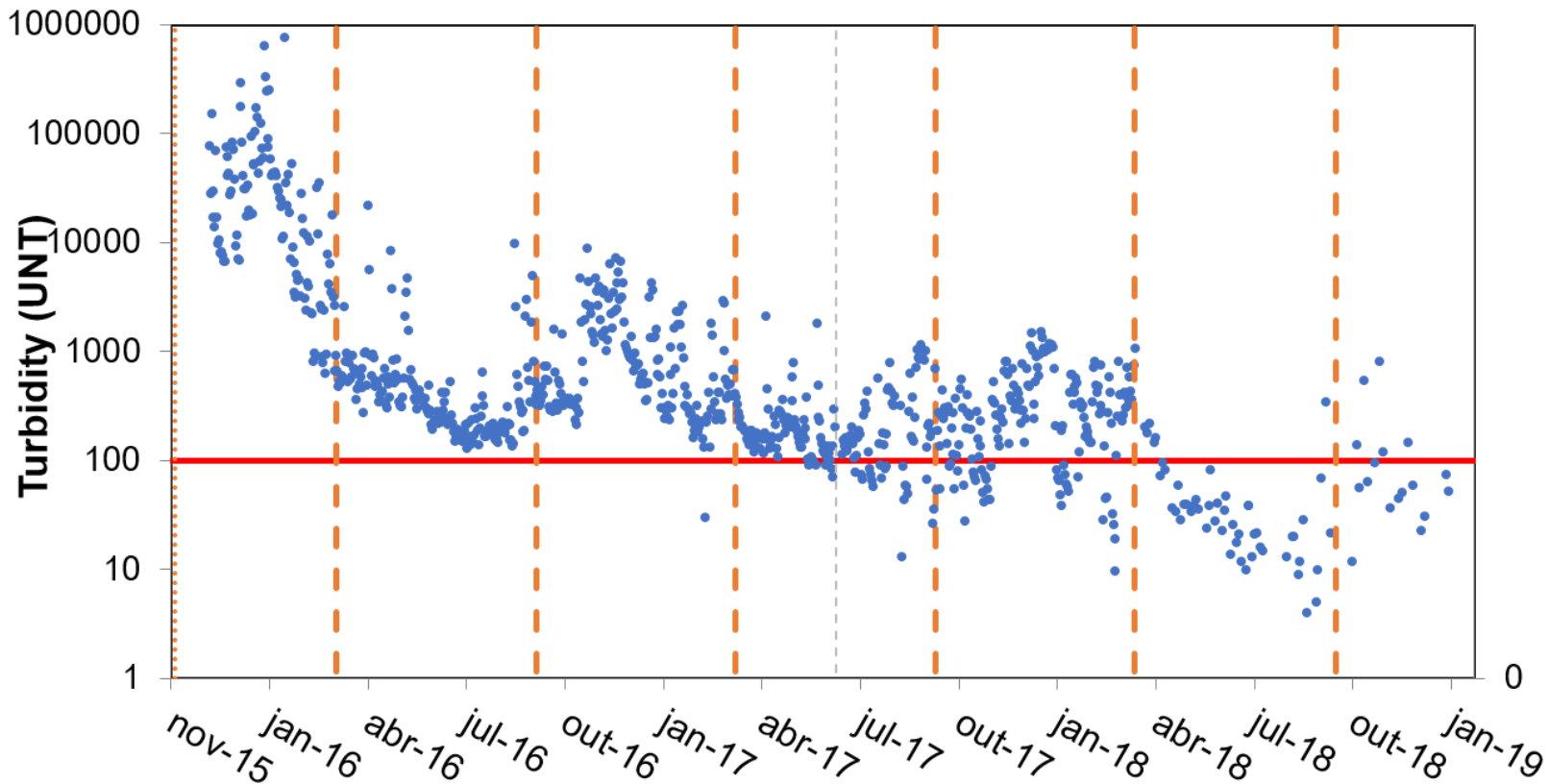
The rate law and the half-life concepts indicate that following disruptions, geomorphic systems approach new steady states very rapidly at first, but that adjustment becomes progressively slower.



# Case Study

## Recovery Trajectory – Samarco Tailings Dam Failure

### RIO GUALAXO DO NORTE



Not Hydrobiology Data



# Case Study

Samarco





# Case Study

Samarco







## Dams & Weirs

- Sediment interruption
- Environmental Flows







# Bridges & Pipeline Crossings

- Structural risks
- General scour
- What's the river doing?
- Aggradation? Degradation?





# Threatened Infrastructure

- What's driving the erosion?
- What's the solution?
- Can it be fixed?





# Diversions

- Sustainable landform – how?







Thanks