

# Rehabilitation of Alluvial Gully Erosion in the Normanby Catchment

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Sediment Sinks Sources & Drivers  
in the Normanby Basin



CAPE YORK WATER QUALITY



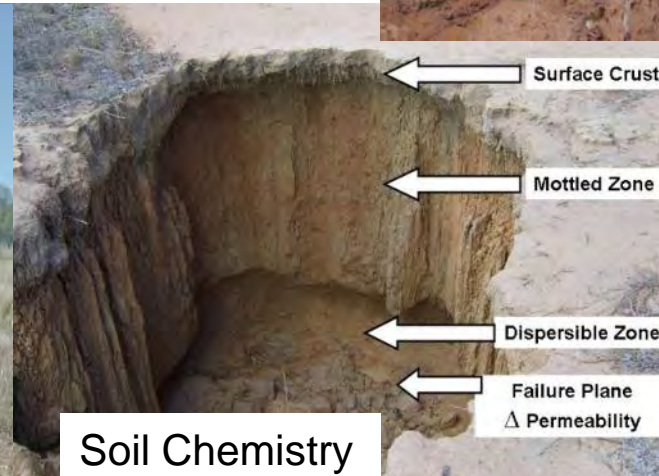
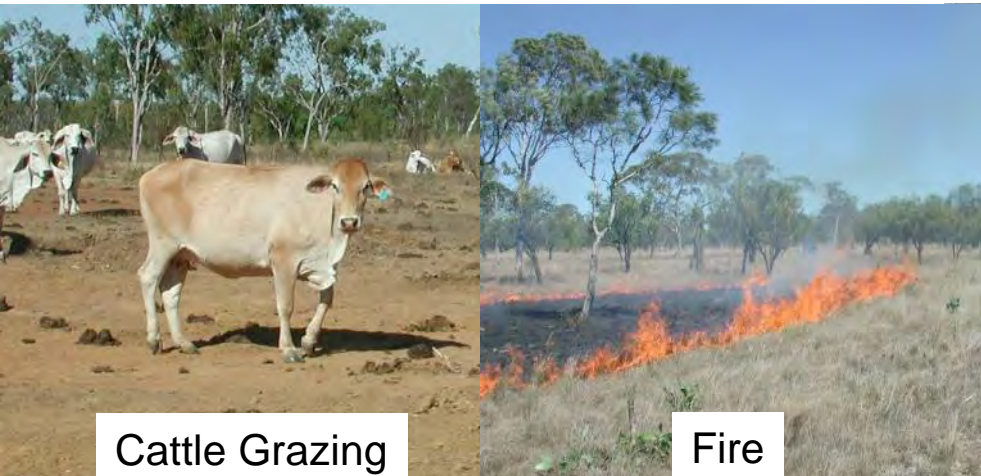
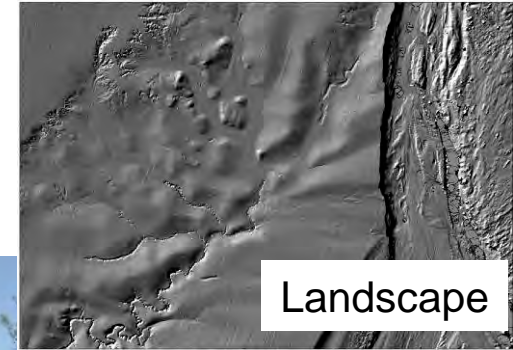
Sediment Sinks Sources & Drivers  
in the Normanby Basin



CARING  
FOR  
OUR  
COUNTRY

# Factors Controlling Alluvial Gully Erosion

- **Inherited Landscape**
  - Floodplain geomorphology, landscape evolution
- **Elevational Relief**
  - Floodplain to channel and degree of incision
- **Monsoon Climate and Hydrology**
  - Tropical rainfall, floodplain hydrology
- **Soils texture and chemistry**
  - Sodic, alluvial, silts/clay soils, hardsetting, dispersible
- **Vegetative cover**
  - Grass woodlands, drought, fire, animal grazing
- **Land use**
  - Cattle grazing, fire regime changes, weeds, roads

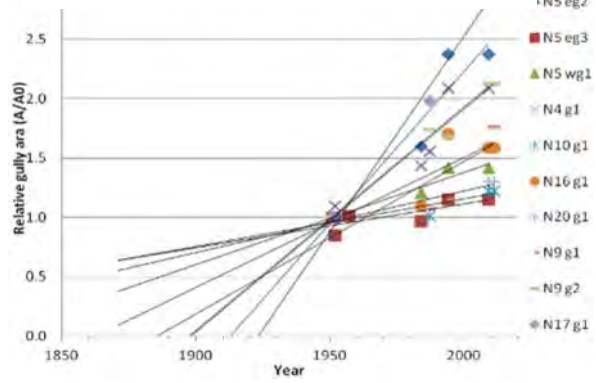


# Land Use Can Accelerate Water Runoff and Gully Erosion in River Frontages

Over-Grazing / No Cover



Increase In Gully Area



Cattle Pads on Flats



Hot Fires



Land Clearing



Cattle Pads on Banks



Fences



Roads

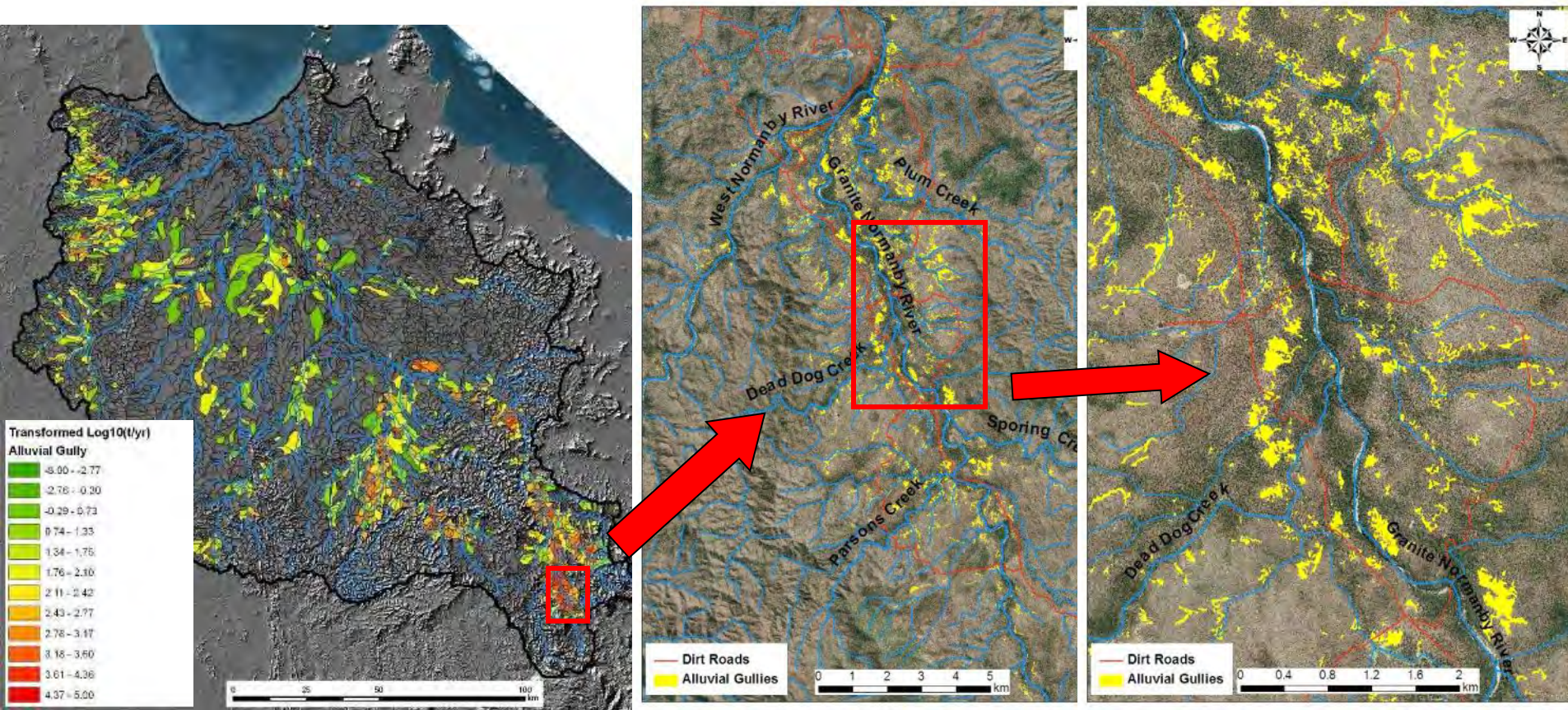


Invasion by Annual Weeds



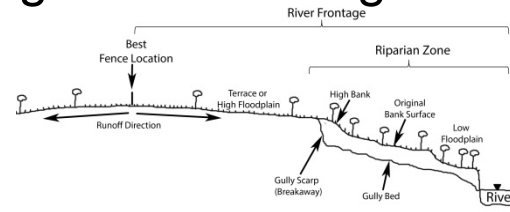
# Cumulative Effects And Scale

- **Cumulative impact** (CEQ 1971)
  - Impacts from incremental actions (past, present, future) regardless who makes them
  - Individually minor but collectively significant actions taking place over time
- **Cumulative watershed effects** (Swanson 1986)
  - Downstream changes in hydrology, sediment production, transport, and storage in response to land management practices



# Rehabilitation of Alluvial Gully Erosion (Breakaways) Along River Frontages

1. Reduce Water Runoff Into Gullies (Drivers)
2. Increase Vegetation in Gullies (Resistance)
3. Reduce Slope (Grade) of Gully Channels (Resistance)



## Install water diversion/retention banks above gully heads

- Divert excess water to safe disposal areas



## Install grade control structures

- Only at narrow gully outlets or finger headcuts



## Active rehabilitation gully slopes

- Re-grade gully slopes with machinery
- Amend sodic soils with gypsum ( $\text{CaSO}_4$ )
- Add compost or mulch for soil protection from rain drop
- Add fertilizer or compost for plant nutrients
- Sow gully with perennial grass seed (native or exotic)



## Increase grass cover in gullies

- Fence out cattle
- Aerial, hand or spray grass seed in the wet season



- Fence river frontage away from high banks
- Full cattle exclusion or wet season spelling



## Reduce cattle pads over steep banks

- Reduce water concentration



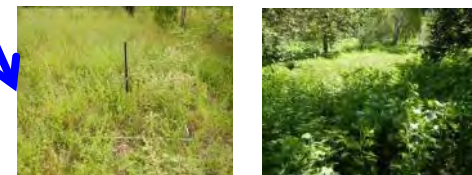
## Increase perennial grass cover on river flats

- Cover Target >75% at BOS, >1000 kg/ha
- Reduce water runoff



## Fire management in river frontage

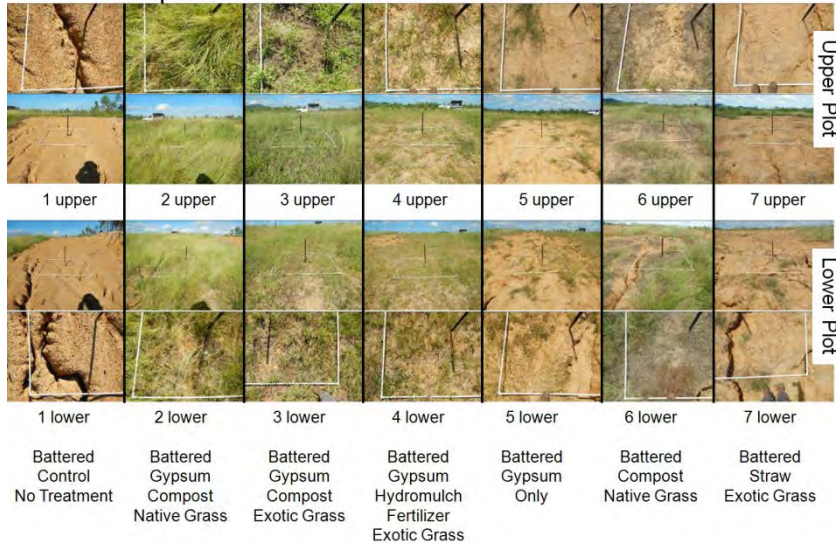
- Cool winter fires (3-5 yrs)
- Infrequent hot fires (> 7-10 yrs)



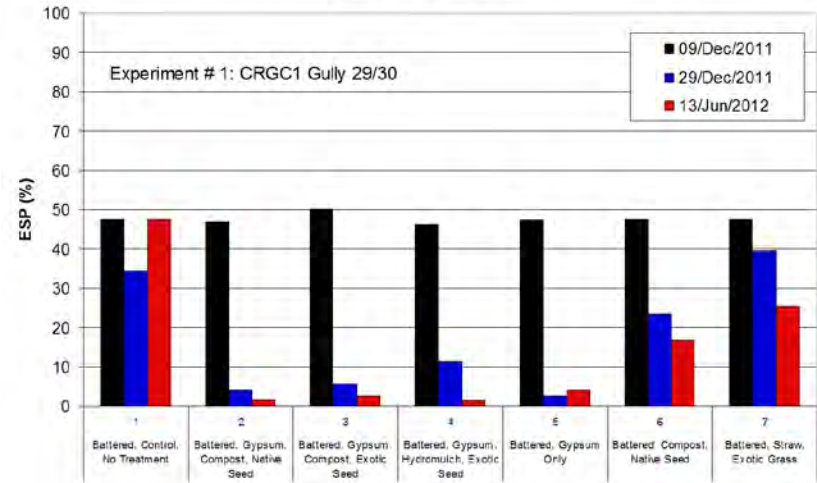
## Weed management and control

# Various Options for Intensive Intervention

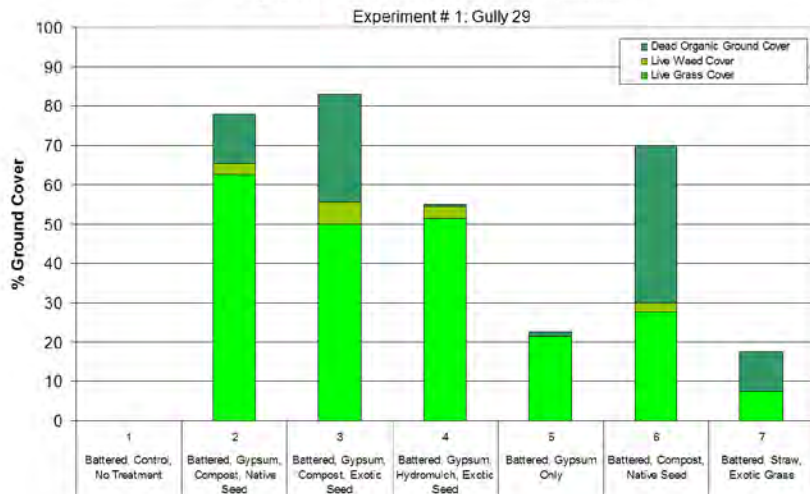
April 2013 Results [After Two (2) Wet Seasons]  
 Experimental Treatment Plots: CRGC1-29/30



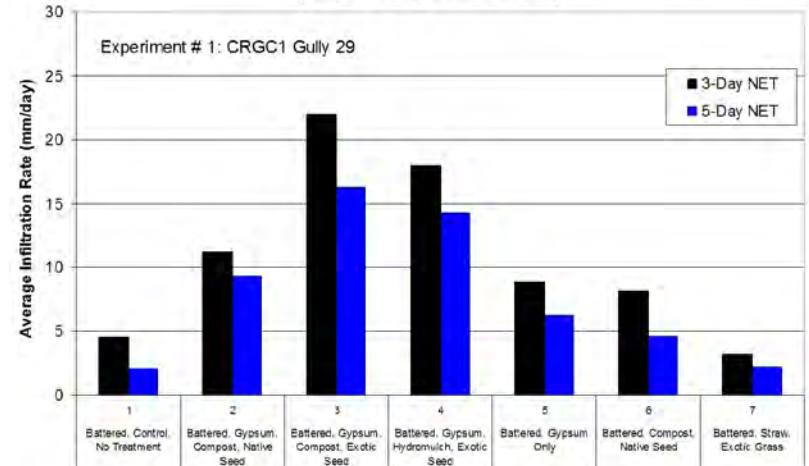
Exchangeable Sodium (Na) With Gypsum Treatment  
 Surface Soils ONLY



Ground Cover: April 2013 Results  
 Vegetation Cover After Two (2) Wet Seasons



Infiltration Rates Aug/Sept 2012 Following Treatment  
 (Double Ring Infiltrometer)



# Grade Control Structures in Battered and Revegetated Gullies

Original Gully, Nov-2011



Gully Battering, Dec-2011



Gully Battering, Dec-2011



Hydro-mulching, Dec-2011



Diverting Hillslope Water, Adding Wood Weirs, Dec-2011



Adding Gypsum, Dec-2011



Headcut Re-initiation, Jan-2012



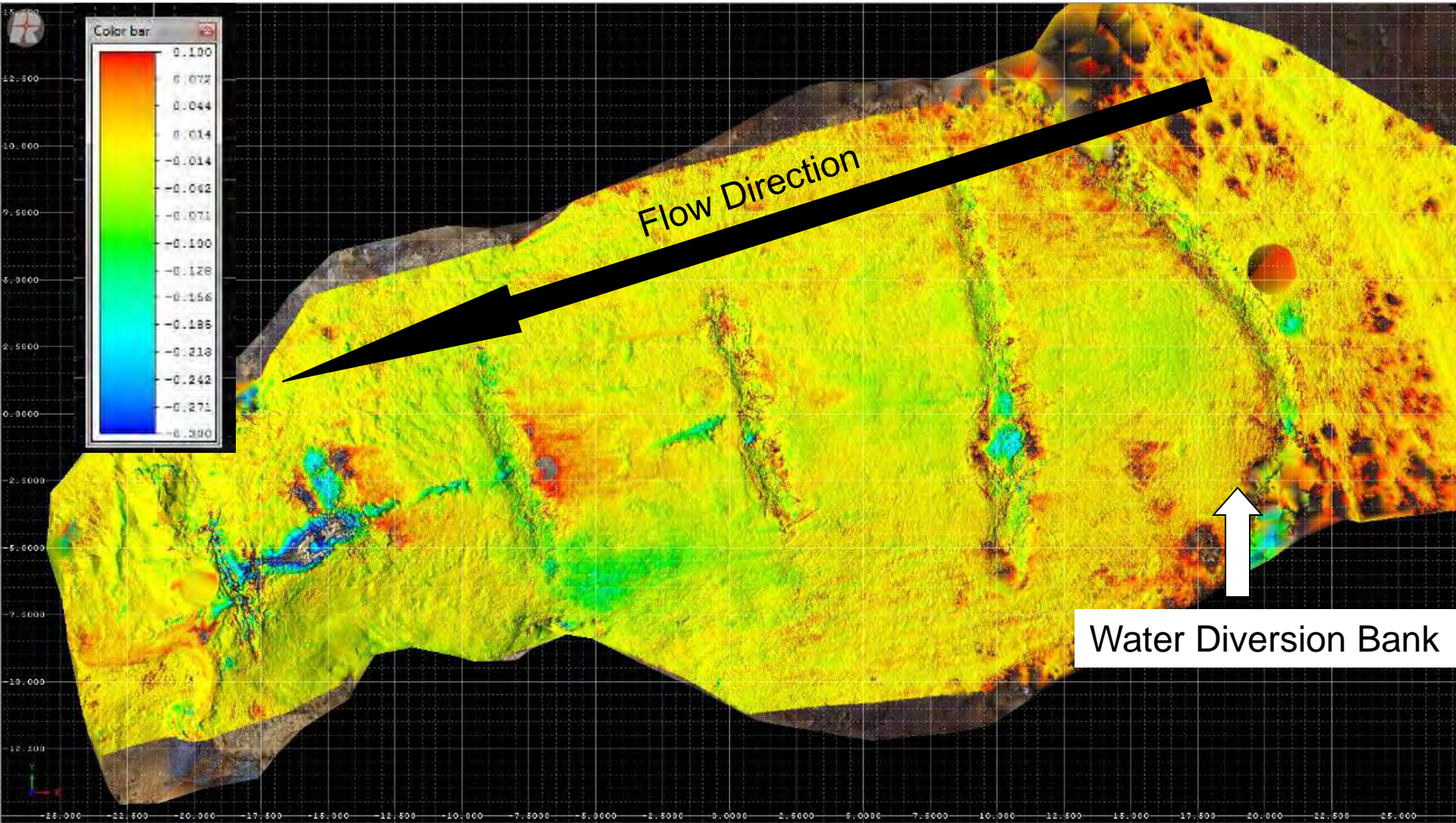
Water/Sediment Retention, Jan-2012



Vegetation Growth, April-2012



# Terrestrial LiDAR Changes at CRGC1-40 Dec 2011 to November 2012



- Head cut reinitiation still a problem, despite water diversion, wood grade control, gypsum, hydromulch.....



- The everything option will definitely slow things down (data still to come by how much)
- But – its not cheap.

# Summary: Gully Slope Stabilization

- **Re-grading gullies does not stop erosion**
  - Just reinitiates- possibly accelerates....
- **Adding gypsum, mulch and grass reduces erosion.....**
  - by protecting and binding the soil and increasing infiltration
- **Rill erosion continues to be persistent.....**
  - Rainfall > Infiltration promotes water runoff, sheet flow, rilling.....
- **Gully head-cutting from the bottom still a major threat to slope stability**
  - Can add grade control structures to improve stability
- **Hydromulch, gypsum best for short term erosion reduction**
- **Compost, gypsum, perennial grass best for long-term vegetative cover**
- **PHYSICAL INTERVENTION IS EXPENSIVE !!!!!**
  - ~ \$6,000 to bulldoze, gypsum, hydromulch a 0.2 ha (50x40m) gully slope
  - ~ \$60 million to treat 2000 ha of mapped alluvial gullies in the Normanby

Would this actually reduce erosion or accelerate it ???

# Cattle Exclusion Trials and Passive Rehabilitation

Will Grass Vegetation Recover and Reduce Erosion if Cattle Are Excluded From These Sites for 10-20 Years?



- Rely on Natural Resilience of Vegetation
- Applicable at Large Scales
- Potential to Destock Larger Areas of Erosion?
- Cumulative Sediment Reductions?

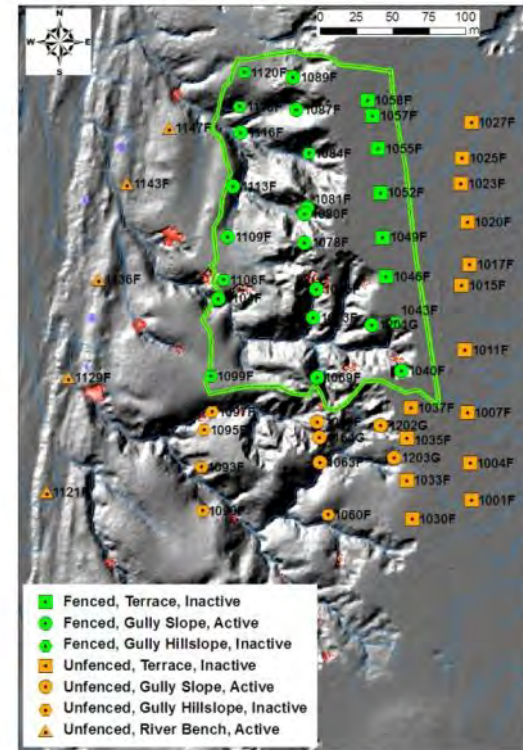
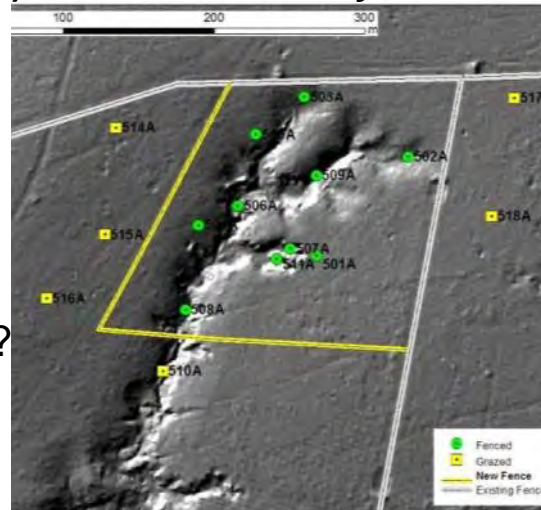
# Trial Fenced Cattle Exclusion Sites

## #1) West Normanby River Frontage

### Study Design

- 2-5 ha exclusion areas
- Before-After Control-Impact design
- Control vegetation plots (outside)
- Treatment vegetation plots (inside)
- Different geomorphic units
- Before Fence: Nov-11, Apr-12
- After Fence: Nov-12, Apr-13, ongoing???
- LiDAR Topography 2009 & 2011

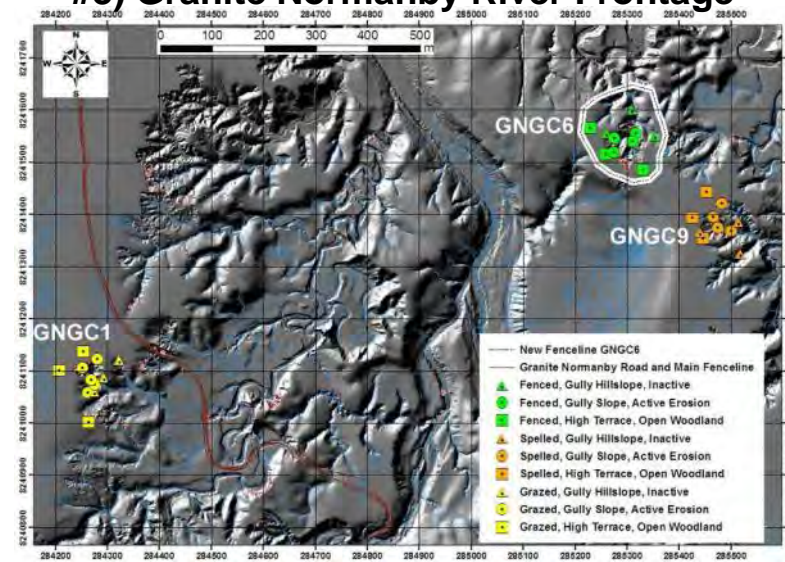
### #2) Crocodile "Old Hay Paddock"



### Metrics At Vegetation Plots

- % cover
- # of species
- Tussocks counts
- Pasture yield
- Soil condition
- Overall land condition rating
- Grass & weed species ID and diversity

### #3) Granite Normanby River Frontage



# Best to Not Initiate Gully Erosion in the First Place !!!!

Reduce land use pressures in erosion sensitive areas



- This gully producing ~ 1500t/yr
  - @ \$600\*/t  
= \$900,000
- (Can significantly slow erosion for much less)



(\* Gale pers. comm. 2013)

Normanby Sediment  
Budget

# Acknowledgments

## Stations

- Crocodile Station and Indigenous Land Corporation
- Springvale Station and Outback North
- Kings Plain
- Olivevale/Fairview
- Normanby Station

## People

- CYSF: Isha Segboer, Trish Butler, Peter Thompson
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- Christina Howley
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- Anglea Gleeson
- Amanda Hogbin

## Materials and Equipment

- Mo Jenkins
- Mario Puccini Excavating
- Oz Earthmoving
- Swiss Farms Compost
- Native Seeds
- Tony Illing Seeds
- Jones Mobile Crushing and Screen
- Revegetation Contractors
- Miriwinni\_Lime
- Far North Earthmoving

## Analysis

- RPS: Nick McKelvey
- Australian Tropical Herbarium: Gerry Turpin & Darren Crayn
- Environmental Analysis Laboratory: Graham Lancaster & Kris Saville
- Griffith University: Rawaa Abdul Jabbar, Bahar Nader Al-Uzairy, Scott Byrnes, Daniel Borombovits
- Terranean Mapping Technologies/RPS: David Moore

