Coal seam gas and research in Australia: an introduction & overview

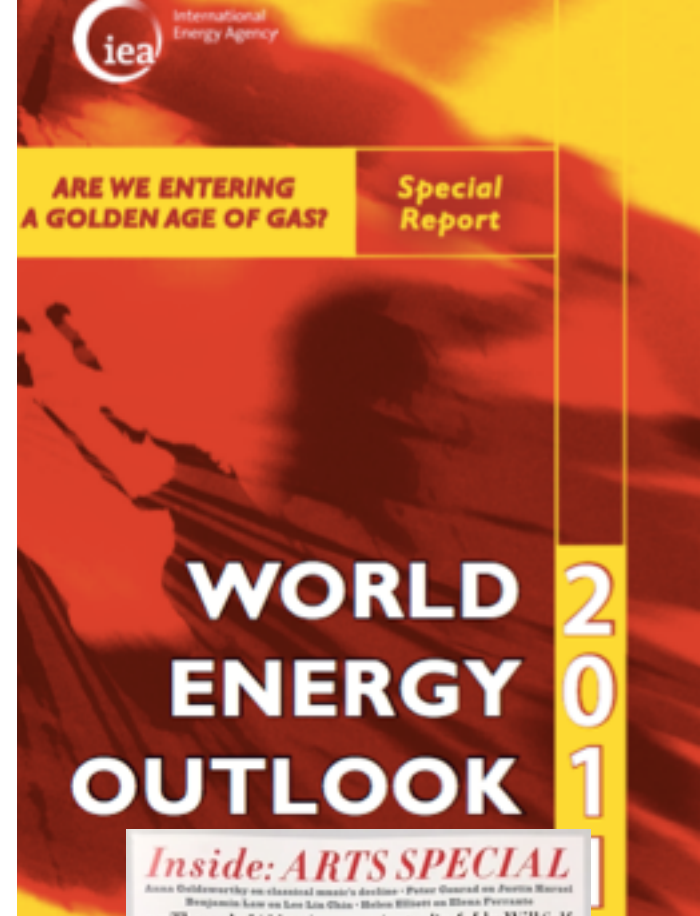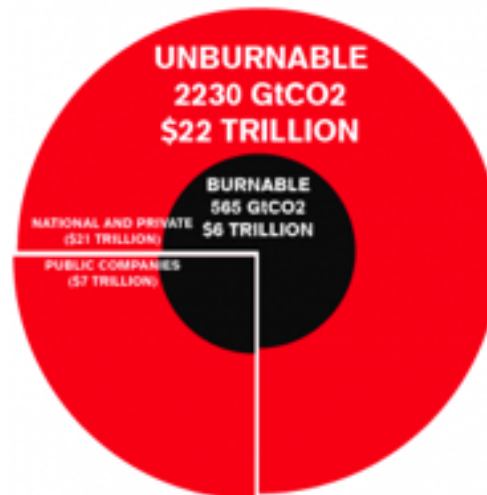**Presentation to Community Consultative Committee, Narrabri Gas Project**

Gas, the great energy transition?

1. Gas, as at May 2016
2. Energy demand
3. Energy supply and competing fuel sources
4. Forward curves 2040, 2050, 2060
5. Climate change

ARE WE ENTERING A GOLDEN AGE OF GAS? Special Report

WORLD ENERGY OUTLOOK 201

iea International Energy Agency

GISERA Gas Industry Social & Environmental Research Alliance

PROVEN FOSSIL FUEL RESERVES
2795 GtCO2
$28 TRILLION

UNBURNABLE
2230 GtCO2
$22 TRILLION

BURNABLE
565 GtCO2
$6 TRILLION

NATIONAL AND PRIVATE
($21 TRILLION)

PUBLIC COMPANIES
($7 TRILLION)

Inside: ARTS SPECIAL
The end of Abbott's era on Australia & L by Will Self

THE MONTHLY

COAL CRASH

WHAT IT MEANS FOR AUSTRALIA BY PAUL CLEARY

Gas use

homes

commercial buildings

generating power

manufacturing

oil & gas sector

vehicles

Coal Seam Gas (CSG) – an opportunity & a challenge

- Presents opportunities and challenges
- Opportunities:
  - Infrastructure development (roads, wells, water resources)
  - Revenue and farm income (rent)
  - Economic development (towns, services)
  - Environmental protection/rehabilitation
- Challenges:
  - Landscape fragmentation/alienation/degradation
  - Aquifer/alluvium connectivity/drawdown/subsidence
  - Chemical contamination from drilling, hydraulic fracturing, flowback, spills
  - Resource sector economic cycles

- Not evenly distributed across landscapes and through time
- Uncertainty creates tension and public discontent
- Need to maximize benefits and minimize challenges

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GISERA's research portfolio
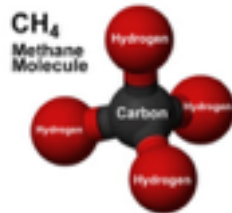
- **Agriculture**: identifying landscape/ development configurations that maximise co-benefits

- **Water**: understanding risks associated with extraction & use of groundwater

- **Biodiversity**: understanding & minimising impacts of development on regional ecological function

- **Marine**: understanding vulnerable components of the marine ecosystem to minimise or offset impacts

- **Socio-economic**: informing & supporting change to enhance regional & community benefit

- **Greenhouse footprint**: identifying sources and profiling the region

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GISERA NSW

Narrabri & Macarthur regions
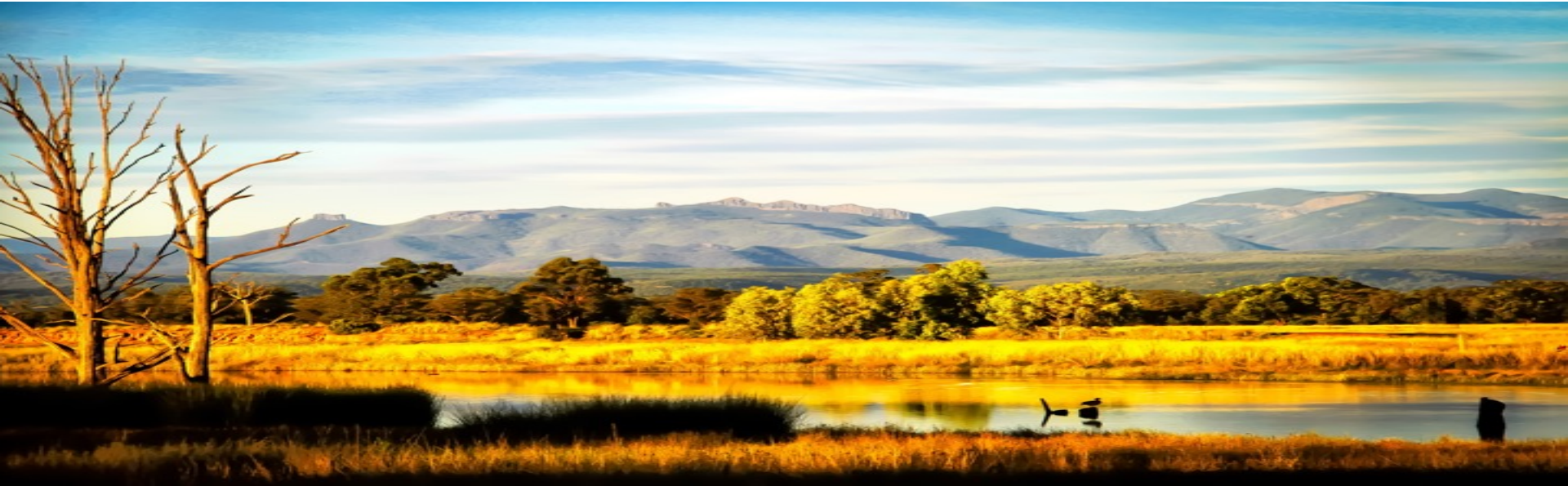
GISERA objectives

- Seeks to develop
    - Science: Predict and solve challenges & opportunities
    - Integrated, regional, systems-based research
    - Provide communities evidence based knowledge
    - Informed debate
    - Underpin decisions: Maximize benefits & minimize costs

- Outcomes
    - New knowledge & reduced uncertainties for relevant stakeholders
    - Foster collaboration by communities, industry, government, universities
    - Synthesize data & knowledge at a regional scale
    - Provide non-exclusive opportunities (win-win)

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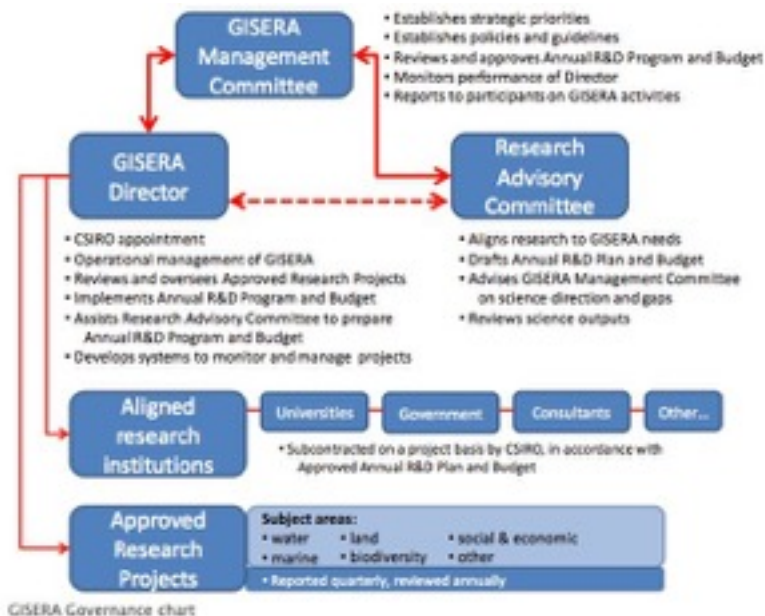
GISERA governance

GISERA Governance chart

www.gisera.org.au

- Research Advisory Committee
  - Contains 2/8 (industry/other) members
  - Contains 4/5 (party/independents)
  - Identifies, develops, approves, stop projects
  - Ensures research priorities are independent
  - Ensure research is transparent
  - Oversees conduct
  - Internal documentation completely visible
  - Science reports publicly available
  - CSIRO peer-review process

- Research Management Committee
  - Composition: CSIRO, APLNG, QGC
  - Oversees day-to-day operations
  - Financial governance
  - Milestone sign-off

NSW Research Advisory Committee

Alliance Director:

    Dr Damian Barrett: GISERA Director and Research Director Unconventional Gas, Energy Business Unit (CSIRO)

CSIRO:

    Dr Peter Wallbrink: Research Director - Basin Management Outcomes, Land and Water (CSIRO)

    Amir Aryana: Reservoir Engineering Group Leader, Onshore Gas Program, Energy Business Unit (CSIRO

Industry:

    Armon Hicks: Manager ENSW Public Affairs (Santos)

    Aaron Clifton: NSW Environment Manager, Gas Operations (AGL)

Independents:

    Jock Laurie: NSW Land and Water Commissioner

    Jack Warnock: Lower Namoi Cotton Growers Association

    Ken Flower: General Manager, North West Local Land Services

    Phillip Wright: DPI Chief Scientist

    Prof Alison Sheridan: Head of School, UNE Business School

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GISERA independence

GISERA purpose-built to ensure that:

- identification of research priorities

- selection...

- conduct...

- reporting of research projects

is independent of gas interests

- Only the Research Advisory Committee (4/5 party/independent members) can develop, approve or stop projects

- All reports publicly available following CSIRO peer-review

- All 'internal' documentation publicly available at gisera.org.au

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National GISERA Model

Regional Research Advisory Committees (RRAC)

NSW RRAC	QLD RRAC

Project Approval

Individual Projects

P1	P2	P3	P4	P5	P6

Strategic Priorities and Performance

National Research Management Committee (NRMC)

National Research Management Committee

GISERA Director

National Advisory Committee

GISERA — Gas Industry Social & Environmental Research Alliance

National GISERA total budget

Contributor	Nature of Contribution	Amount (excluding GST)	GST Payable	Amount (including GST)
CSIRO	In-kind	$1,500,000	N/A	$1,500,000
NSW State Government NSW Department of Trade and Investment	Cash	$1,500,000	N/A	$1,500,000
Federal Government Department of Industry and Science	Cash	$1,500,000	N/A	$1,500,000
Industry Partners				
Australia Pacific LNG Pty Limited	Cash	$450,000	$45,000	$495,000
QGC Pty Limited	Cash	$450,000	$45,000	$495,000
Origin Energy Resources Limited	Cash	$450,000	$45,000	$495,000
Santos Limited	Cash	$450,000	$45,000	$495,000
AGL Energy Limited	Cash	$450,000	$45,000	$495,000
TOTAL CONTRIBUTIONS		**$6,750,000**	**$225,000**	**$6,975,000**

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Queensland projects

Greenhouse footprint
- **G.1** Methane seepage fluxes, Surat Basin
- **G.1** Methane seepage fluxes (enhancement), Surat Basin
- **G.2** Whole of life cycle GHG assessment of exploitation of Surat Basin gas reserve: global benefits and risks

Groundwater
- **W.1** Geo-chemical response to reinjection
- **W.2** Re-injection of CSG water (clogging)
- **W.3** High performance groundwater modelling (feasibility of largescale injection schemes)
- **W.4** Geochemical baseline monitoring (groundwater flow systems)
- **W.5** HCs in groundwater, Surat & Bowen Basins (defunct)

Marine
- **M.1** Towards an integrated study of the Gladstone Marine System

Agricultural land
- **L.1** Preserving agricultural productivity
- **L.2** Shared space
- **L.3** Gas farm design
- **L.4** Making tracks, treading carefully
- **L.5** Ag land Without a trace
- **L.6** Telling the Story (a communications project)

socioeconomics
- **S.1** Monitoring Regional Transition
- **S.2** Community Functioning and well being
- **S.3** Economic assessment and forecasting
- **S.5** Understanding Community Aspirations
- **S.6** Community functioning and wellbeing survey 2

Terrestrial biodiversity
- **B.1** Threat identification
- **B.2** Fire Ecology
- **B.3** Habitat selection by two focal species
- **B.4** Translocation research project for Rutidosis lanata (an offsets projects)

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Greenhouse footprint

profiling molecules from satellite to microscopic inspections

CH_4
Methane Molecule

Hydrogen

Carbon

Hydrogen

Hydrogen

Hydrogen

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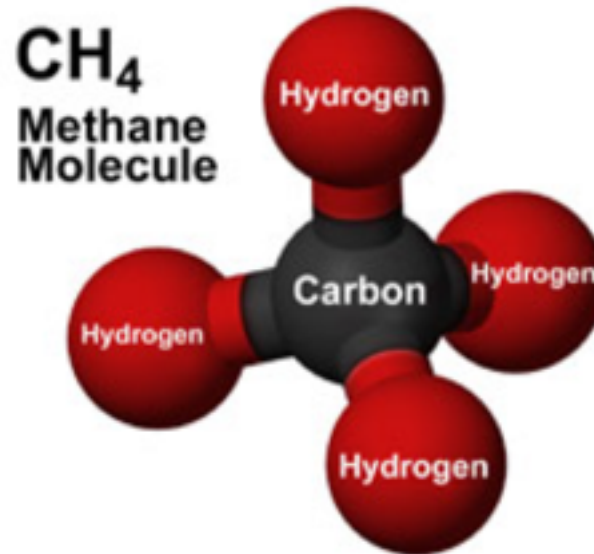
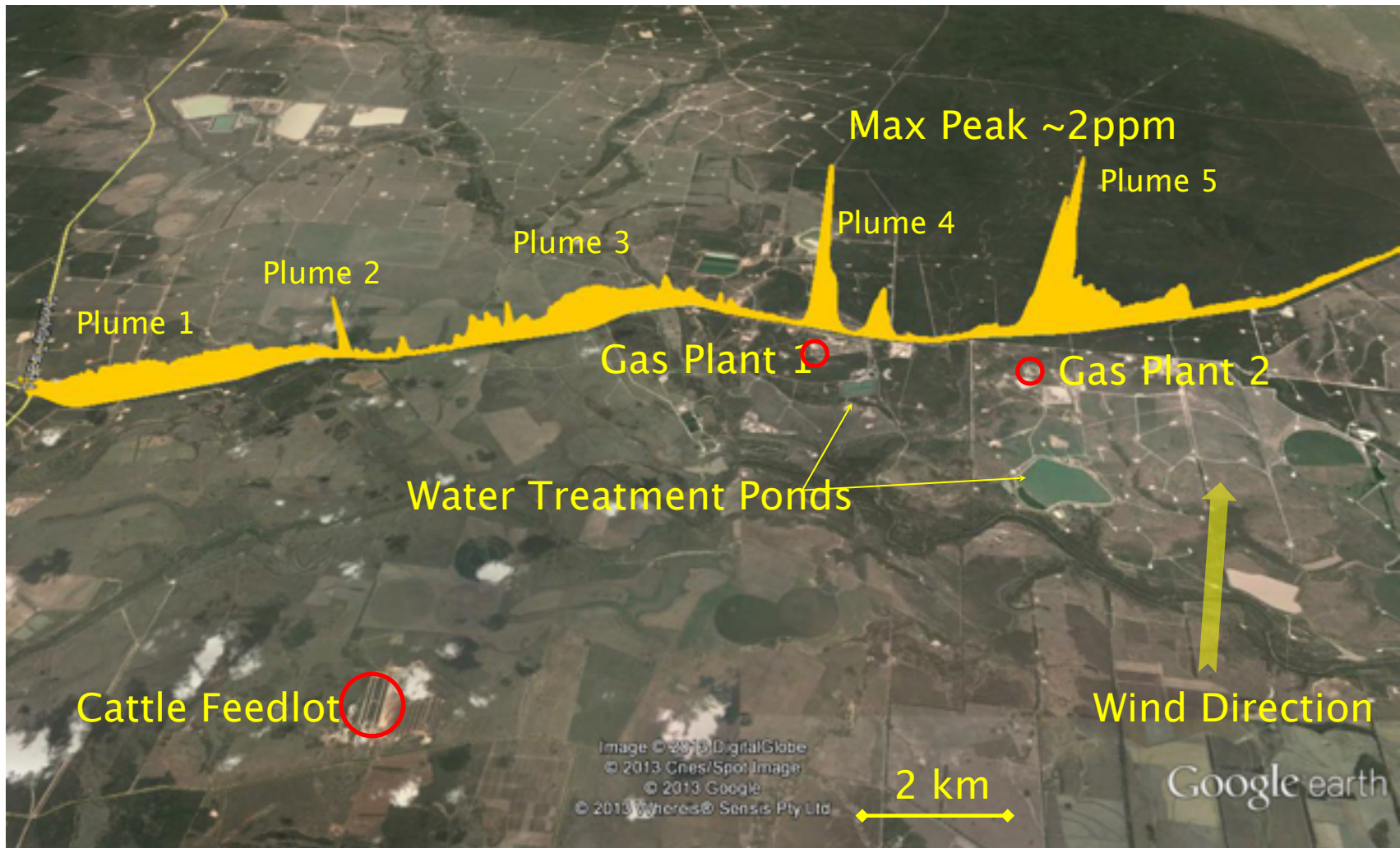# Methane seeps and fugitive emissions

Methane is a significant GHG

To quantify industry methane emissions necessary to know seeps

Bespoke research program to locate, identify, quantify and monitor seeps

CSIRO research program on fugitives

Early research suggest well-head emissions are low compared to US

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identifying and quantifying methane sources

Cattle Feedlot

- 1 km downwind
- 25,000 cattle
  - $>4{,}000$ L min^{-1}
  - $1{,}500$ t y^{-1}

Feedlot; Peak ~2.5 ppm

Cattle; Peak ~1.9 ppm

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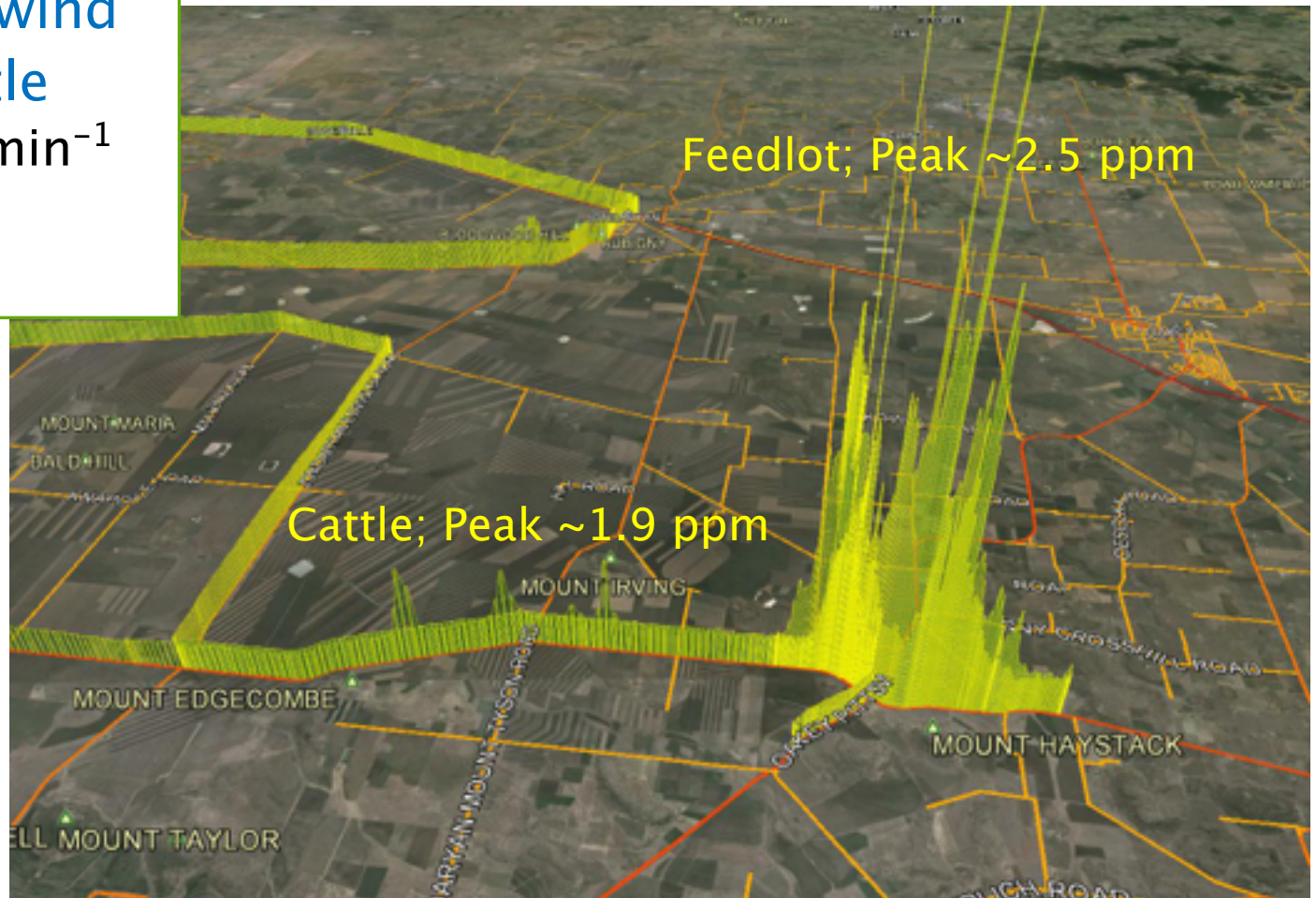
Abandoned Boreholes

Localised emission

No obvious source

Gas seeping from ground

Nearest CSG well   > 2.5 km away

Traversed to estimate flux

Up to 18 ppm CH_4

~50 L min^{-1} (17 t y^{-1})

100 m

Wind
1–3 m s^{-1}

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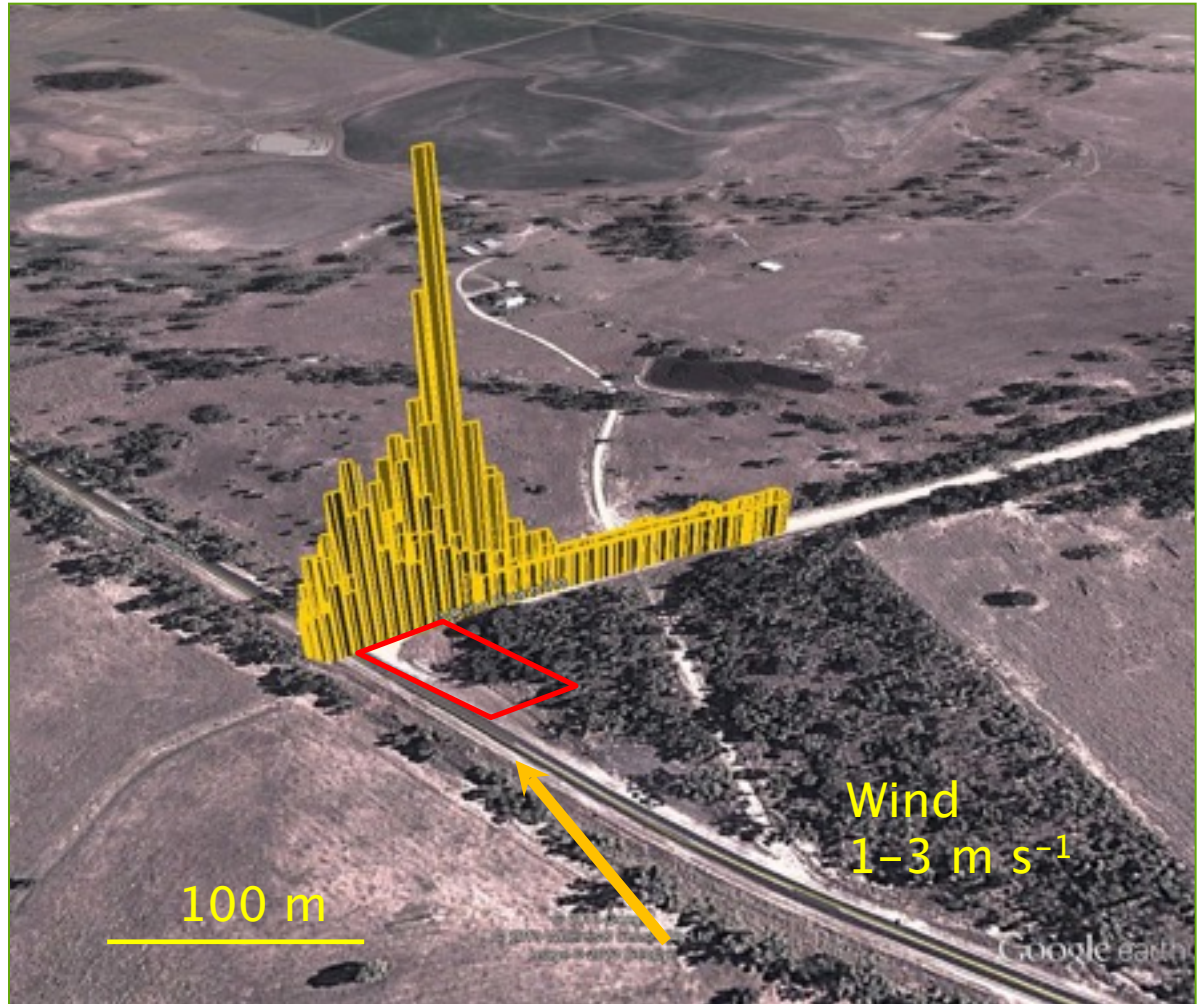
Lots of Borehole Sources
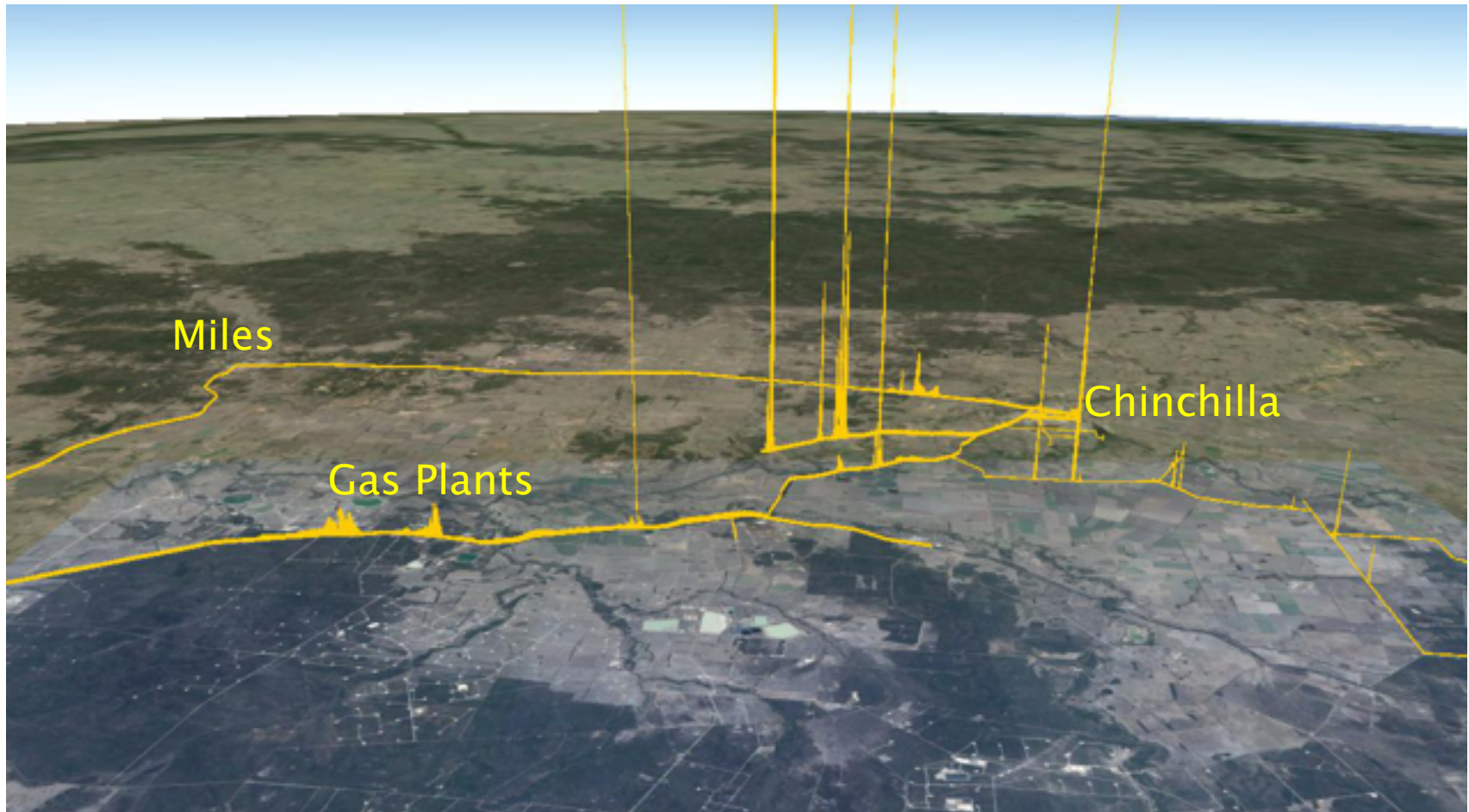
Water

produced water re-injection

TASK 3: HYDROGEOLOGICAL AND HYDROCHEMICAL DATA COMPILATION AND PROCESSING
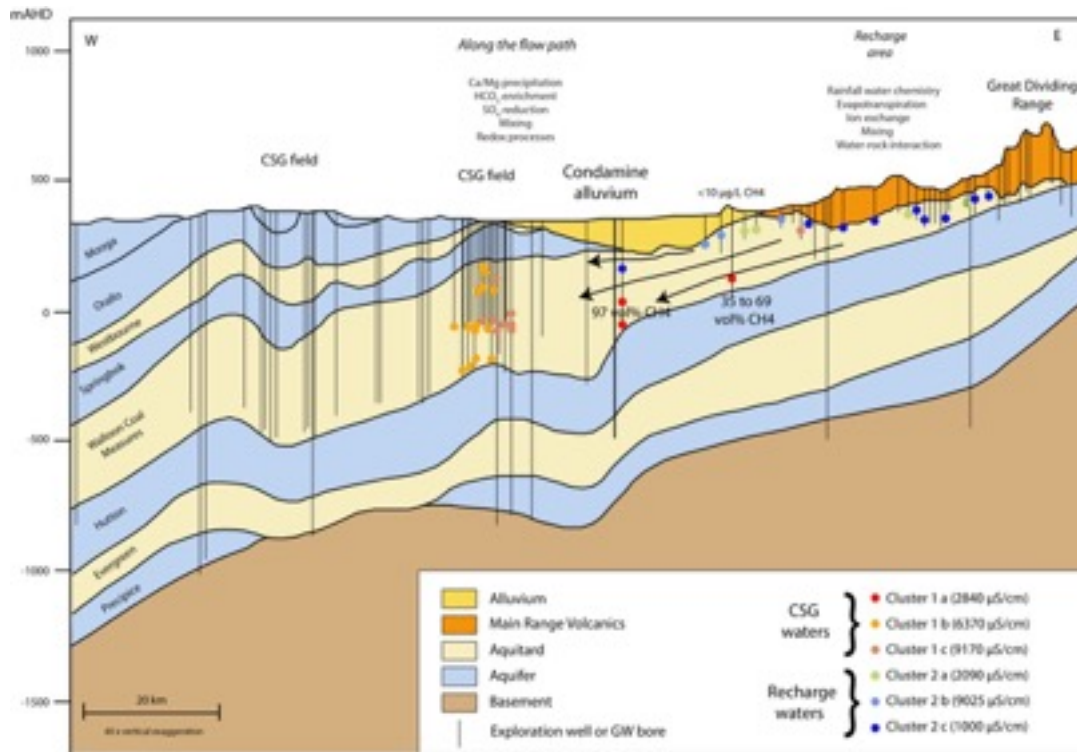
- Determine if there are within-, or inter-aquifer gradients linked to aquifer connectivity or geological heterogeneity within aquifers

- Refine existing, or develop alternative, conceptual models of groundwater recharge and aquifer connectivity.

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Re-injection of CSG water
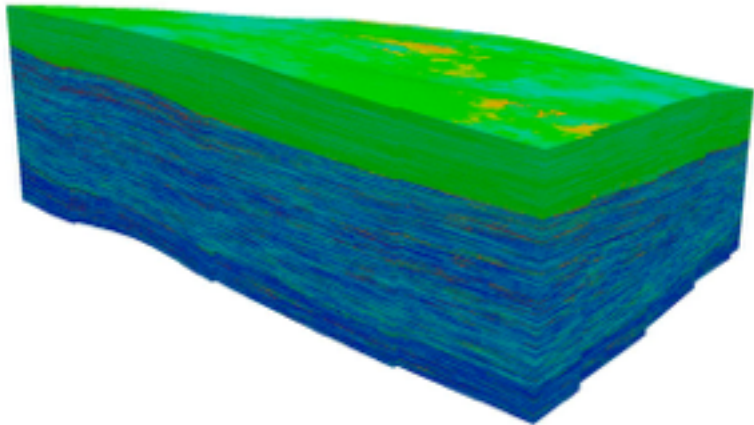
CSG associated water – 'waste'
Requires treatment and 'beneficial use'
CSG water – a significant resource
~ ¼ SW/GW allocations in Condamine
Reinjection offers significant benefits

Where does reinjected water flow to?
How does it react with aquifer water?
Does it connect with other aquifers?
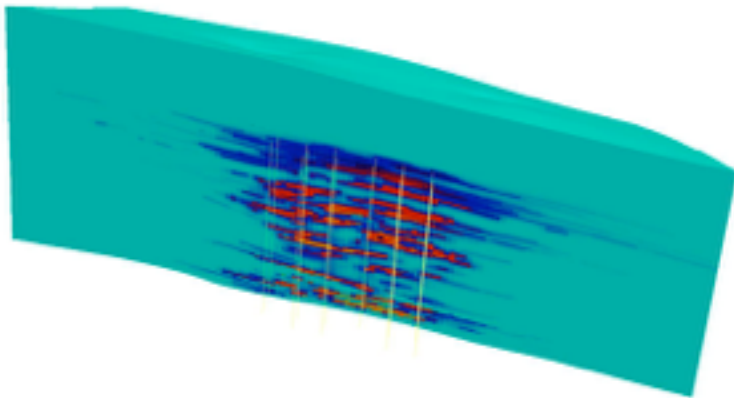
Groundwater model of Walloon Coal Measures in Surat Basin, Qld

Agricultural land management

Coexistence of CSG & agriculture

Woodland   Roadway   Pipelines   Agricultural Field
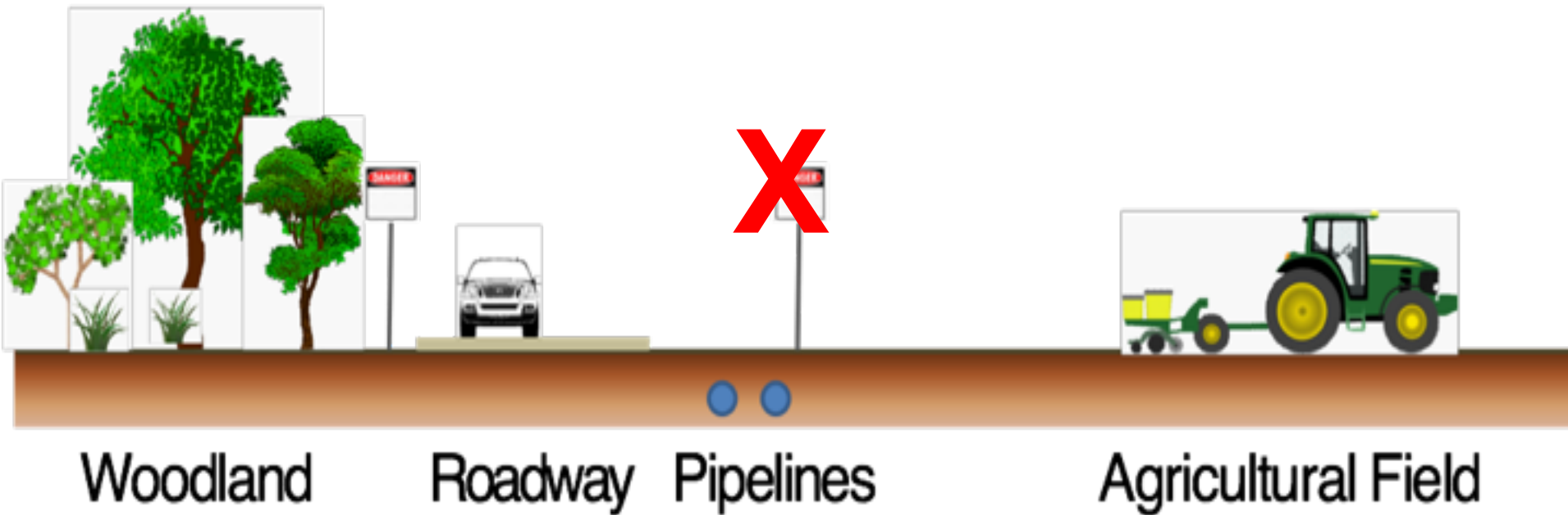
Look at soil quality Inside *vs* Outside the compaction zone
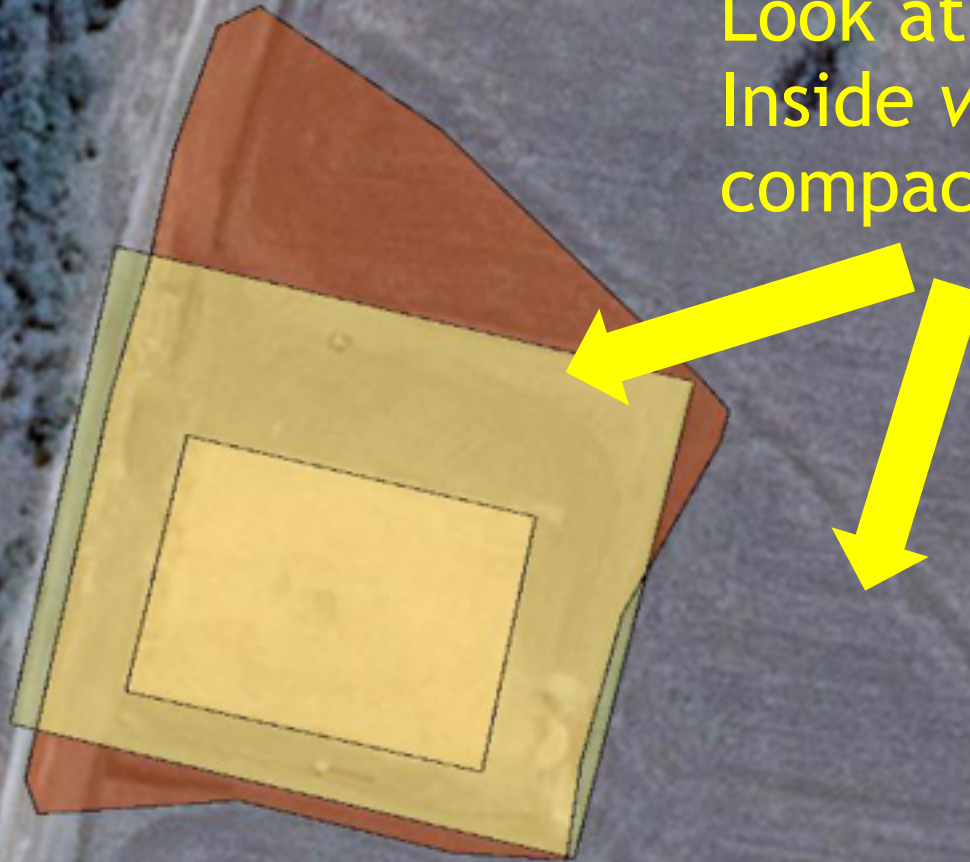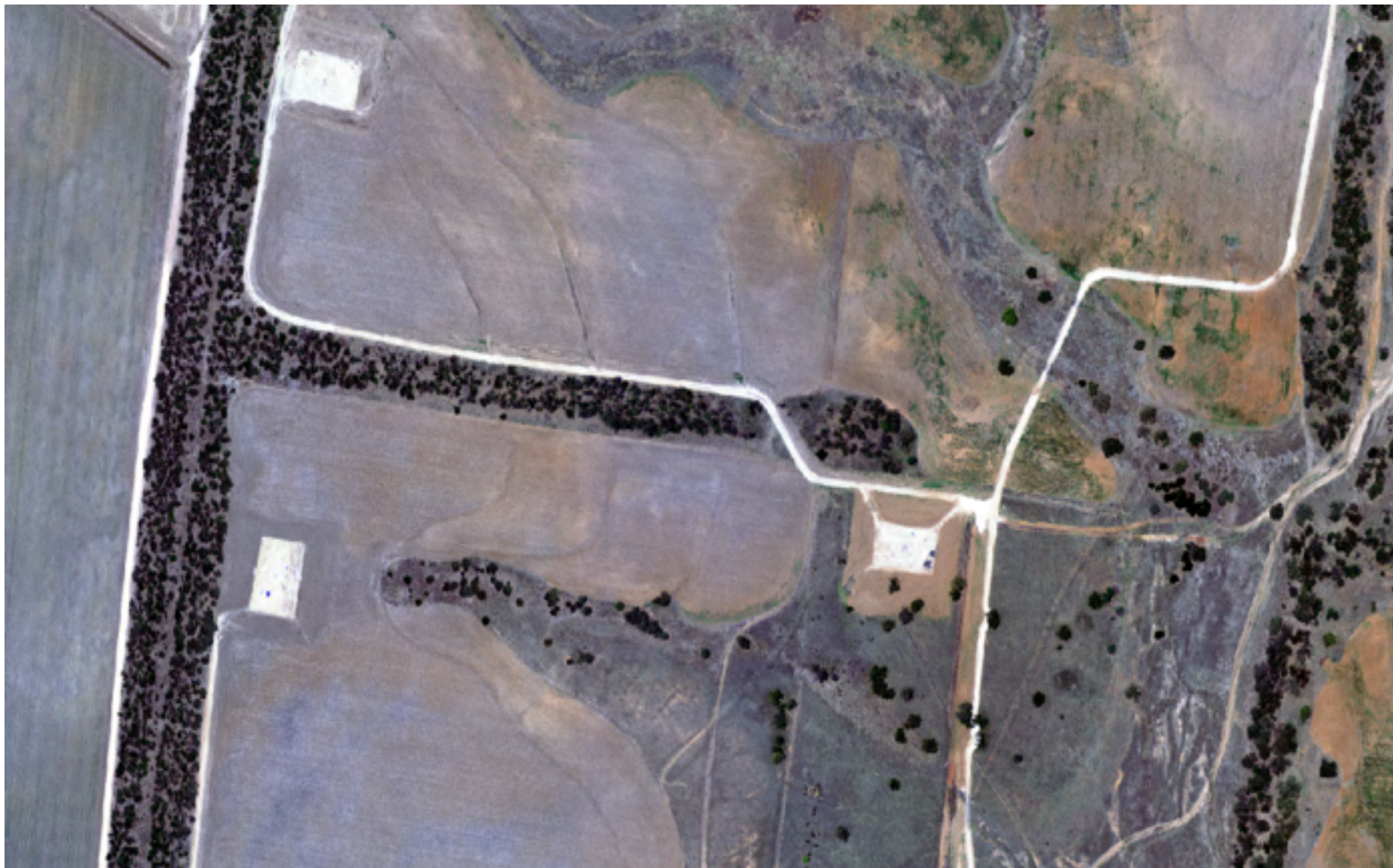
RGB image

Digital surface model (DSM)
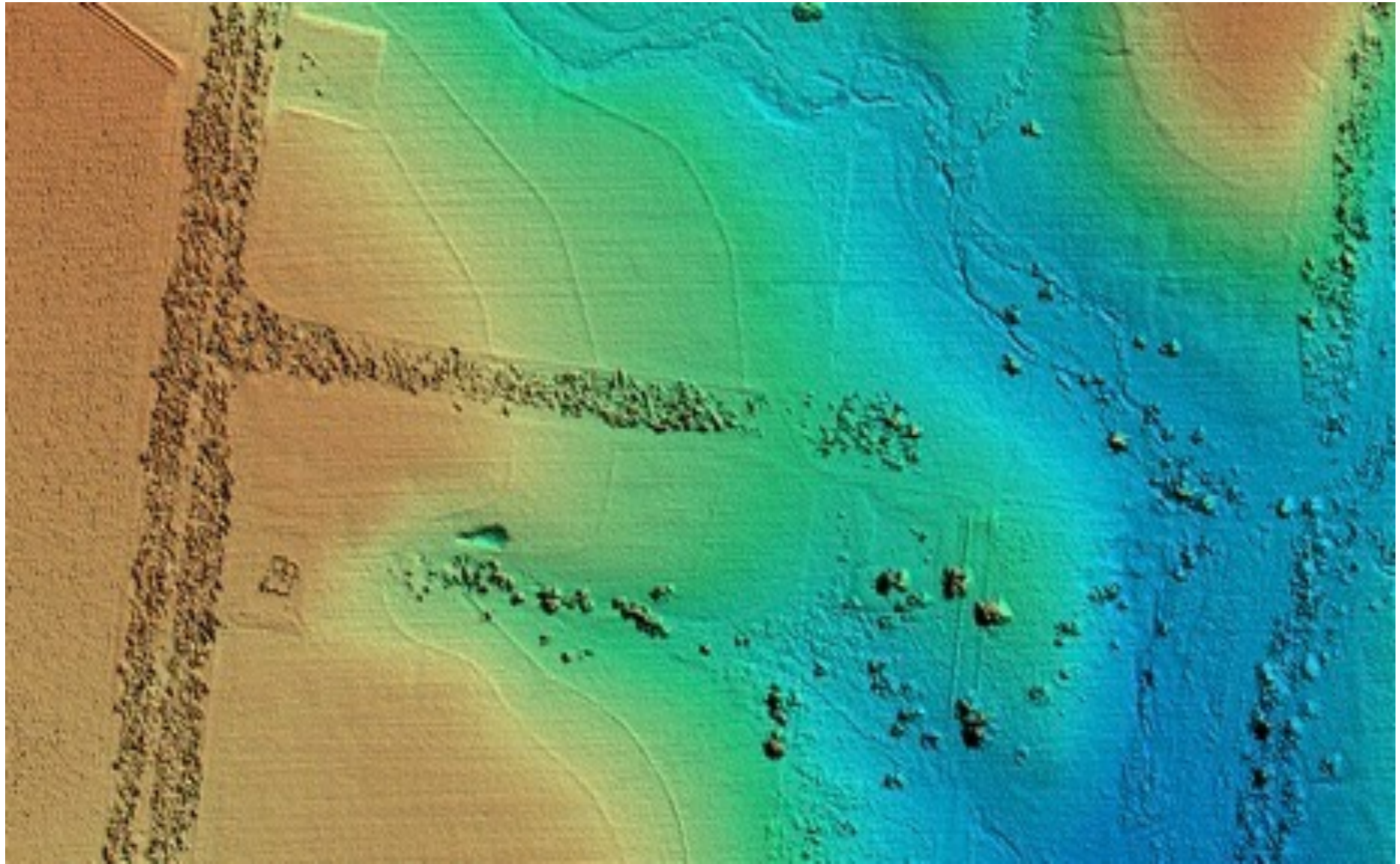
Ground elevation model (GEM)
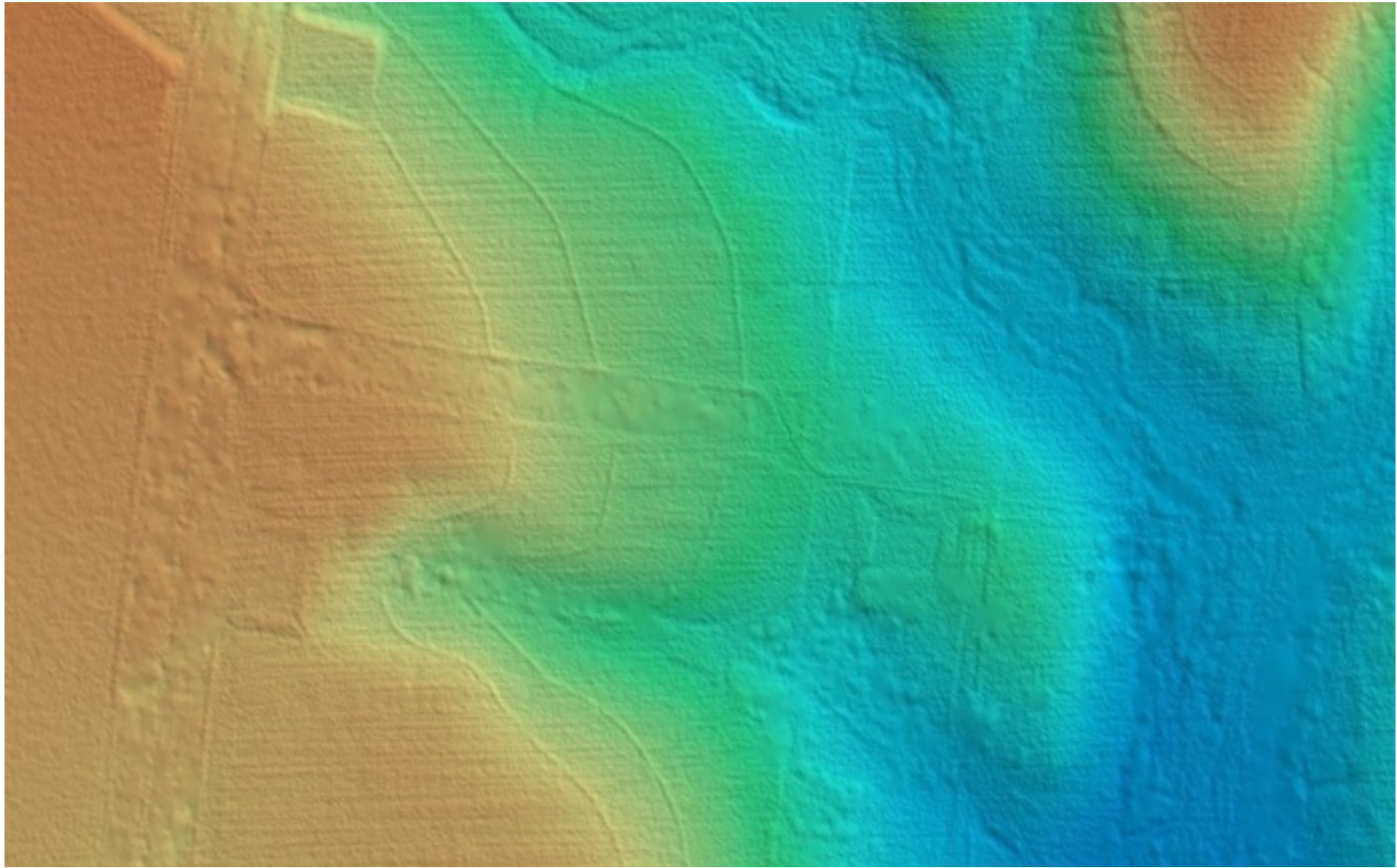
Water accumulation model – flow paths
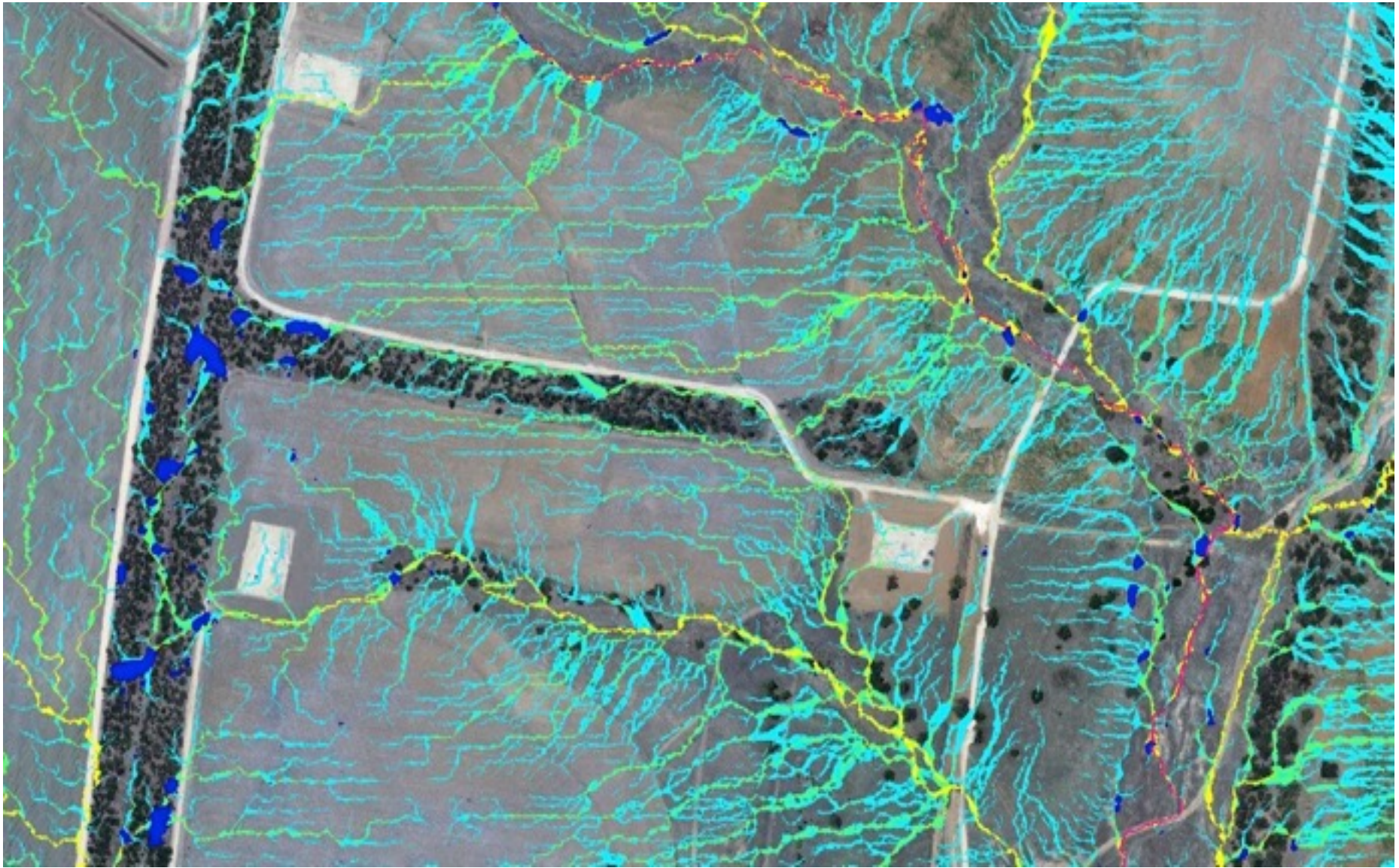
Terrestrial biodiversity

priority threats and management

Terrestrial biodiversity

1. Cost-effective threat management strategies to protect imperilled species

2. The sensitivity of plants and animals to changes in fire regimes

3. Habitat selection by two focal species: golden-tailed gecko, glossy black-cockatoo

4. Ensuring biodiversity offset success: the right kind of seed for a rare daisy

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Marine environment

Turtles and seagrass management

GISERA Marine Project Components

1. **Habitat quality – water column properties and seagrass distribution**
2. **Modelling – Hydrodynamic / Biogeochemical model of Port Curtis; predicting water quality and seagrass growth**
3. **Turtle behaviour – habitat use and risk modelling**

Bottom light as a percentage of surface (quantum weighted)
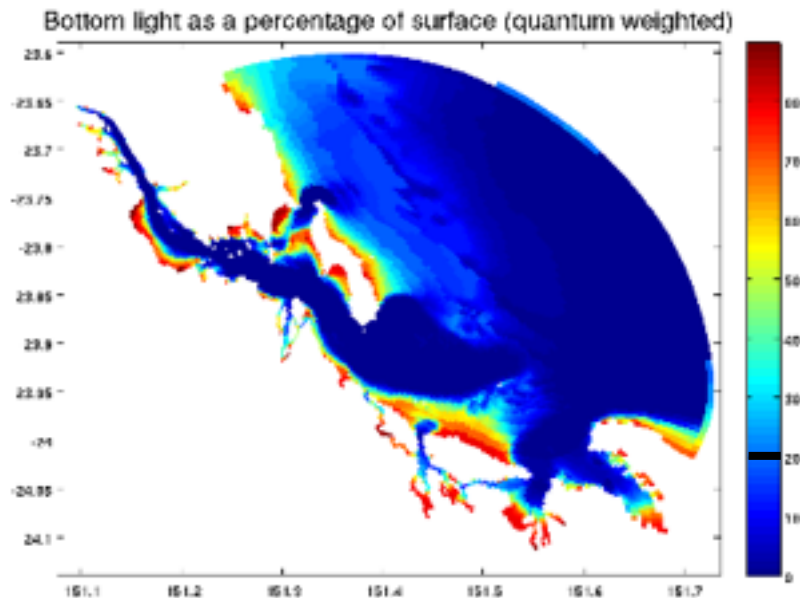
Socioeconomic impacts and opportunities

community resilience and wellbeing
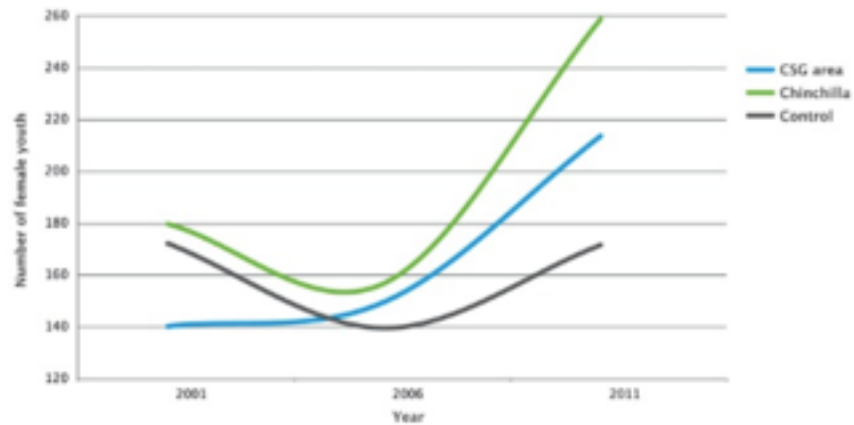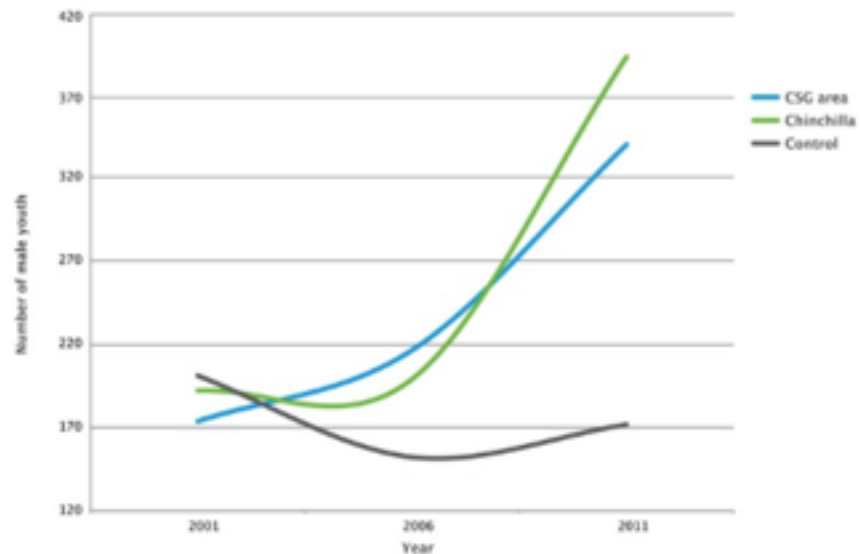
Bucking global trend in rural decline?

Figure 2: Changes in female youth over time (ABS 2013). The blue line is the average for towns and communities where CSG development occurs. The dark grey line is the average for regions without CSG development (control). The green line represents Chinchilla. CSIRO
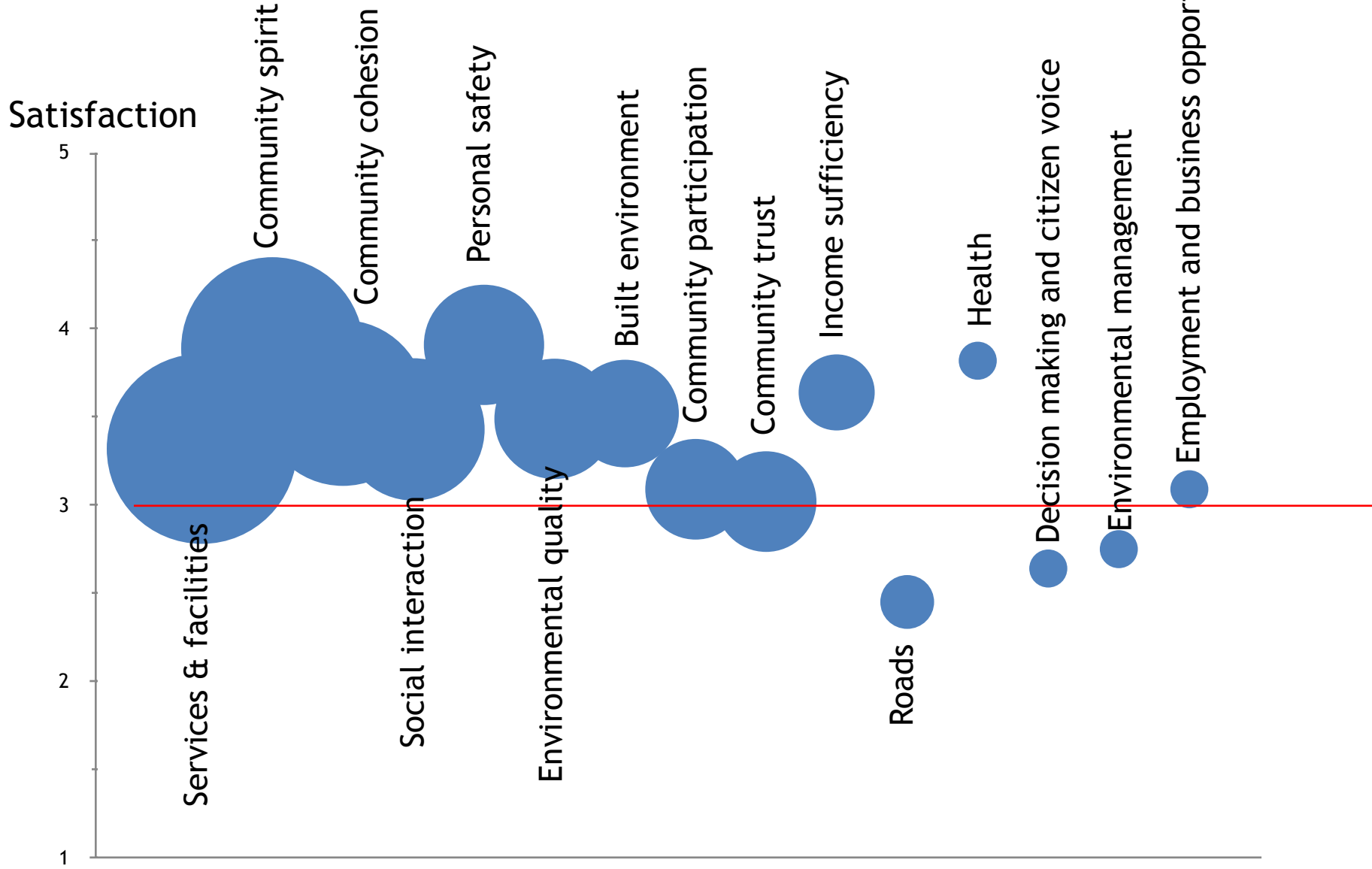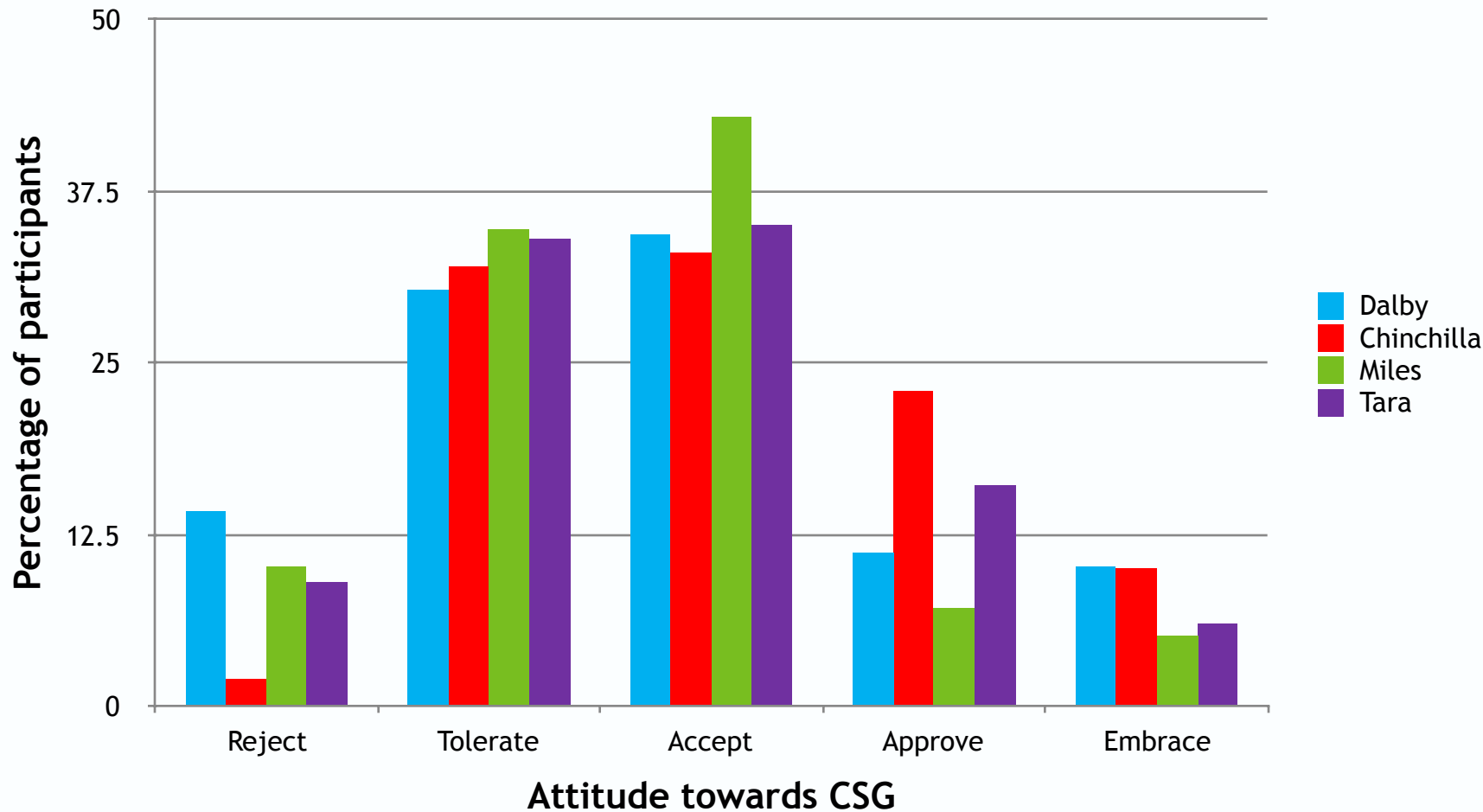
Regional economics

- Construction phase (2008 – 2014)
- Family income +15% in CSG region
- ~30% higher 'non-mining' employment growth
- ~100 mining/gas jobs generated per SLA
- 1400 new jobs for residents 2006-2011
  - Excludes FIFO/DIDO in work camps
  - 600 directly in resources sector
  - 800 in other sectors
- Job growth from CSG:
  - Construction and professional services
  - Jobs shift: Agriculture/non-agriculture
- Operational phase TBD (2015 onwards)
- GISERA economic modelling and advising business strategies to maximise opportunities
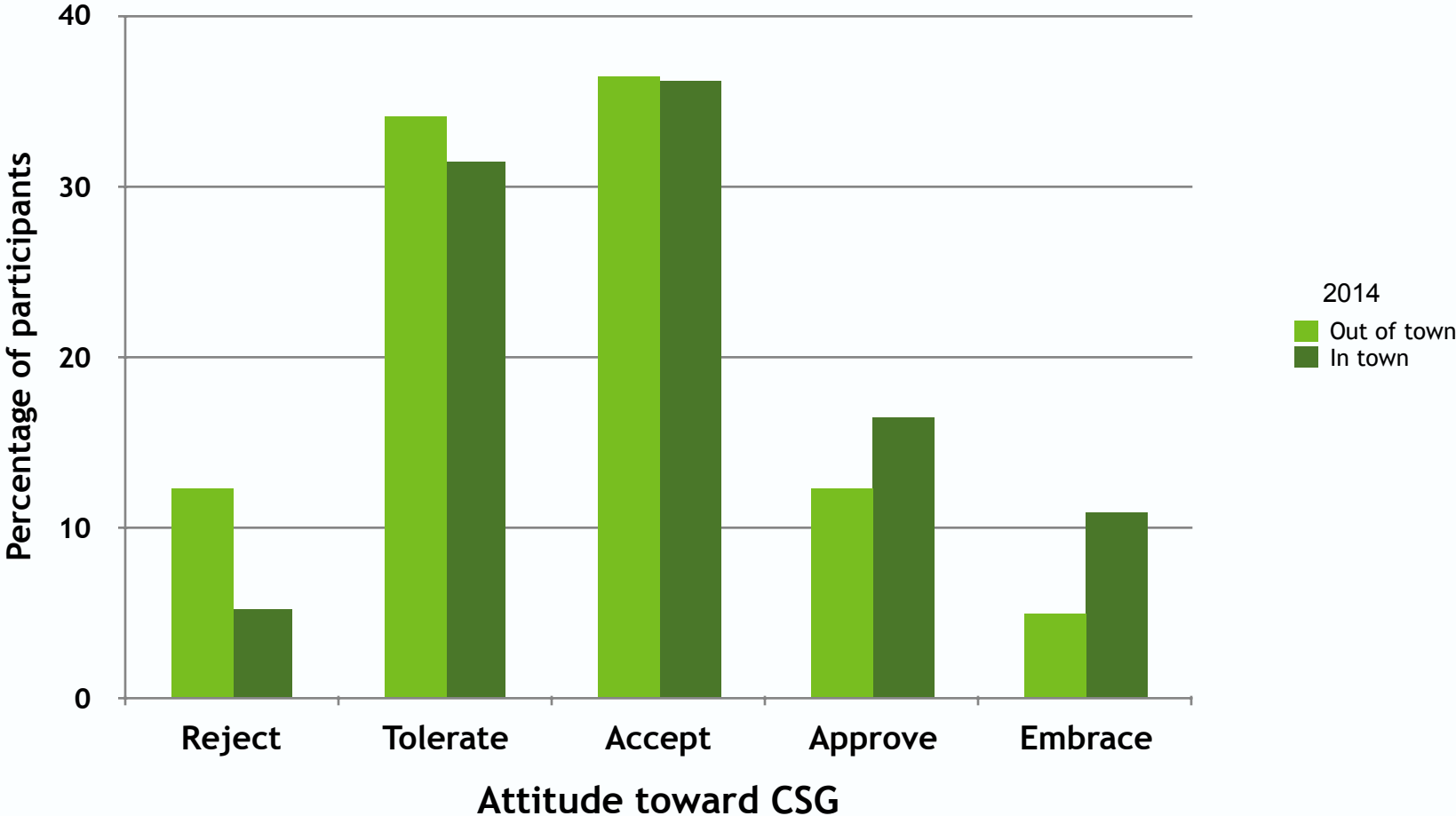
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Importance for predicting community wellbeing

Satisfaction

Community spirit

Community cohesion

Personal safety

Built environment

Community participation

Community trust

Income sufficiency

Health

Decision making and citizen voice

Environmental management

Employment and business opportunities

5

4

3

2

1

Services & facilities

Social interaction

Environmental quality

Roads

Acceptance: most people either tolerate or accepted CSG in 2014

Out of Town v in Town

People feel more positive about CSG when

- They are being listened to
- Can have a say
- Trust is high
- The environment is being managed well for the future
- There are employment and business opportunities
- The community is planning and learning

Adapting to change

When people feel their communities are adapting well to change

- they are more accepting of and positive towards CSG

- they are more positive about their future

Communication and engagement

connection, proximity, performance

Areas of significant community concern

Extensive community engagement suggests most consistent concern about:

- negotiation process
- property value
- dust, traffic, 'strangers'
- compensation
- long-term groundwater impacts
- just another fossil fuel (ghg)
- fraccing chemicals
- food security

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Thank you