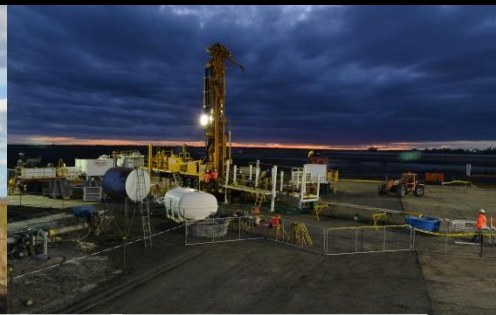




Arrow Energy

Surat development update

September 2019



About Arrow

CSG 101

Operations
update

Surat Gas
Project update

Water

What happens
next?





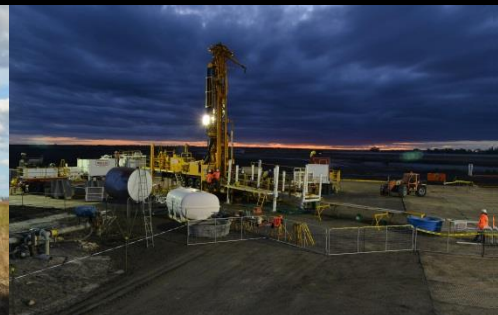


- An integrated coal seam gas company owned 50/50 by Shell and PetroChina
 - Produces gas equivalent to 25% of Queensland's annual demand
 - Provides gas for industrial users and electricity generation
 - tenure over two major production basins - the Surat and Bowen basins
 - about 1,450 gas wells
 - some 17,000km² of Queensland production and exploration tenements
 - Existing domestic gas operations:
 - five gas producing projects in the Surat and Bowen basins - Tipton, Daandine, Kogan, Stratheden (Surat Basin) and Moranbah Gas Project (50/50 AGL - Bowen Basin)
 - supply gas to power stations - Braemar 1, Braemar 2 (100% owned), Yabulu, Daandine, Moranbah, Swanbank
 - generation enough to power 800,000 average-sized Queensland homes.
- In 2017, Arrow announced a gas supply deal between Arrow and QGC-operated to commercialise most of Arrow's gas reserves in the Surat Basin through a phased development over 27 years.
 - Arrow and QGC remain standalone companies.



Since our last update:

- meeting domestic gas contracts in the Surat Basin with ~50 new wells, ~10km gathering pipelines
- detailed planning for 700-800 wells to 2025
- planning for development post 2025
- \$32 million invested state-wide since 2011 through social investment initiatives
- working towards a Financial Investment Decision for the Surat Gas Project before year end (a matter for Arrow's Shareholders).



About Arrow

CSG 101

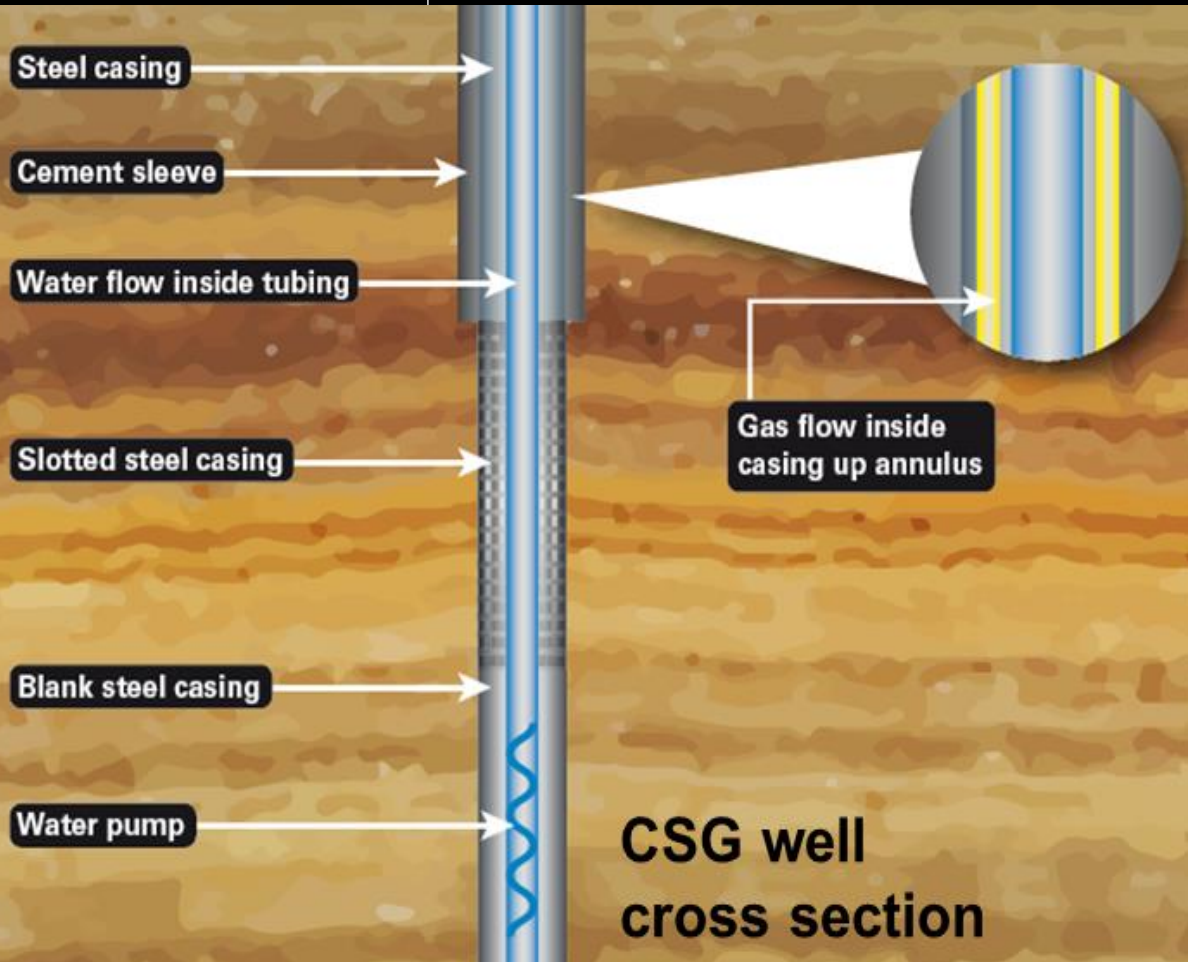
Operations
update

Surat Gas
Project update

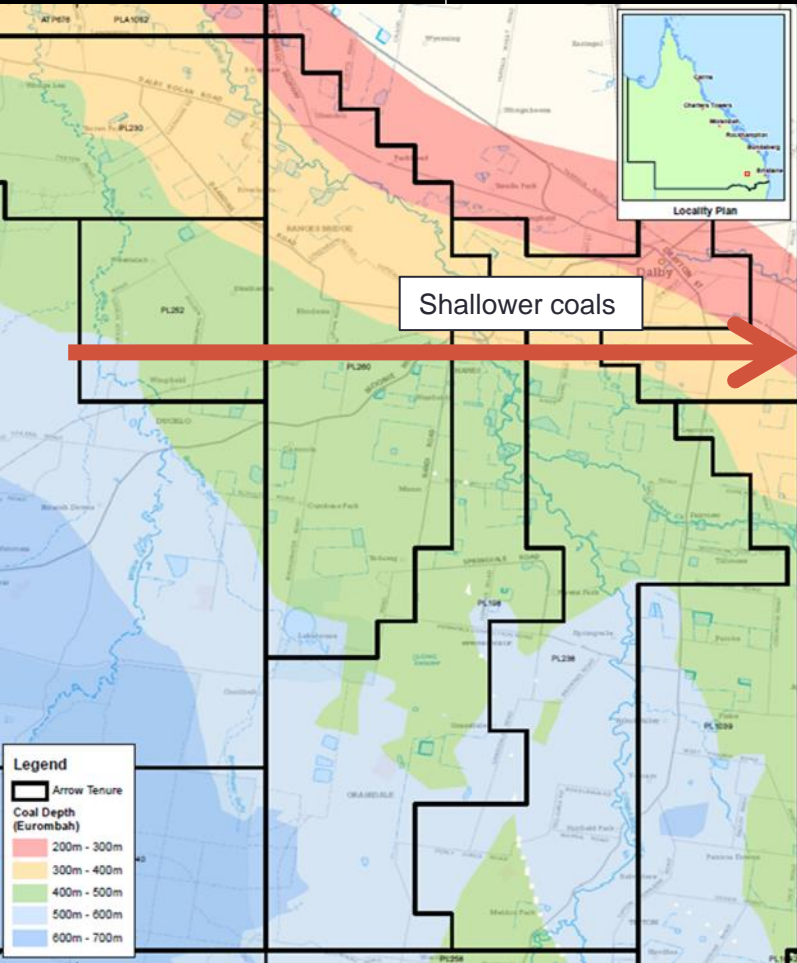
Water

What happens
next?





- CSG is natural gas:
 - trapped in underground coal beds
 - by water and pressure.
- To extract CSG:
 - 300-750m well to the target seam/s
 - in-seam water pumped out to release gas
 - gas and water flow separately to the surface.
- Well design isolates coal seams from groundwater aquifers.



- Coal seam depths are shallower to the east.
- Shallow coal has lower gas content but greater permeability - the gas flows better.
- Coal depth determines well type:
 - shallower coals <400m: vertical wells
 - deeper coal seams: deviated wells from a multi-well pad:
 - between 400-450m: up to four wells on a pad
 - > 450m: up to eight wells pads on a multi-well pad.
- Average surface spacing between well sites ranges:
 - ~800m (single vertical wells)
 - up to 2km (for multi-well pads).



About Arrow

CSG 101

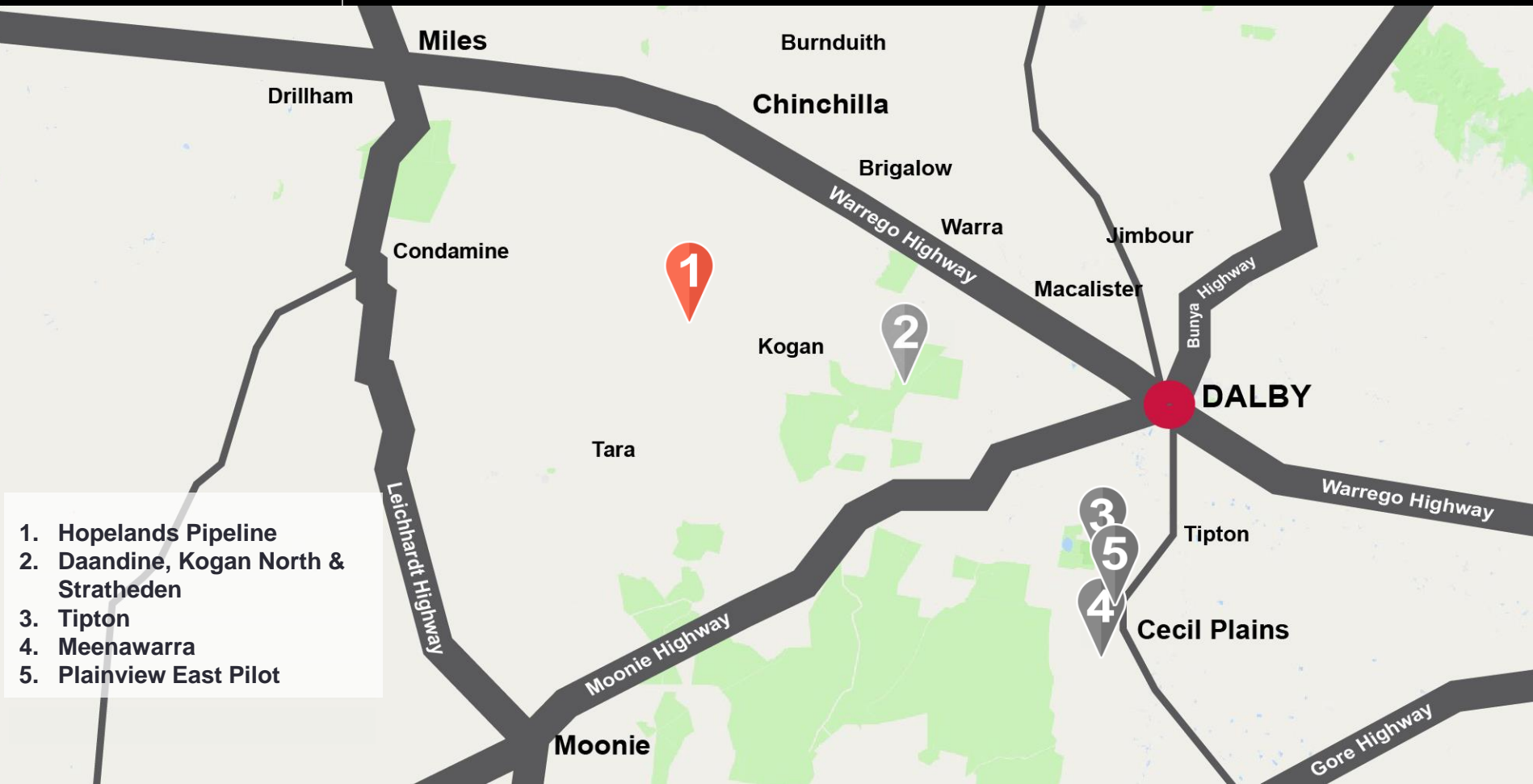
Operations
update

Surat Gas
Project update

Water

What happens
next?



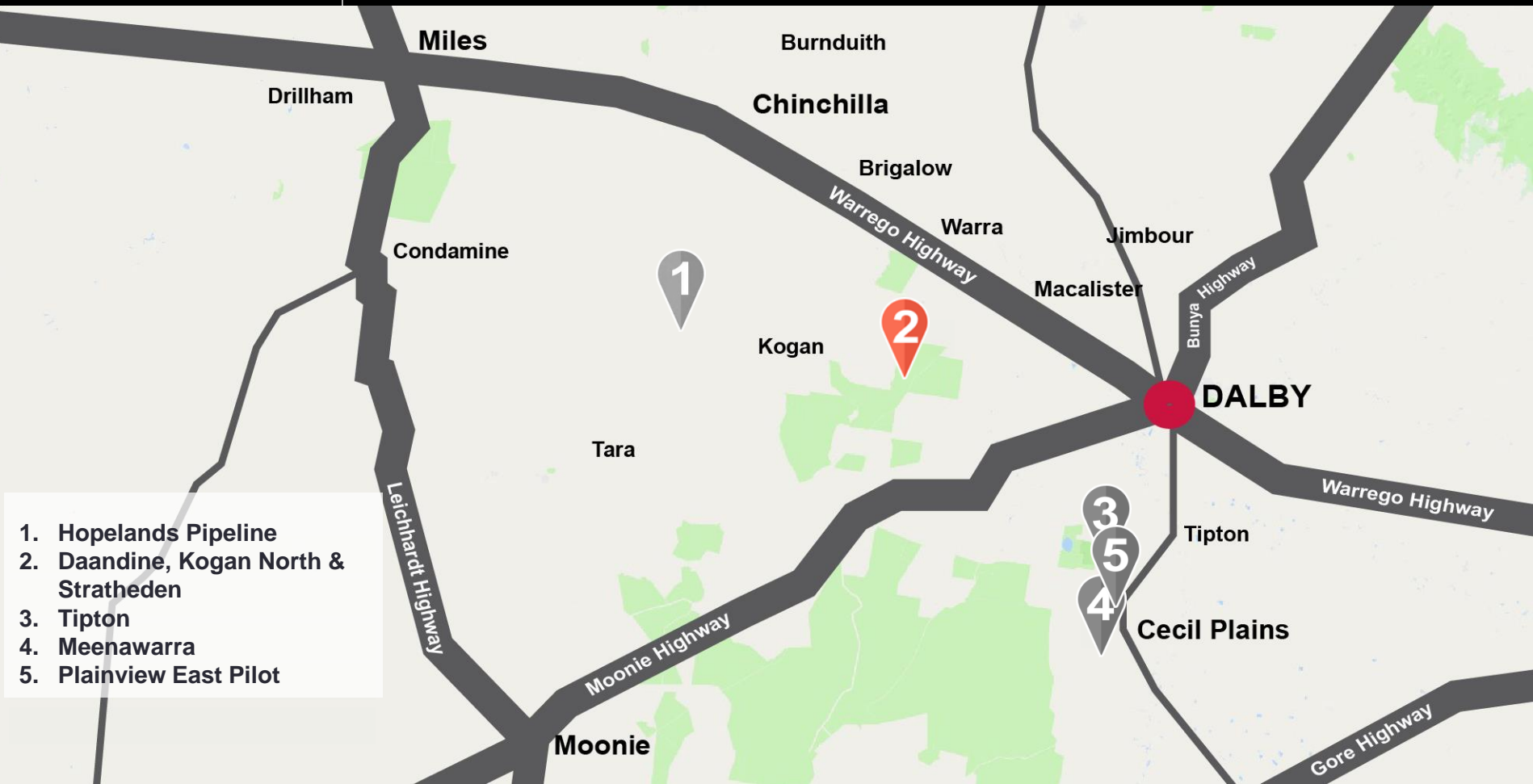


- 1. Hopelands Pipeline
- 2. Daandine, Kogan North & Stratheden
- 3. Tipton
- 4. Meenawarra
- 5. Plainview East Pilot



- Connecting existing pilot site to third party infrastructure
- Project included two phases:
 - 2km of gas pipeline
 - Installation of metering skid.
- Part of the pipeline and the connection point is off-tenure and constructed under a Petroleum Pipeline Licence
- Short-term flaring of gas via a field flare will occur once pilot wells are restarted, before tie in work is complete (from mid-September to October).

Image: during construction of the Hopeland Pilot Pipeline



- 1. Hopelands Pipeline
- 2. Daandine, Kogan North & Stratheden
- 3. Tipton
- 4. Meenawarra
- 5. Plainview East Pilot



Braemar 2 Gas Turbine maintenance

- 40 days of maintenance completed in May:
 - 27,460 hours on site during the 40 days
 - strong safety focus - no safety incidents.

Daandine Central Gas Processing Facility

- Roma to Brisbane Pipeline connected into Braemar 1 and 2 Pipeline systems:
 - Daandine now directly connected to the domestic gas market and supplements B2 Power Station with additional gas.
- Full facility maintenance shutdown completed mid-April.
- No further major works for 2019.

Daandine field

- Drilling of 15 new wells underway:
 - temporary traffic increases on Dalby-Kogan and Daandine-Nandi Roads
 - night-time drilling – additional wellsite lighting.
- Decommissioning of 5 wells to October
- Ongoing well maintenance towards late 2019.

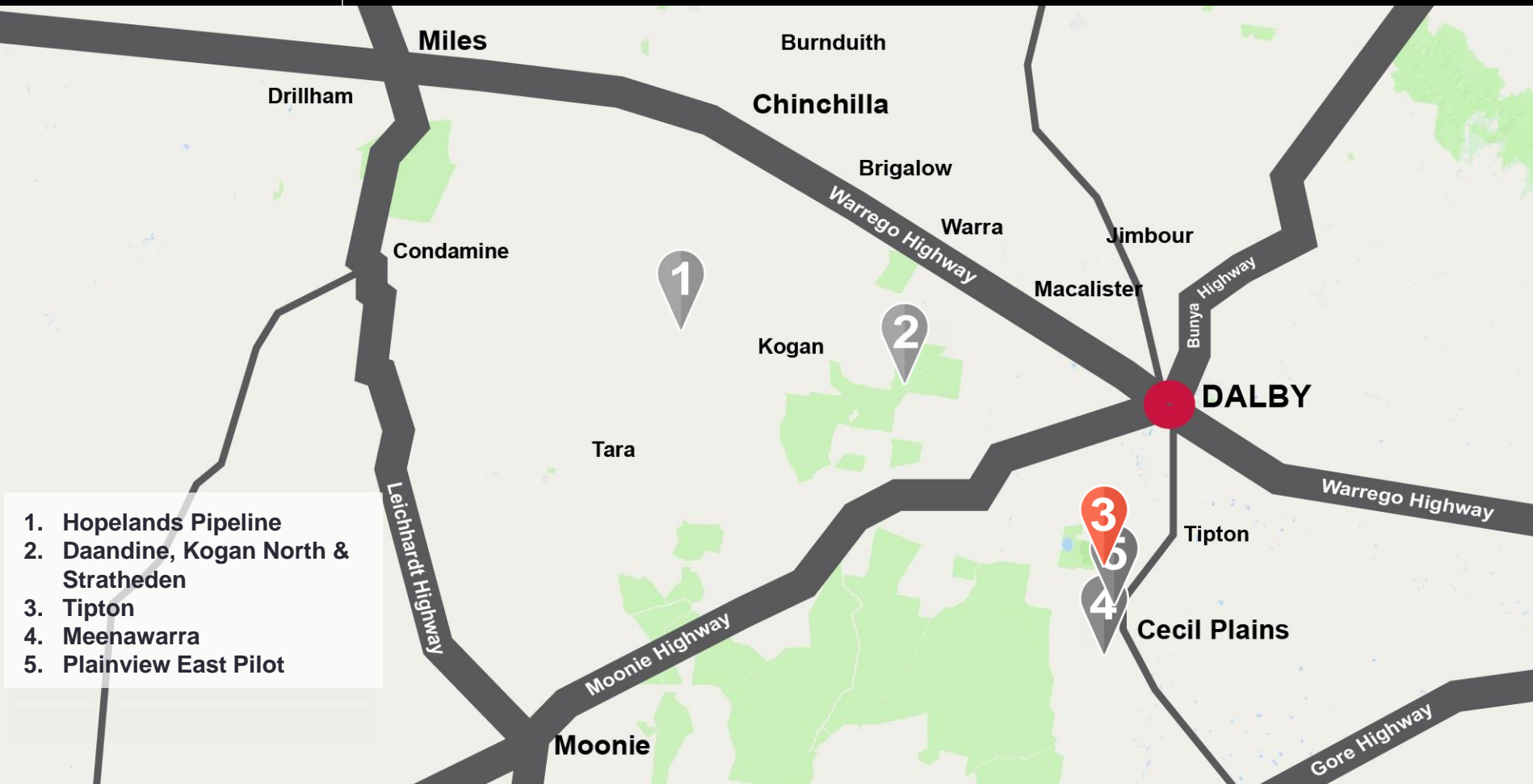
Kogan North

- 3 new wells drilled in July, currently installing surface infrastructure.
- Decommissioning of one well underway.

Stratheden

- Well maintenance (workovers) until October.





- 1. Hopelands Pipeline
- 2. Daandine, Kogan North & Stratheden
- 3. Tipton
- 4. Meenawarra
- 5. Plainview East Pilot

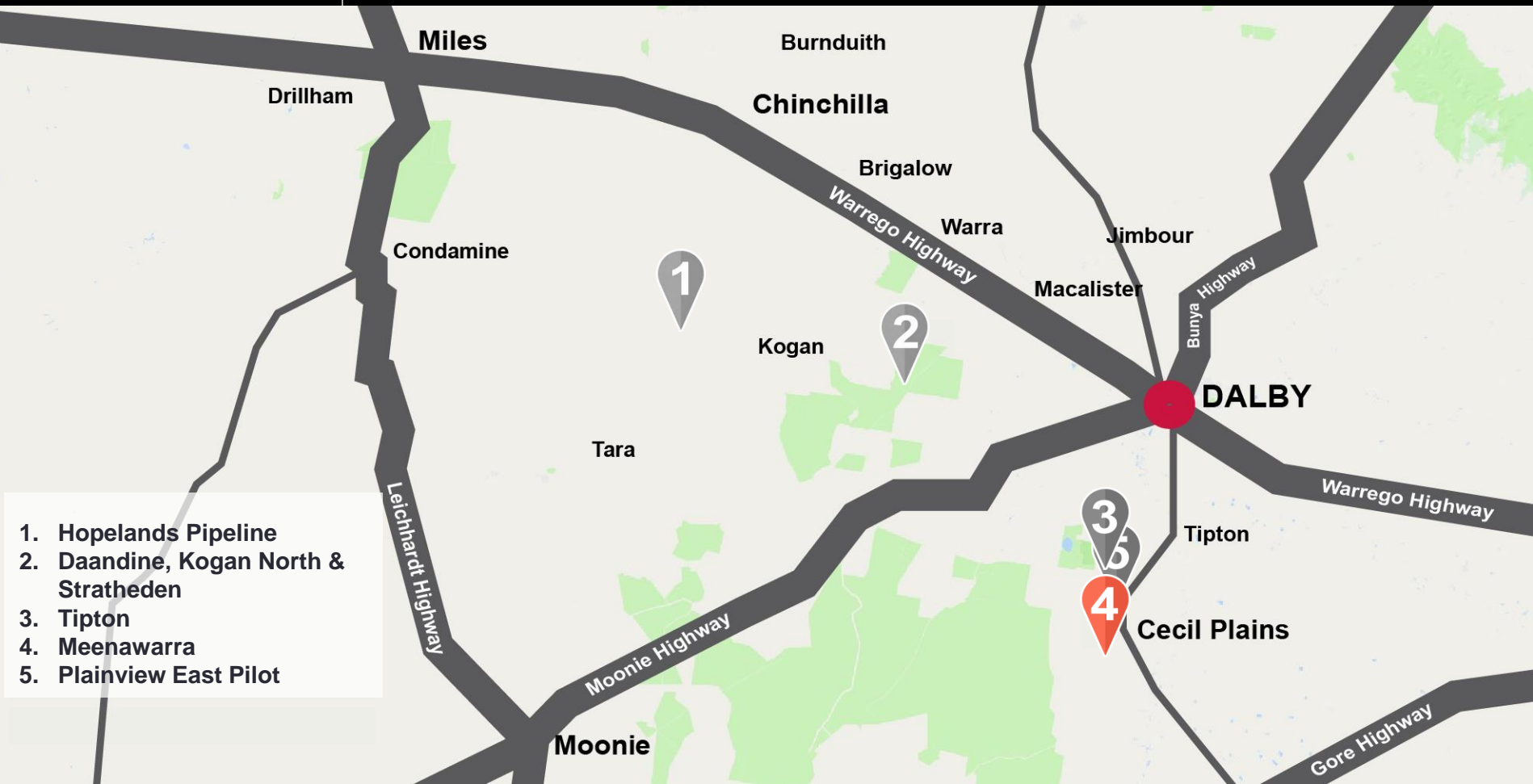


Tipton field

- 10 new wells were drilled in 2019, awaiting completion:
 - construction of gathering from October 2019
 - community was notified via mail earlier this year.
- Site preparation has commenced for 11 new wells:
 - early drilling will commence soon, to continue into 2020
 - gathering to connect wells will begin in October 2019
 - increased traffic expected along Broadwater Road.
- Decommissioning of wells is ongoing.

Tipton Central Gas Processing Facility (CGPF)

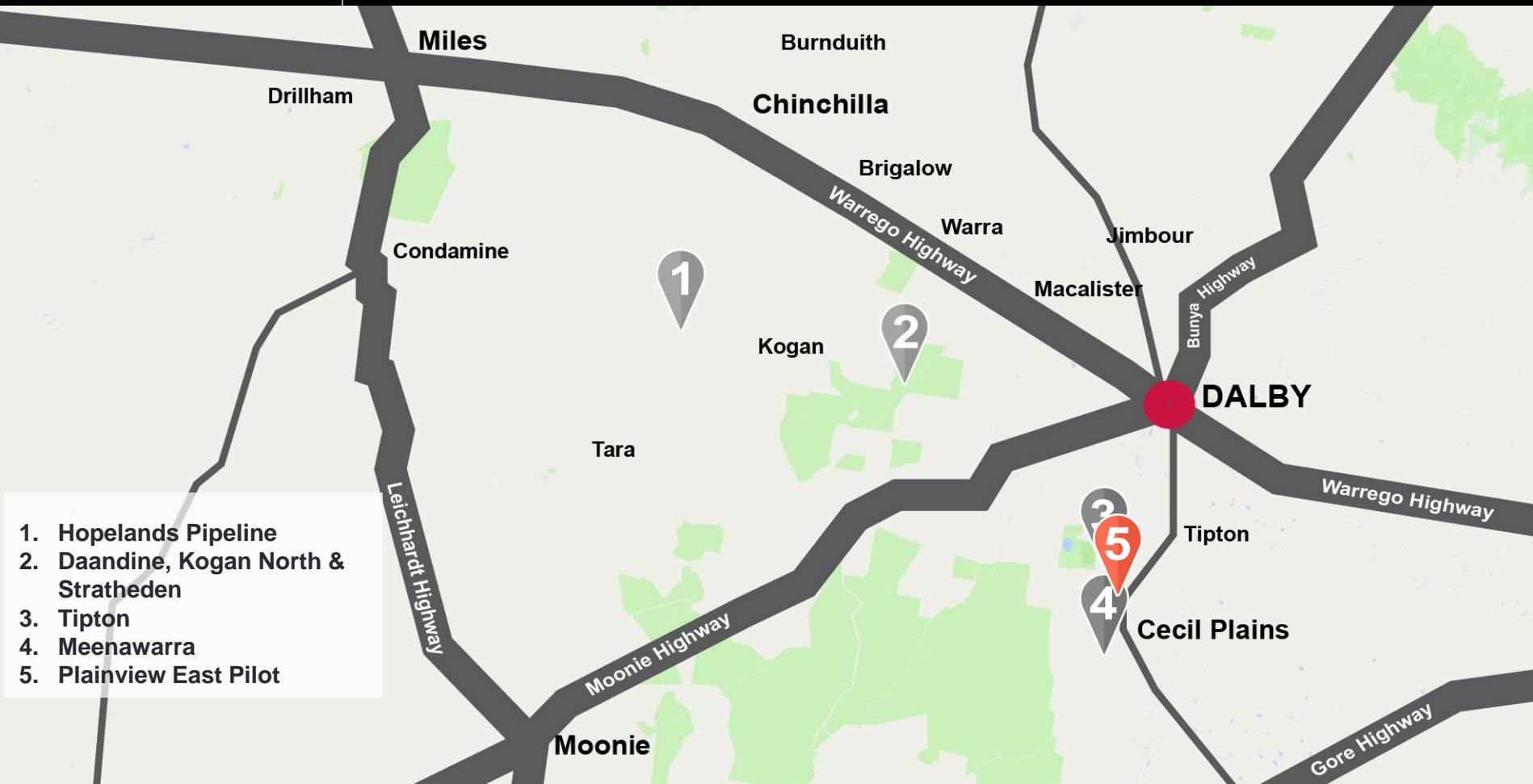
- Full shutdown for CGPF maintenance scheduled for Q4 2019, no anticipated community impacts.



- 1. Hopelands Pipeline
- 2. Daandine, Kogan North & Stratheden
- 3. Tipton
- 4. Meenawarra
- 5. Plainview East Pilot

- Four wells completed in early 2019.
- Two additional wells drilled mid-2019, awaiting completion. Expected to be online late December 2019.





- 1. Hopelands Pipeline
- 2. Daandine, Kogan North & Stratheden
- 3. Tipton
- 4. Meenawarra
- 5. Plainview East Pilot



Construction of Plainview Pilot in 2018



Pipeline welding at Plainview Pilot in 2018

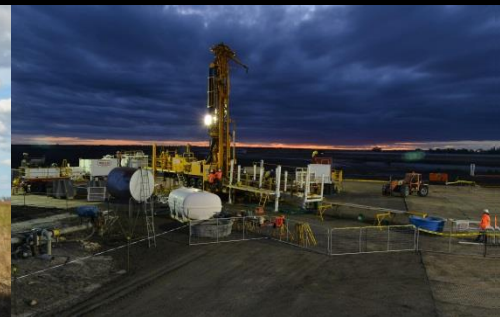


Soil gas monitoring for Plainview Pilot in 2018

- New gas production pilot is being planned north of Cecil Plains:
 - four deviated wells on a single well-pad, targeting the Walloon Coal Measures
 - ~11km of gas and water gathering pipeline back to Meenawarra pipeline and Tipton.
- Similar objectives to the Plainview Pilot:
 - to test coal characteristics and production east of the Horraine Fault.
- All landholders have been engaged and site surveys complete.
- Proposed construction in mid-2020.

Gas monitoring points

- 25 soil gas monitoring points:
 - obtain baseline soil methane levels before and after production
 - landholder engagement has commenced.



About Arrow

CSG 101

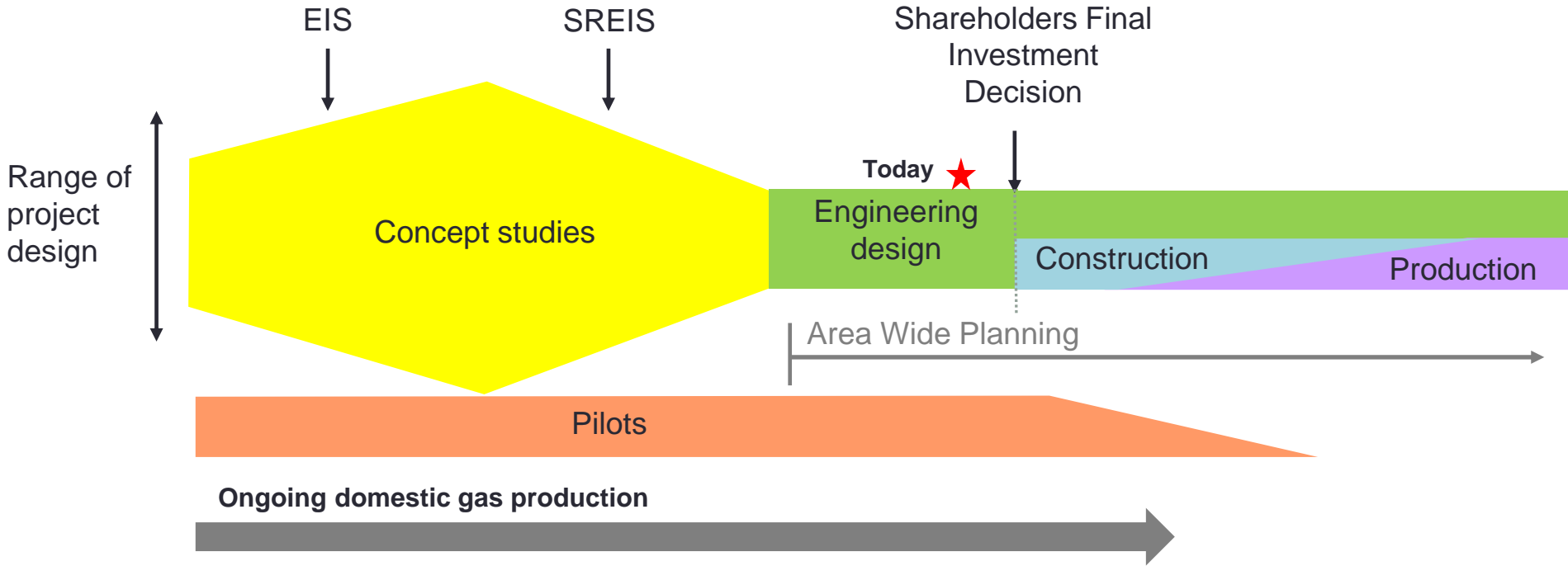
Operations
update

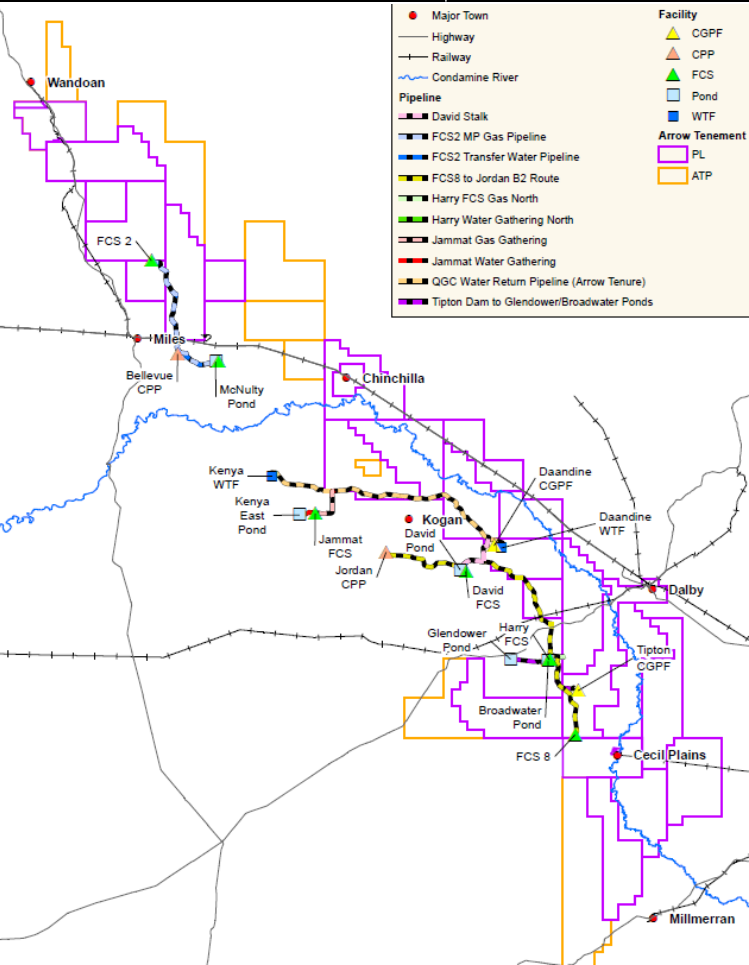
Surat Gas
Project update

Water

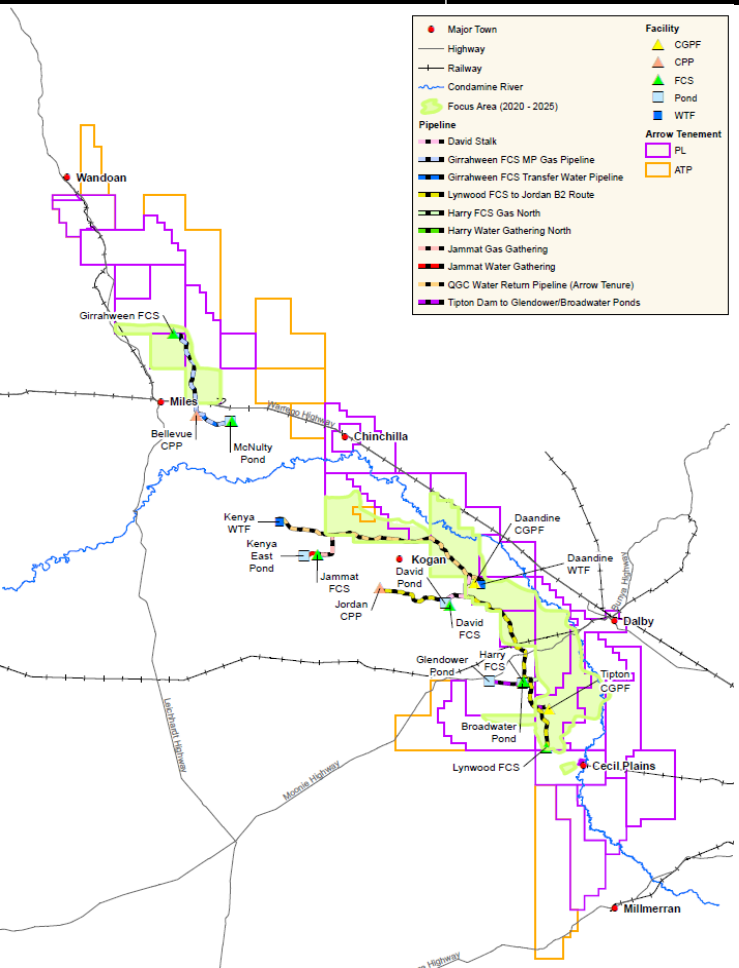
What happens
next?





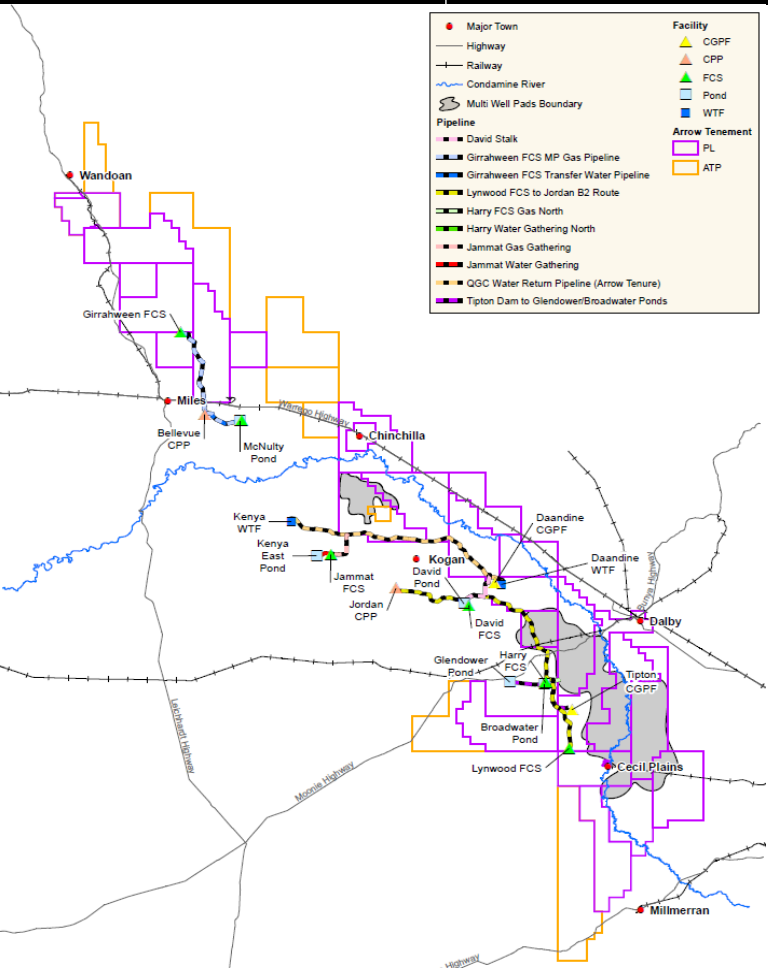


- Arrow is operator and developer:
 - phased development over 27 years
 - uses existing QGC-operated infrastructure (gas compression, pipelines and water treatment).
- Development includes:
 - two new proposed Arrow gas facilities (near Miles and Tipton/Cecil Plains)
 - ~2,500 wells across entire development:
 - well life ~20 years
 - power generation through onsite gas generators (or reticulation where applicable)
 - some off tenure pipelines are required.
- Surat Gas Project requires Final Investment Decision (FID) by Arrow shareholders.

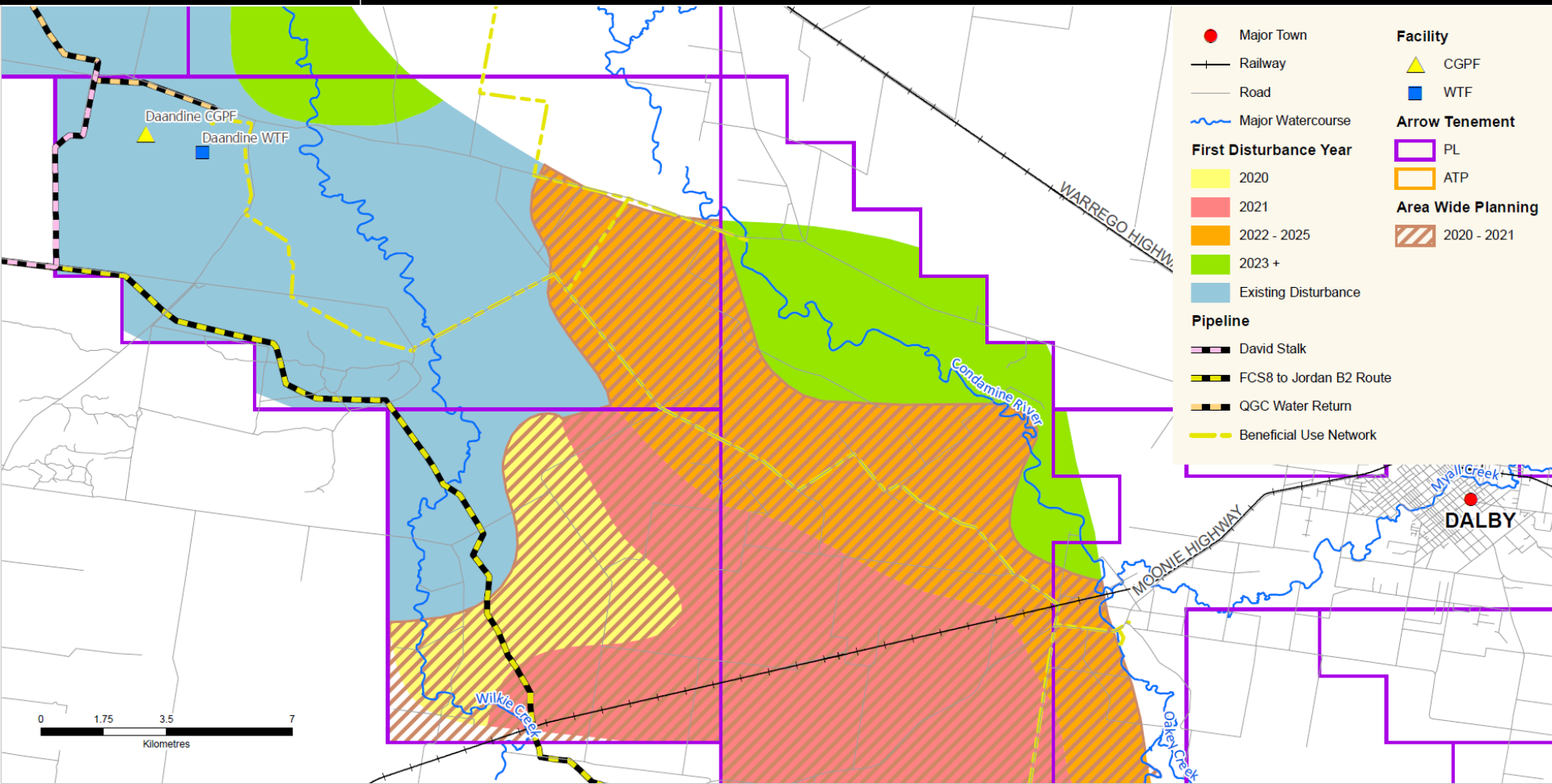


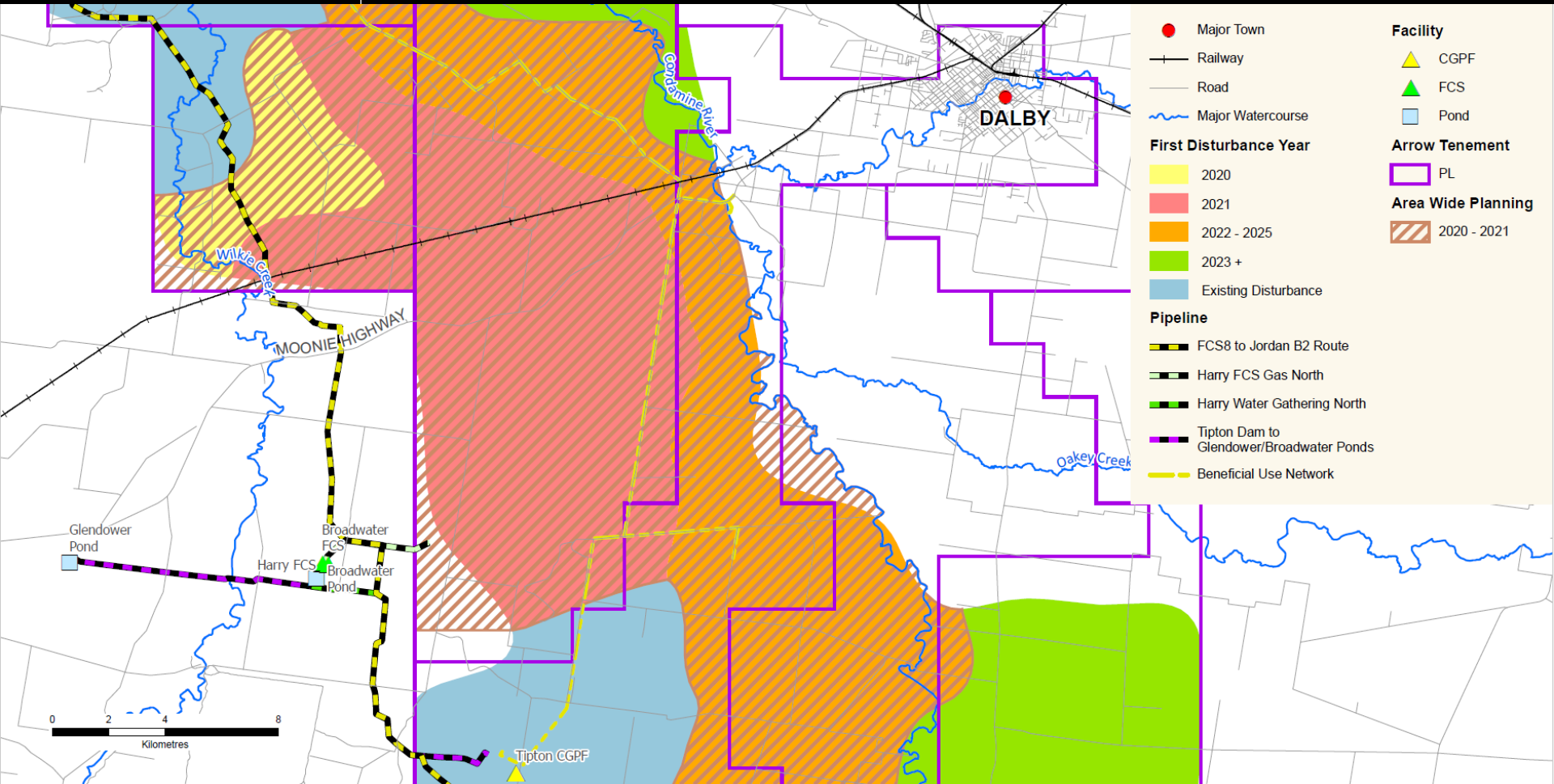
Arrow's current focus includes:

- planning for 700 to 800 wells to 2025:
 - expansion north and south from current operational areas at Daandine and Tipton, south towards Cecil Plains and near Miles
 - maturing 2020-21 development plans including Area Wide Planning south of Daandine
 - continuing investigation for development south of Chinchilla.
- planning for development post 2025:
 - progressing concept planning for additional wells from south of Wandoan, to south and east of Cecil Plains.

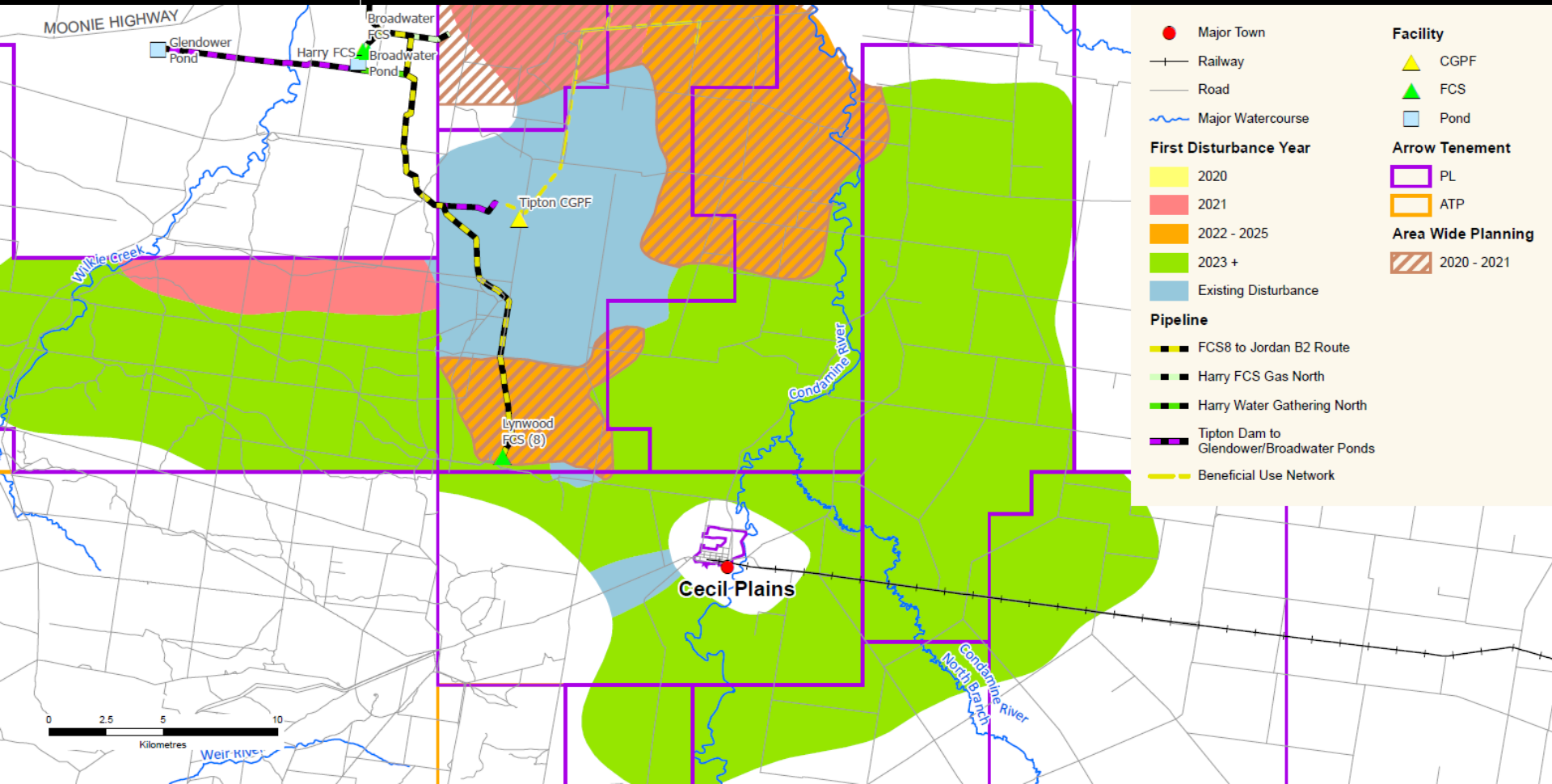


- Multi-well pads where coal depth allows, unless negotiated
- Gathering lines deep enough for future land use
- Power: generated on-site (or reticulated)
- Well site surface spacing will average not less than 800m
- Area wide planning to identify infrastructure locations and incorporate landholder knowledge into plans
- Arrow's compensation framework considers the value of prime farming land:
 - value of the land
 - level of disturbance
 - intensity of development.

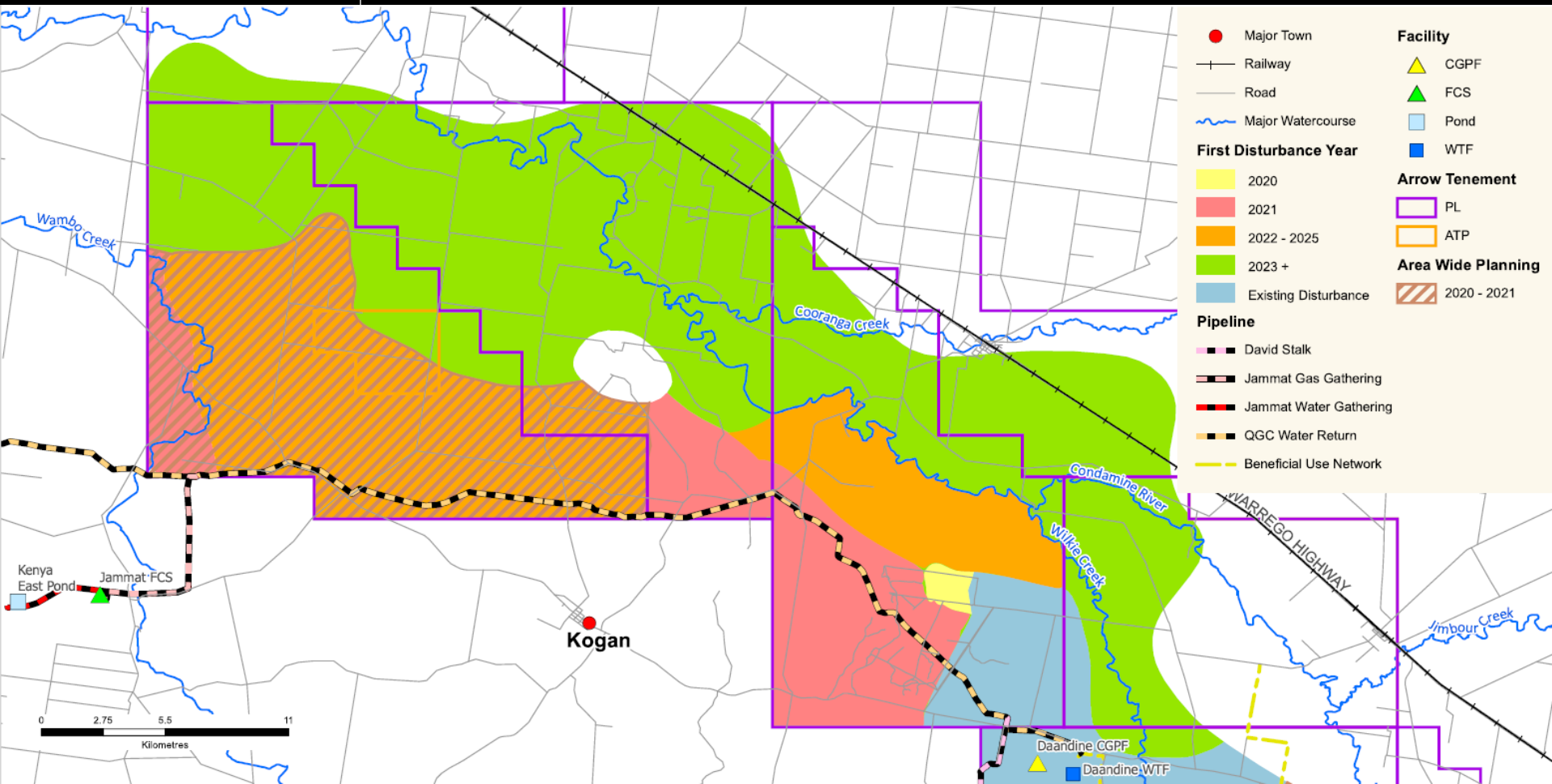


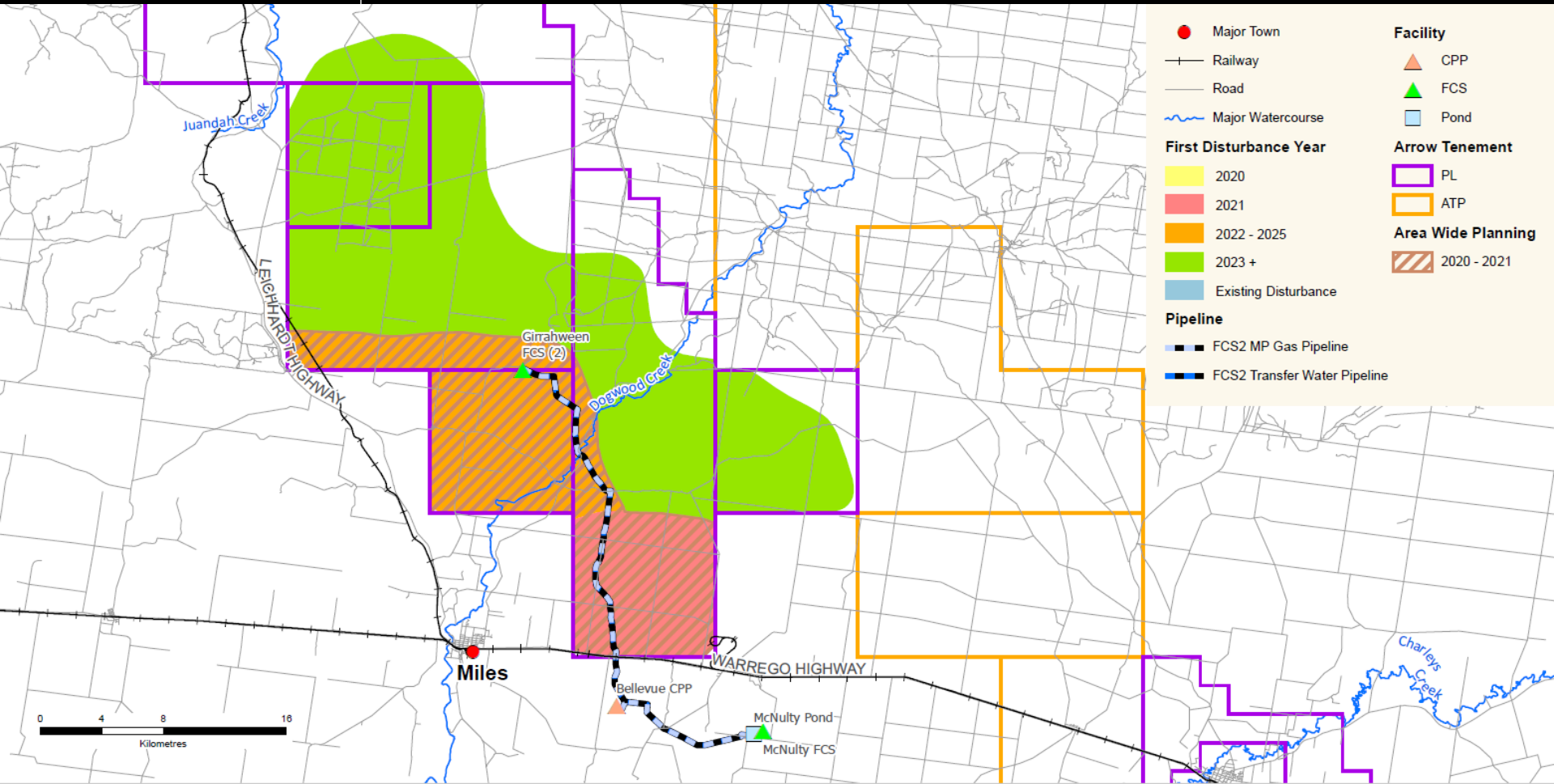


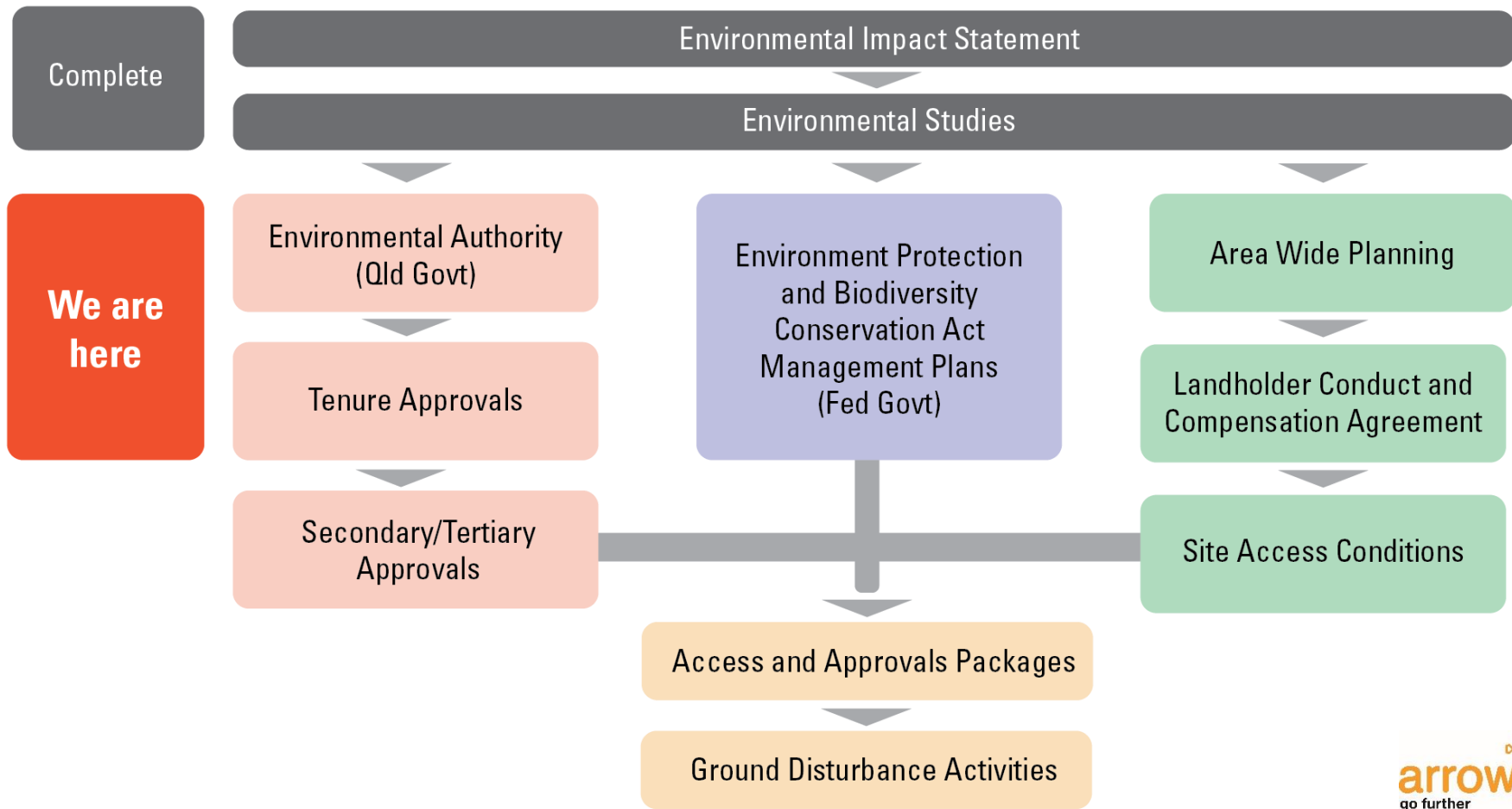
- Major Town
- Railway
- Road
- Major Watercourse
- First Disturbance Year**
- 2020
- 2021
- 2022 - 2025
- 2023 +
- Existing Disturbance
- Pipeline**
- FCS8 to Jordan B2 Route
- Harry FCS Gas North
- Harry Water Gathering North
- Tipton Dam to Glendower/Broadwater Ponds
- Beneficial Use Network
- Facility**
- CGPF
- FCS
- Pond
- Arrow Tenement**
- PL
- Area Wide Planning**
- 2020 - 2021

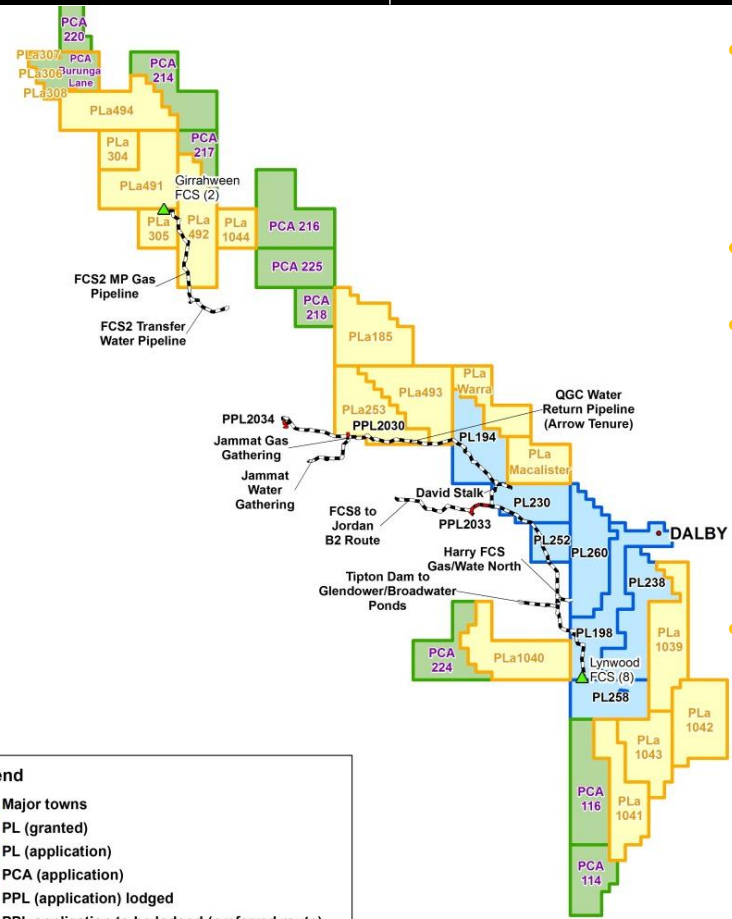


● Major Town	Facility
Railway	▲ CGPF
Road	▲ FCS
Major Watercourse	 Pond
First Disturbance Year	Arrow Tenement
 2020	 PL
 2021	 ATP
 2022 - 2025	Area Wide Planning
 2023 +	 2020 - 2021
 Existing Disturbance	
Pipeline	
FCS8 to Jordan B2 Route	
Harry FCS Gas North	
Harry Water Gathering North	
Tipton Dam to Glendower/Broadwater Ponds	
Beneficial Use Network	

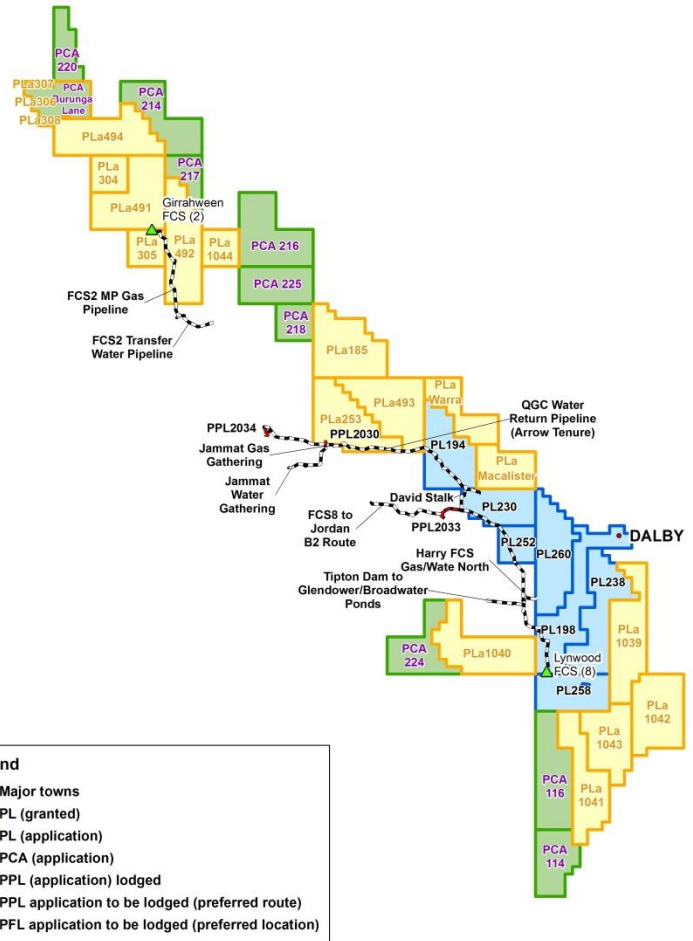








- Resource activities, including coal seam gas, require:
 - tenure (petroleum licences) *and*
 - environmental authority (EA) before production.
- Arrow's SGP will require both on-tenure and off-tenure approvals
- On-tenure approvals include:
 - Regional Interest Development Approvals (RIDA)
 - 16 petroleum leases and associated environmental authorities
 - 2 petroleum facility licences (field compression stations) and EAs.
- Off-tenure pipelines and activities will require:
 - New federal (Environment Protection and Biodiversity Conservation Act) approval – lodged May 2018
 - 8 petroleum pipeline licences (PPLs) and associated EAs – phased lodgement from 2018 to 2022.



On-tenure approvals:

- Regional Interest Development Approvals (RIDA) granted for groundwater monitoring bores south of Chinchilla.
- 16 Petroleum Leases (PLs) and associated Environmental Authorities (EAs):
 - 15 granted
 - 1 awaiting grant
 - all EAs granted.
- Two Petroleum Facility Licences (field compression stations) and EAs yet to be lodged.

Off-tenure approvals:

- Environment Protection and Biodiversity Conservation Act (Federal approval):
 - lodged May 2018
 - awaiting government support to progress to public notification.
- 8 Petroleum Pipeline Licences (PPLs) and associated EAs:
 - 2 lodged and granted to date
 - 2 lodged and awaiting approval, public notifications soon
 - continued phased lodgement until 2022.



About Arrow

CSG 101

Operations
update

Surat Gas
Project update

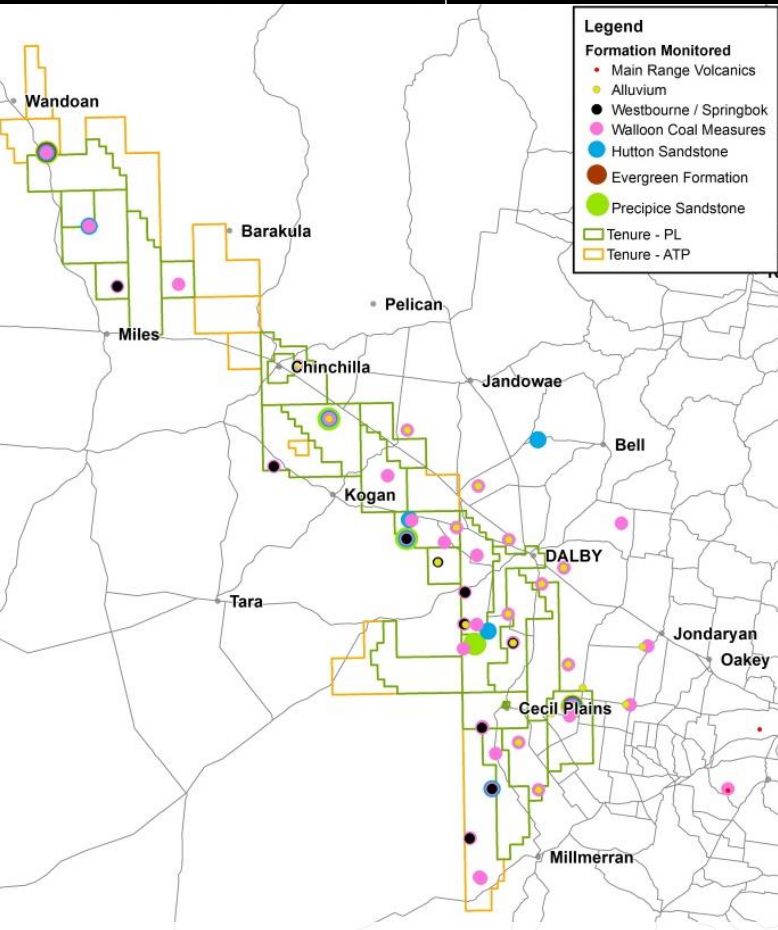
Water

What happens
next?



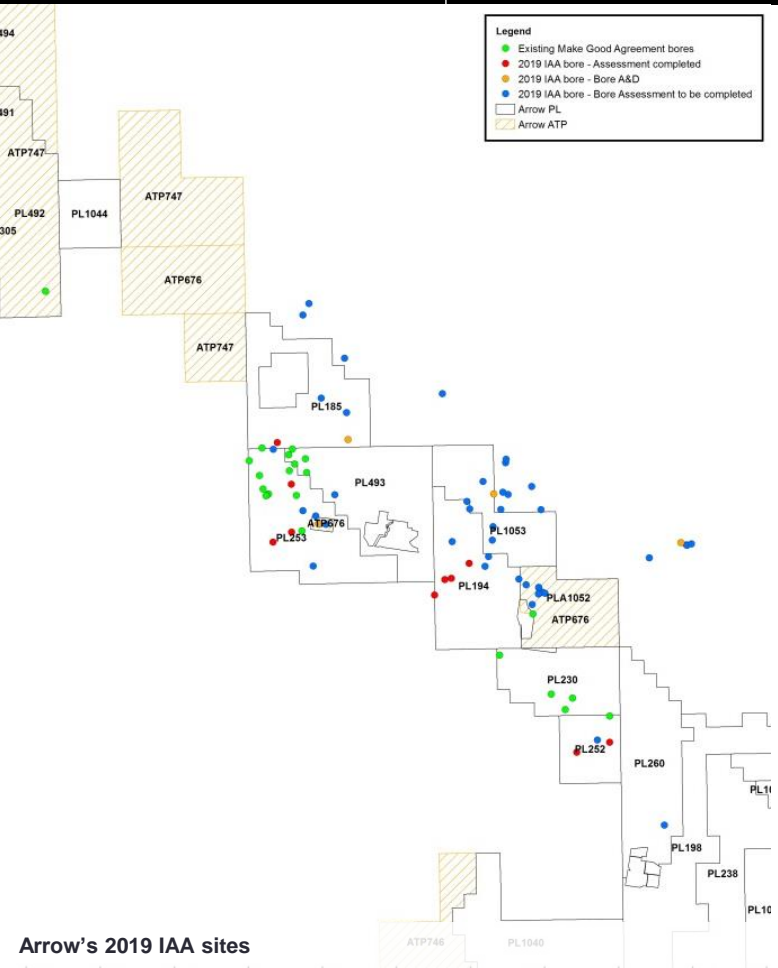


- Every 3 years, industry-wide CSG impacts to groundwater are modelled by the Queensland Office of Groundwater Impact Assessment (OGIA)
- Information is presented in the Underground Water Impact Report (UWIR)
- The third Surat Cumulative Area UWIR was released in May 2019 for consultation (following 2012 and 2016 versions) and found:
 - less impacts are predicted to the Hutton Sandstone and Condamine Alluvium.
 - greater impacts are predicted to the Walloon Coal Measures and Springbok Sandstone.



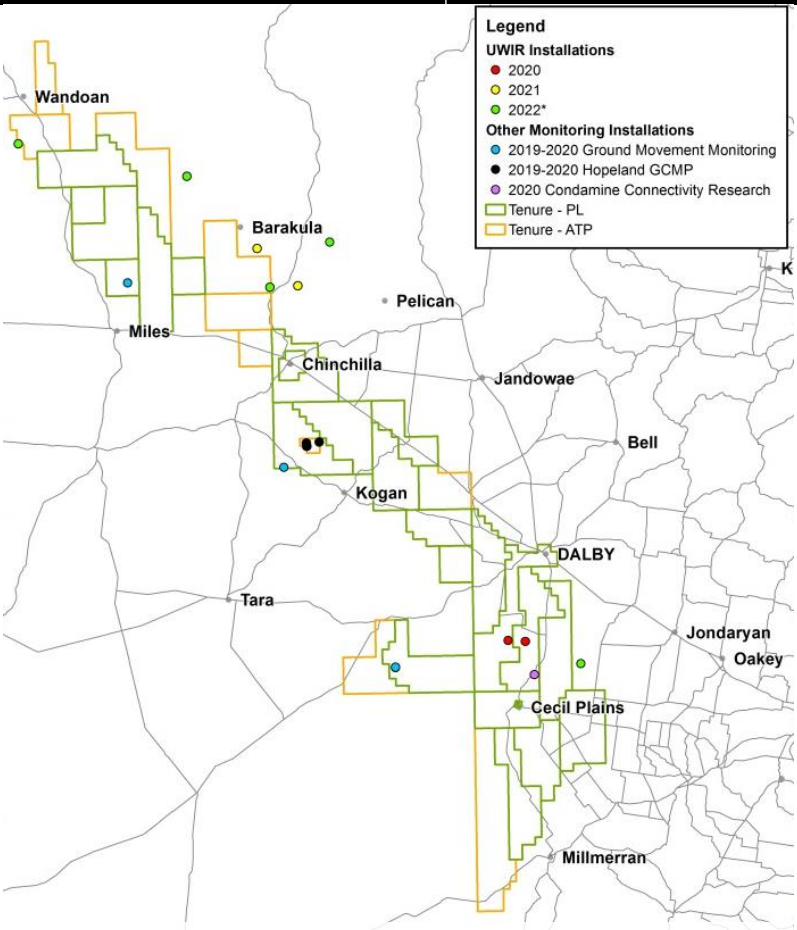
- Across the CSG industry at late 2018, the UWIR monitoring network comprised ~600 monitoring points in the Surat Basin.
- Arrow’s own monitoring network includes:
 - 210 groundwater bores in the Surat Basin (additional bores in the Bowen Basin)
 - UWIR monitoring obligations:
 - 134 points for water level and pressure
 - 17 points for water quality
 - telemetry for ‘real time view’ of data collected every ~10 mins
 - data contributes to the understanding of groundwater impacts in the Surat Basin and OGIA’s Annual Review.
- Data is available to download via Queensland Globe: <https://qldglobe.information.qld.gov.au>

Arrow’s existing monitoring sites



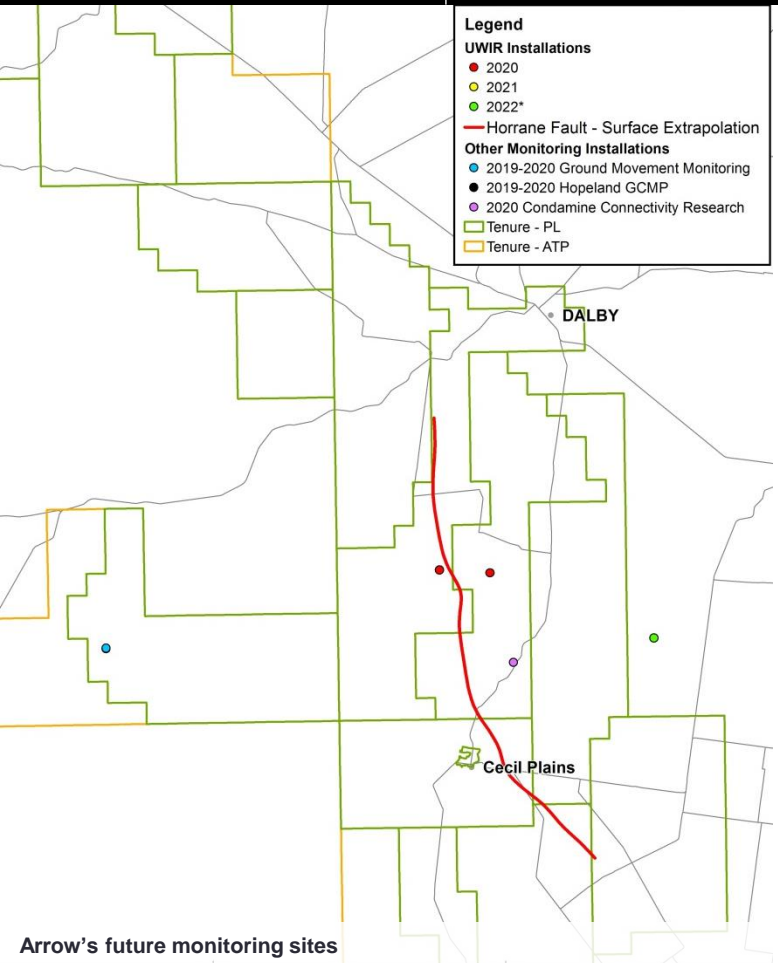
- The Queensland *Water Act* requires CSG companies to ‘make good’ impacts to water bores due to CSG.
- OGIA’S 2019 draft UWIR identified 58 immediately affected area (IAA) bores for which Arrow is the responsible tenure holder.
- If your bore is identified in the UWIR:
 - Arrow will contact you to conduct an assessment of your bore
 - If your bore is found to be impacted, Arrow will provide make good measures.
- If you think your bore might be impacted, contact Arrow through your Land Liaison Officer, or the 1800 number.
- Arrow will not make good bores which cannot make water.

Arrow’s 2019 IAA sites



- In response to the 2019 UWIR, and other obligations, across the Surat Basin Arrow will install:
 - 18 points for water level and pressure for the UWIR
 - 1 point for water quality for the UWIR
 - 2 points for Condamine Alluvium connectivity research
 - 8 points for water quality and pressure for the PL253 (Hopeland) Environmental Authority
 - 4 points for ground movement monitoring.

Arrow's future monitoring sites



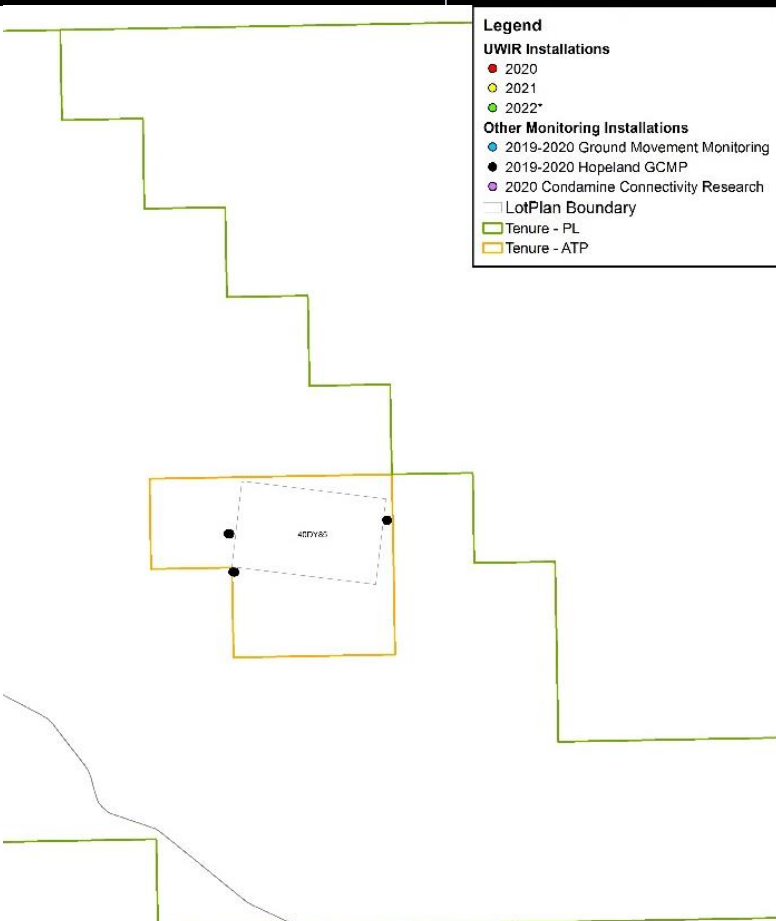
Horrane Fault

- The Horrane Fault is a sub-surface crack through rock layers, caused by deep-earth pressures over many millions of years.
- Since 2015, Arrow has been collecting data to better understand the fault.
- Arrow’s 2020 UWIR installations will generate additional data to inform understanding.

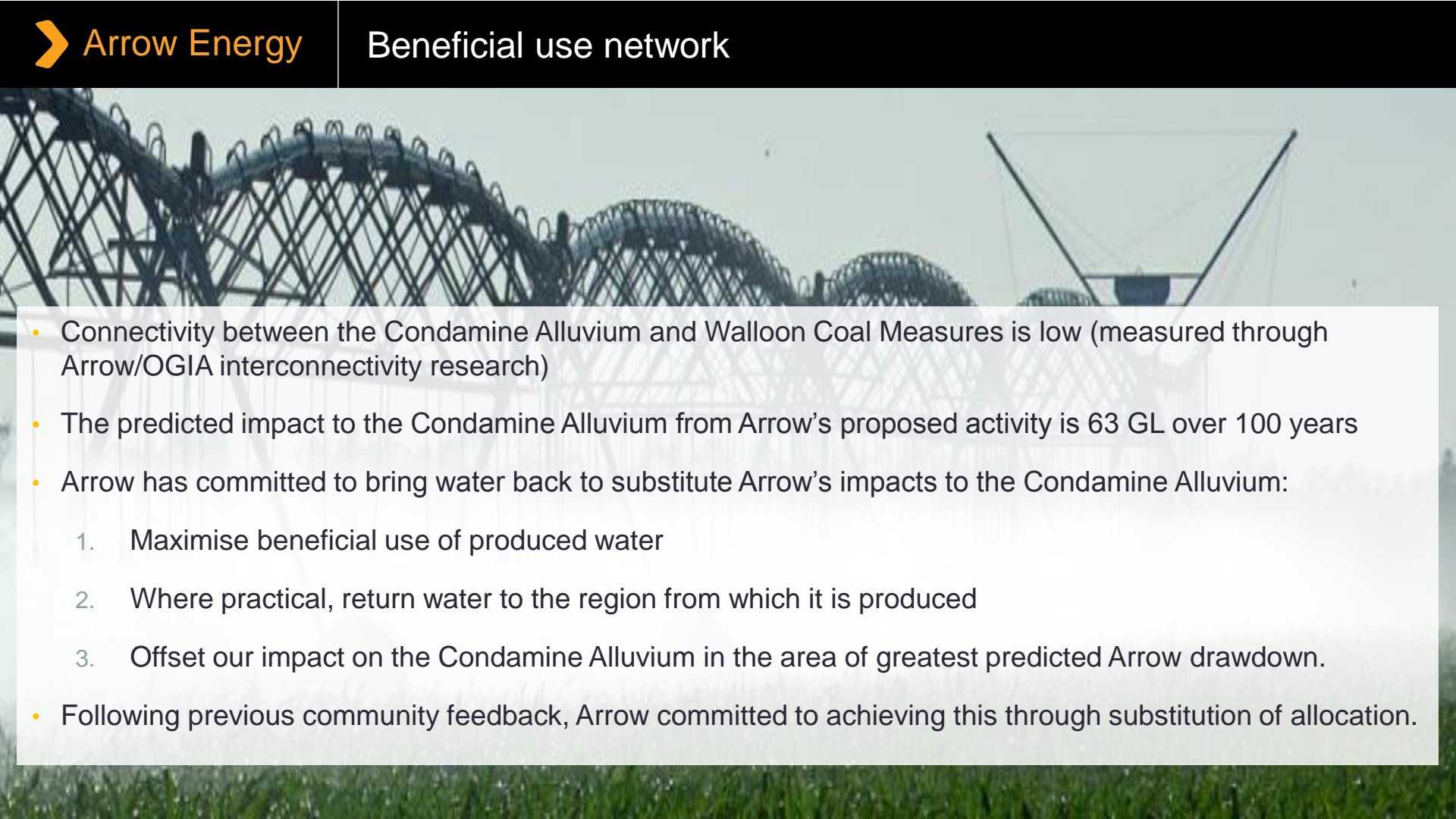
Condamine Connectivity

- Plainview East Pilot site – furthest easterly production on the Condamine Alluvium.
- Nested monitoring site:
 - Springbok Sandstone
 - Condamine Alluvium.

Arrow’s future monitoring sites



- As part of the Environmental Approval for Petroleum Lease 253, Arrow must conduct groundwater modelling and monitoring activities.
- This includes installation of up to 14 additional water monitoring bores.
- Arrow is planning to construct eight of these groundwater monitoring wells, scheduled to commence in October 2019:
 - 2 Springbok Sandstone
 - 3 Macalister Coal Seam
 - 3 Wambo Coal Seam.
- Information gathered will be provided to the Queensland Department of Environment and Science (DES) and OGIA:
 - to contribute to a broader understanding of the groundwater system in the area.

- 
- Connectivity between the Condamine Alluvium and Walloon Coal Measures is low (measured through Arrow/OGIA interconnectivity research)
 - The predicted impact to the Condamine Alluvium from Arrow's proposed activity is 63 GL over 100 years
 - Arrow has committed to bring water back to substitute Arrow's impacts to the Condamine Alluvium:
 1. Maximise beneficial use of produced water
 2. Where practical, return water to the region from which it is produced
 3. Offset our impact on the Condamine Alluvium in the area of greatest predicted Arrow drawdown.
 - Following previous community feedback, Arrow committed to achieving this through substitution of allocation.

Treatment

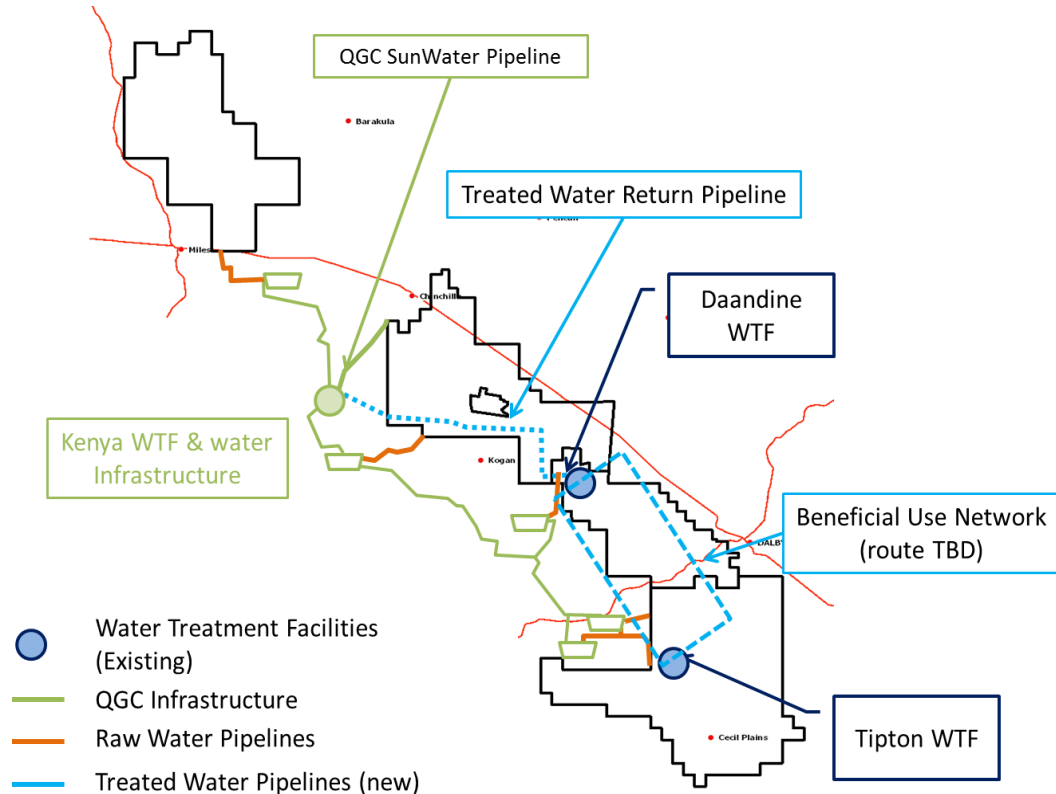
- Existing Arrow water infrastructure (Tipton & Daandine)
- Existing QGC water infrastructure (Kenya).

End use

- Existing QGC/SunWater pipeline
- New pipeline back to Condamine Alluvium region
- New beneficial use network.

Milestone dates

- Underway – Arrow Beneficial Use Network committee meetings (Arrow and allocation holders)
- 2023 – target date for beneficial use network.





About Arrow

CSG 101

Operations
update

Surat Gas
Project update

Water

What
happens
next?





- Continue work to support a shareholder Financial Investment Decision:
 - Area wide planning
 - tenure approvals
 - proposed approach to beneficial use network
 - identifying opportunities for local employment and contracting – workshops will be scheduled.
- Development in 2020 including:
 - ~70 wells between Daandine to Tipton
 - ~120km gathering pipelines.
- Development in 2021 including:
 - ~200 wells in 2021 between Daandine to Tipton, opportunity near Miles
 - ~200km gathering pipelines.

© Arrow Energy Pty Ltd September 2019

While Arrow Energy Pty Ltd has endeavoured to ensure that all information provided in this publication is accurate and up to date at the time of publication, it takes no responsibility for any error or omission relating to this information. Furthermore, the information provided shall not constitute financial product advice pursuant to the Australian Financial Services Licence held by Arrow Energy Pty Ltd's related body corporate. To the maximum extent permitted by law, Arrow Energy Pty Ltd will not be liable for any cost, loss or damage (whether caused by negligence or otherwise) suffered by you through your use of this publication.

