



Hydraulic fracture stimulation

A safe way to extract coal seam gas

What is hydraulic fracture stimulation or fracking?

Hydraulic fracture stimulation, hydraulic fracturing or fracking is an existing, proven and accepted well completion technology to increase the flow of fluids and gas from the target formation to the wellbore. Fracking is not new to Australia, and has been used on an ongoing basis for more than 40 years. More than half a million fracs have been performed globally in the last six years and more than one million in the last 60 years.

A fluid called fracking fluid, or frac fluid, which primarily consists of water and sand (about 99%), is pumped down the well under pressure. The aim of the frac is to open, connect and create fractures, as well as placing sand in existing and new fractures which in turn, holds them open to provide a pathway for gas to flow more easily into the wellbore for extraction.

Why do we use fracking in coal seam gas extraction?

As the cleanest fossil fuel, natural gas meets a variety of our energy needs; from generating electricity to cooking to heating homes and powering vehicles.

Increasingly, natural gas is produced from unconventional sources, such as coal seam gas (CSG). CSG is cleaner than natural gas from conventional sources.

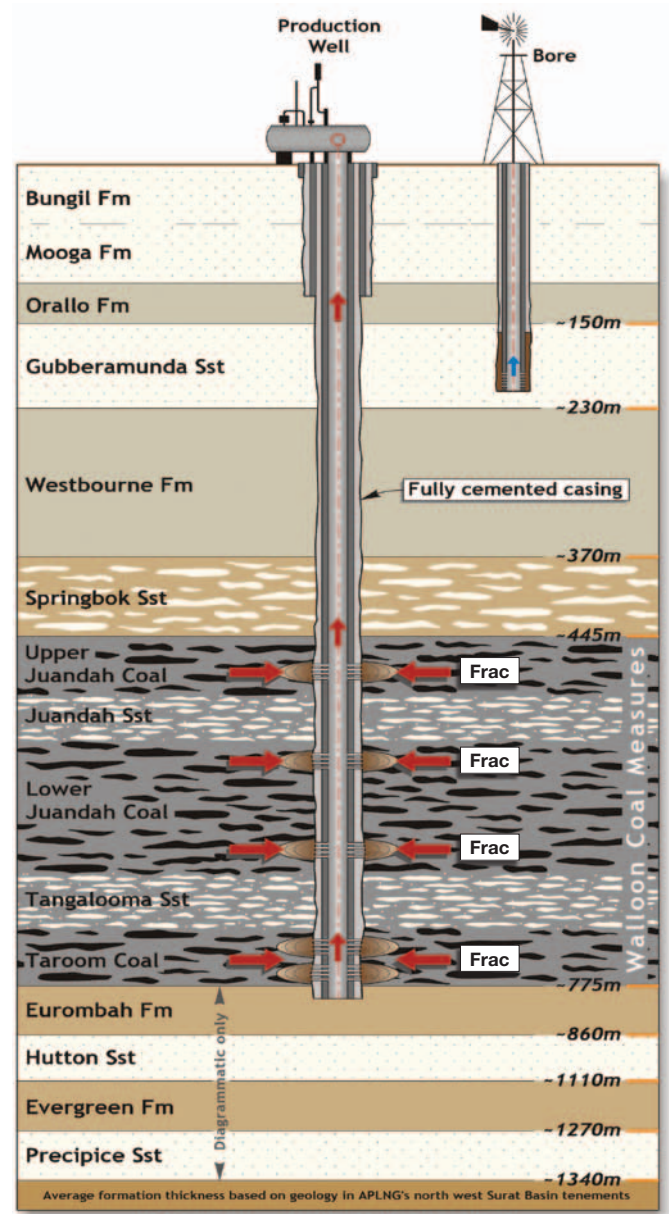
In some areas, such as low permeability coals, fracking is necessary to enable a more effective release and flow of gas from the coal seam.

Fracking can unlock an area of low productivity potential, it can convert a non productive well into a productive one and it can increase the drainage area of each well. This means that fewer wells need to be drilled in order to produce the same amount of gas.

Fracking significantly reduces the overall environmental impact of CSG operations in areas of low permeability coals.

While hydraulic fracture stimulation technology supports the efficient development of CSG reserves, not all CSG wells need to be fraced. Approximately 30% of the Australia Pacific LNG Project's wells are expected to be completed by hydraulic fracture stimulation over the life of the Project.

Gas production from a hydraulically fractured well



Why are chemical additives used in hydraulic fracture stimulation?

Chemicals are an integral component of food and pharmaceutical processing, industrial processes and manufacturing.

The chemical additives used in hydraulic fracturing enable:

- the fluid to form a gel and hold the sand in suspension (allowing more sand to be spread throughout the fractures and less water to be used)
- the gel to break down once the process is complete
- clays to be stabilised and to prevent swelling
- pH levels to be balanced, and
- the prevention of bacteria transfer from surface water to the coal seams.

What chemical additives are used in hydraulic fracture stimulation?

Australia Pacific LNG exclusively uses water based hydraulic fracturing fluids. The viscosity (or thickness) of the frac fluid is engineered to cater to specific formation characteristics and to optimise the volume of sand placed in the coal seams.

A low viscosity, or low thickness, frac fluid usually called a water frac, consists of treated water, sand and a small amount of additives (0.1%).

A higher viscosity, or thicker, frac fluid usually called a gel frac, is used in different formations and has an additive content of (0.33% to 1.21%) depending if produced or fresh water is used. The significant difference between the various frac fluids is the inclusion or exclusion of guar and KCl (potassium chloride, a common salt). Guar is a natural gummy substance that forms a gel when mixed with water. Both guar and KCl have many common uses. The extra additives make the fluid thicker and enable more sand to be suspended in the same volume of fluid (up to six times more) and reduces the amount of water used.

The additives used are all commonly occurring and are contained in many standard household products. They are used in very diluted concentrations in frac fluids and at lower concentrations than normally used in other common products. Additives include sodium bicarbonate (bicarb of soda), acetic acid (vinegar), sodium hydroxide (caustic soda, used in toothpaste), and calcium chloride (found in sports drinks and pickles).



The table on the back page explains the additives we use in hydraulic fracture stimulation. It also shows the percentage range of the additives used in our frac fluids and how these additives are also used for everyday purposes.

The number of chemicals used in a particular frac can vary from 2 to 16. Many of the chemical additives are included in the Therapeutic Goods Administration (TGA) list for therapeutic use in hospitals (www.tga.gov.au).

Importantly, Australia Pacific LNG does not use BTEX (benzene, toluene, ethylene, xylene) in its frac fluids.

What happens to the hydraulic fracturing fluids after they are pumped into the formation?

The majority of fluids which are pumped into the coal seam during the hydraulic fracturing process are recovered from the well after the well is placed into production. These fluids are then removed and disposed of appropriately in accordance with strict regulatory guidelines.

Much of the frac fluid that remains in the formation is brought back to the surface during normal CSG production and operations. All recovered fluids are collected along with the CSG water produced and transported to a water treatment facility.

The small amounts of fluids that remain in the formation will degrade overtime, turning into water similar to the existing salty water in the formation. The sand is designed to stay in the fractures to keep them open.

How safe is hydraulic fracture stimulation and the use of these chemical additives?

Fracking is a highly regulated and controlled process. The frac fluid is pumped into isolated coal seams, deep underground and in the diluted concentrations used, the chemical additives are not considered harmful.

It is safe to say that we eat, drink or wash in the chemical additives that we use in fracking. These additives do not remain in the environment after use because they quickly degrade.

During the course of the fracking process, the chemicals are further diluted when injected into the coal seams by the water already present in the seams.

The additives we use are commonly found within homes as ingredients in foods, toothpastes, personal and hair care products and soap. Their functions in these products are similar to their functions in frac fluid – for example, the suspension of other ingredients (sand in the frac fluid and herbs and spices in salad dressings).

To restrict frac fluids and gas from entering surrounding aquifers, rigid design standards are followed and well integrity is confirmed prior to fracking. All wells have multiple steel casings with cement sheaths that isolate surrounding formations from each other and the well bore. The wellhead system used is designed specifically to manage the fracking process.

Hydraulic fracture stimulation is designed to only frac the target coal seams which are typically separated by more than 140m of very low permeability barriers of siltstones and mudstones. The cemented casings and the siltstone and mudstone barriers prevent cross-contamination of the fluids into surrounding aquifers.



Only experienced contractors are used to provide fracking services and their equipment is certified and tested prior to every frac.

The technology used in fracking continually improves and the additives have become much cleaner and safer over the past 60 years.

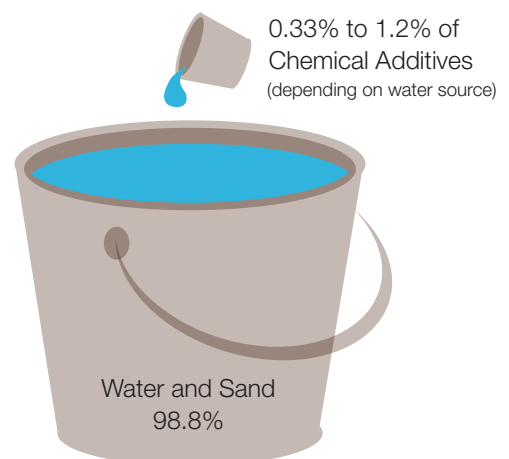
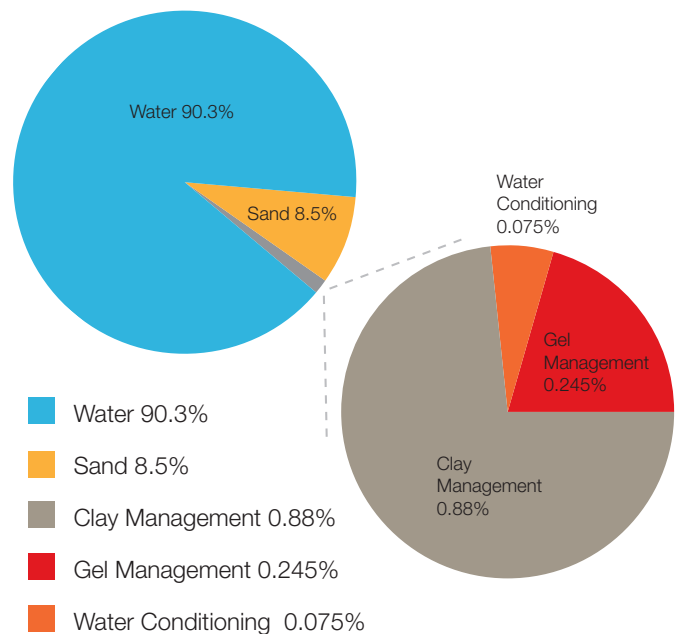
Regulatory and Compliance Requirements

The Queensland Government has introduced strict regulatory requirements covering the fracture stimulation process and the additives used in frac fluids. Australia Pacific LNG has developed and applies very stringent procedures for its fracking activities.

Compliance requirements include:

- Over 13 specific hydraulic fracture stimulation conditions and over 20 monitoring conditions, with a monitoring regime for over 45 analytes (chemical, chemical compound or physical property).
- Source water sampling prior to any fracking activity. The mixed frac fluid is sampled and tested before being used to ensure it meets regulatory requirements. Samples of the frac fluid being pumped are taken and tested. The testing is undertaken by independent NATA certified laboratories. All testing results are available to the regulator. Water bores adjacent to a hydraulically fractured well site are baseline tested prior to any activity and then, on a regular basis as per regulation.
- Taking samples of produced fluid following completion of fracking, which are tested on a regular basis as per regulation.
- Compliance with Queensland Government restrictions on the use of BTEX.
- Compliance with on-site audits of fracture stimulation activities implemented by the Department of Environment and Resource Management (DERM).
- Listings of chemicals used and MSDS sheets on the Australia Pacific LNG website.
- Discussion with landowners about each frac job
- A copy of the post fracking summary report is provided to the landowner and the regulator within 10 days, with a comprehensive final report provided to the regulator two months after the fracking activity.

Composition of gel frac fluid



The Australia Pacific LNG Project

Australia Pacific LNG is the leading coal seam gas producer in the Queensland natural gas industry. The joint venture between Origin, ConocoPhillips and Sinopec is currently undertaking a major CSG to liquefied natural gas (LNG) project that will supply natural gas to both domestic and international markets. The Australia Pacific LNG Project involves developing CSG fields in the Surat and Bowen Basins, construction of a 530km main gas transmission pipeline and a new LNG facility on Curtis Island, off the coast from Gladstone.

CSG is a cleaner and greener alternative to many currently used fossil fuels, such as coal and petroleum. Power stations fired by CSG emit around half the greenhouse gases of coal-fired electricity generation and use only a fraction of the water. CSG is emerging as a preferred transition energy source as the world develops its renewable energy capacity. The CSG industry is set to provide Queensland with huge economic benefits.

The chemical additives used in the fracking process

Group/Function	CAS Number	Chemical type or name	Commonly found/used in household products	Common Use	Range of Volumes in Frac Fluid	
					Group % by volume (average)	% volume range of chemical in frac fluid
Sand (Proppant)/ Water	7732-18-5	Water	Irrigation, Drinking , bathing, cooking	1% to 100%	98.79% to 99.9%	88% to 97.6%
	14808-60-7	Silicon Dioxide (quartz / sand)	Hand Cleaner, arts & crafts, glass	1% to 100%		2.3% to 12%
Water Conditioning (Microbial / pH Control)	7681-52-9	Sodium hypochlorite	Disinfectant, bleaching agent, cleaners, cleaning of milking equipment, water treatment, medical use, mildew remover, anti- bacterial cleanser	0.1% to 20%	0.075% to 0.1%	0.01% to 0.02%
	1310-73-2	Sodium hydroxide (caustic soda)	Food preparation, soaps, detergents, toothpaste, aftershave, face mask, teeth whitening strips, eau de cologne, body wash, face cleaning pad, Hair remover, cocoa processing,	0.1% to 5%		0.002% to 0.1%
	497-19-8	Sodium Carbonate	household and laundry / dishwasher cleaners, toothpaste, fish aquarium, hair care, spa water clarifier	0.5% to 85%		0.0% to 0.025%
	144-55-8	Sodium Bicarbonate	Baking powder, Cakes, household cleaners, vegetable cleaner, toothpaste, fish aquarium, baby powder, deodorizer	1 % to 100%		0.0% to 0.006%
	64-19-7	Acetic Acid	Vinegar, food preparation and manufacturing, Salad dressings, Pickled Onions, relishes and spreads, household cleaning products	1% to 5%		0% to 0.1%
Clay Management	7447-40-7	Potassium chloride	Table salt substitute, medical use, hair products pet supplements, african violet food	0.5% to 40%	0.0% to 0.91%	0.0% to 0.91%
Gel / Viscosity Management	6410-41-9	CI Pigment Red 5	Food colouring, colour pigment in cosmetics, soaps ink, paint	0.01% to 30%	0.0% to 0.25%	0.0% to 0.00009%
	100-43-52-4	Calcium chloride	Detergents, cosmetics, deodorant, pet products, desiccant , food additive, sports drinks, pickles	0.1% to 90%		0.0% to 0.0002%
	Natural Mixture	Walnut Husk	Hair Dye, Polishing Material, Exfoliate in Facial and Body Scrubs, Aquarium and Aquaculture	3% to 50%		0.0% to 0.006%
	9000-30-0	Guar gum	Cosmetics, baked goods, ice cream, toothpaste, sauces, salad dressing, Substitute for wheat intolerant people to use instead of flour, cattle food, and medical use	0.5% to 20%		0.0% to 0.2%
	14808-60-7	Silica	Hand Cleaner, arts & crafts, glass	1% to 100%		0.0% to 0.002%
	9025-56-3	Hemicellulase Enzyme	Wine Additive, Soybean Paste, Fibre Additive, Commercial Baking and Food Processing, Farm feed additive	0.1% to 25%		0.0% to 0.0005%
	26038-87-9	MEA borate	Cosmetics, hair texturizer, hairspray, antiseptic, laundry detergent	0.1% to 5%		0.0% to 0.1%
	proprietary information	Acrylic Resin	Disinfectant Cleaner, FDA Approved Colorant, paint, food packaging, medicinal chemistry.	< 0.01% to 2%		0.0% to 0.002
	7647-14-5	Sodium chloride	Food production, table salt, food additive, detergents, hair products, water softener and medical saline drips.	0.03% to 99%		0.0% to 0.004%
	proprietary information	Enzyme	Laundry detergent, laundry stain remover, silverware cleaner, agricultural feeds, instant coffee production	~ 0.1%		0.0% to 0.0002%
7772-98-7	Sodium thiosulfate	Personal care, food production, home aquarium health / commercial aquaculture, medical use for over 100yrs.	0.1% to 30%	0.0% to 0.04%		

For more information

Got a question about Australia Pacific LNG?

For enquiries about the gas fields or pipeline call **1800 526 369** or email contact@aplng.com.au

For enquiries about the Gladstone operations and LNG facility call **1300 776 205** or email aplng.gladstone@conocophillips.com

Or visit our website at www.aplng.com.au

