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harvesting water for beneficial use

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here



The name BeneTerra was derived from the Latin adverb “bene,” which is the English equivalent of the word “well” as in healthy or prosperous. The Latin noun “terra” refers to “land, soil or earth.”

The term “beneficial use” is much talked about in discussions surrounding water and its disposition. We take this term seriously and formed a business around its expression. BeneTerra was established in 2002 for the purpose of advancing the beneficial use and reuse of water. The business focus has evolved from beneficial reuse of municipal and industrial wastewaters to first beneficial use of produced water from coalbed natural gas production. We continue to seek new opportunities to beneficially use water primarily for agriculture.

...harvesting water for beneficial use



BENETERRA SUBSURFACE DRIP IRRIGATION FOR DISPERSAL OF PRODUCED COALBED WATER

U.S. Patent #7320559

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John Zupancic inspecting alfalfa grown with SDI coalbed produced water

Special points of interest:

- BeneTerra SDI provides 24x7 water dispersal 365 days of the year.
- These systems can be scaled to meet unpredictable and changing water flow from wells.
- The topsoil is left in near native condition.
- SDI provides a tremendous boost to forage crop production.
- SDI can be used after the coalbed water is gone.

The BeneTerra Advantage

BeneTerra has pioneered the use of subsurface drip irrigation (SDI) technology to disperse produced water from coalbed natural gas wells. This system provides year-round water dispersal for energy operators while producing bountiful crops.

BeneTerra is an agricultural company with an understanding of today’s environmental and social challenges. The team members are experienced in agri-business, agronomy, accounting, wastewater treatment and business management. The combined operational knowledge and experience within BeneTerra allows the company to provide unique, comprehensive solutions for water handling.

Experience with wastewater handling has prepared the team to deal with the challenges faced by the coalbed natural gas

industry.

Wastewater effluent is produced year-round and requires environmental permitting and monitoring. The water is normally sodium-rich and must be moved long distances to be land applied.

Effluent and produced waters require care in their application to the land. If done properly, beneficial use is a win-win solution for all concerned. BeneTerra cares for the land while putting water to a higher use.



Swathing grass hay produced with coalbed water through SDI

...harvesting water for beneficial use

VALUES OF SDI TO ENERGY PRODUCERS

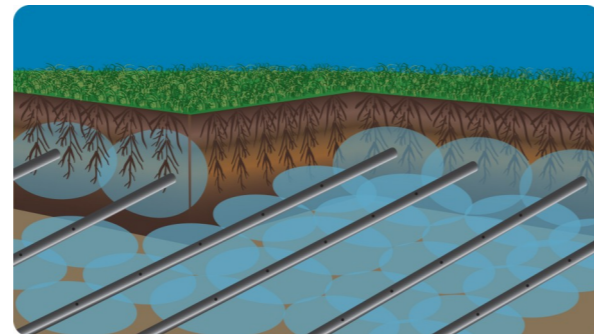
- Turnkey system designed, built and operated by BeneTerra thus allows operators to focus on gas production
- Scalable to meet unpredictable and changing water flow
- Year-round water dispersal
- Puts the water to beneficial use
- Diminishes need for water impoundments
- Decreases environmental risk
- Improved relations with surface landowner because of added value from forage production
- BeneTerra operates and manages the system allowing operators to focus upon gas production
- Reliable water dispersal allows for uninterrupted gas production (1,642 days and counting since 2005)



BeneTerra SDI systems operate in winter by capturing the heat latent in the coalbed water. The systems are managed to replace subsoil moisture and move salts deeper into the soil during winter.

HOW DOES BENETERRA SDI WORK?

Produced water is filtered, treated and pumped through a labyrinth of polyethylene tubing which spreads it uniformly across the land. The tubing has emitters attached to the inside which regulate flow from openings on the tubing.



It is placed in the soil with a chisel plow to depths ranging from 18 to 48 inches. Plants derive moisture from roots in the subsoil while the topsoil remains relatively dry. Haying operations can continue while the field is being irrigated. There is less compaction on dry soil and weeds have little moisture for germination.

WHO PAYS FOR IT? WHO RUNS IT?

BeneTerra contracts with energy companies to handle a given amount of water. Then BeneTerra designs, builds and operates the SDI systems for a given period of time. Surface use and water management agreements are made between all of the parties concerned— energy operator, landowner and BeneTerra.

In short, BeneTerra contracts with the energy operator to disperse a given volume of water over the course of a contract period. BeneTerra agrees to maintain the land in a condition that is at least as productive as it was prior to SDI operation.

Agricultural specialists on the BeneTerra team work with

the landowner to optimize the system to fit his needs. That might include hay production, rotational grazing or something else. Crop species are selected jointly with the landowner. Cool-season forage grasses and legumes are preferred because of their long growing season and ability to produce high yields.

BeneTerra operates the system over the life of the contract. Once the contract expires it may be turned over to the landowner if so desired. If not, then all of the above-ground fixtures are removed.

These systems are designed to last for 10 to 15 years, if well cared for. However, there are SDI systems that have operated for more than 20 years.

VALUES OF SDI TO AGRICULTURAL PRODUCERS



Increased hay production along with available stock water has allowed some ranchers to maintain and even expand their herds during drought.

- Forage production will be increased—there is more hay or pasture thus improving the carrying capacity of the land.
- The natural viewscape is maintained as there are very few above-ground structures visible. Fewer impoundments are needed.
- Native soil surface conditions are preserved because the water is placed well beneath the surface.
- SDI can be designed to fit odd-shaped fields.
- Wildlife habitat can be enhanced.
- Reliable irrigation resulting in high productivity.

WHY SDI INSTEAD OF SURFACE IRRIGATION?

Subsurface drip irrigation is the most efficient technology for watering crops. Since the water is applied beneath the soil surface it does not run off the soil surface and greater amounts of water can be applied compared to surface irrigation.

Crops grown with SDI will luxuriously consume water in greater quantities than are common under conventional irrigation.



Coalbed natural gas wells typically produce large amounts of water early in their development. Then the volume tapers off. Operators' gas production efforts are limited by their water handling capacity and SDI offers some flexibility.

The amount applied is limited by soil permeability and/or underlying groundwater quality. These systems typically require an "Underground Injection Control" permit which is mandated by the USEPA.

WHAT ABOUT THE SALTS?

Coalbed water is typically about 99.8 pure water. The primary mineral is sodium bicarbonate also known as baking soda. Most refer to sodium chloride as salt but technically sodium bicarbonate is a salt as are calcium sulfate (gypsum), magnesium sulfate (Epsom salts) and calcium carbonate (lime).

The subsoils of arid regions naturally contain many tons of salt which are commonly salts of calcium and magnesium. Most of the native calcium and magnesium in semi-arid soils are found beneath the topsoil layer and can extend downward to great depths.

BeneTerra SDI systems are designed to utilize the native calcium and magnesium already present in the soil to offset the effects of sodium.

Then the salts are pushed to a lower depth in the soil where they will reside with other salts that have existed there for thousands of years.

