Commercial Water Solutions

Products for Community Water Systems

arris

water treatment & technology

CONTENTS

Arris can deliver practical water treatment solutions across all aspects of the engineered water cycle, working with domestic, commercial, agricultural, trade waste, government, industrial, mining and gas sectors.

We are able to operate at different scales, with projects ranging from a single household to those that treat 10 million litres per day.

Arris actively engages with clients to ensure their individual needs are able to be met in regard to treated water quality, cost, installation foot print and operation. As part of our service, our experts will design a fit for purpose system, obtain necessary approvals, install the infrastructure and provide ongoing maintenance. This approach ensures we are able to deliver solutions which are robust, reliable and have low operational costs.

Arris has a team of highly skilled and experienced staff which enables us to take a design all the way through to on-site construction, delivering the most cost effective and reliable solutions for your needs. We have extensive experience in constructing potable water treatment systems, wastewater treatment facilities, groundwater treatment chains for irrigation, stormwater transfer and treatment infrastructure, recycled water networks and reuse schemes, pump stations, sewer installations, reticulated water delivery systems, biosolids dewatering, storage tanks and irrigation works.

We also build and containerise our water treatment plants at our Rockhampton or Adelaide facilities and deliver the completed product to site. This reduces costs, particularly for remote and regional decentralised treatment systems.

Arris has a global reputation for delivering on-ground solutions in potable water, wastewater, stormwater and recycled water. We do this by designing, building, operating and maintaining fit for purpose treatment systems. Our projects are both environmentally and economically sustainable.

Arris utilises a range of different technologies for water treatment as outlined in this brochure. These include our own internally developed proprietary treatment method (Rhizopod™) and other systems sourced from some of the most advanced global water technology providers. We are able to access various technologies and components to design and construct bespoke treatment chains for specialised applications.

We also specialise in tackling difficult water treatment situations, with a track record of dealing with sodicity, salinity, excess wastewater volumes, tannins, odours, disinfection, set-back distances, environmental concerns, challenges with water dispersal, elevated levels of BOD/COD, nutrients and heavy metals.

Our team has exceptional skills in trouble shooting treatment issues within existing treatment plants and is able to refurbish and enhance existing systems as a more cost-effective solution than a complete rebuild.

Arris has trained and experienced staff who can operate potable, stormwater, wastewater, and mining water treatment facilities. We can contract these staff out to developers, body corporates, business and industry, and special event managers and we can also assist clients with the operation and maintenance of systems where the original proprietor is no longer available.

CONNECTING WATER WITH AGRICULTURE AND THE ENVIRONMENT

Arris is a unique business with the skills and expertise to oversee end-to-end solutions to a range of land and water management issues. We are a leading environmental, consulting, project management and services organisation based in in Australia, with clients around the world.

We deliver and support a range of alternative water, agricultural and food projects and offer a wide range of services in the broad disciplines of water, environment, farm and cropping systems, stakeholder management and engagement.

Arris has built a name around being one of the nation's leading consultancies in the field of recycled water. We have conducted around 20 recycled water project assessments for major clients such as:

- Water Corporation;
- Power and Water;
- Melbourne Water;
- SA Water;
- Barwon Water;
- Central Highlands Water;
- South East Water;
- ACTEW;
- City West Water.

These projects have typically included economic assessment, land capability assessment and extensive stakeholder engagement. The Arris team has worked with a number of wastewater types – domestic, coal seam gas, hide processing and manufacturing waste streams, determining appropriate levels of water treatment and suitable soil types for the reuse of the treated water for irrigation.

Recycled water is a significant resource which can be exploited for agricultural and horticultural use in Australia and around the globe.

Our team has developed and instigated a number of beneficial reuse schemes across the country which continue to be in operation. The largest of these is the Virginia Pipeline Scheme in South Australia which currently provides more than 100GL of Class A recycled water to growers, with many of these growers relying solely on this water to meet their irrigation supply requirements.

Arris has a range of qualified staff with expertise in the fields of soil science, environmental science, water chemistry, wine making and sensory science.

We have experience in the field of contaminated land assessment and remediation, with ISO 14001 accredited environmental auditors. We take a co-operative approach with regulatory authorities to ensure that site-specific, safe and efficient remediation targets are achieved.

The team has extensive experience in dealing with regulatory compliance issues to effectively assess and develop plans which can accommodate whole-of-site solutions for efficient, cost effective, soil, water and environmental compliance issues.

More detail on the various solutions which we can provide are detailed in the remainder of this brochure.

Arris is recognised nationally and internationally for research, expert advice and project delivery in the water, agricultural and environmental industries.

Trenching systems for underground treated effluent dispersal

Trenching systems that enable the underground dispersal of treated effluent can eliminate public health risks from people coming into contact with the water and also provide better odour control than above ground dispersal systems.

Arris provides a number of different trenching systems which are world's best practice and approved under Australian Standard AS 1547:2012.

As part of our design process, we provide advice on the most suitable solution for your site.

Trenching systems are passive, provide additional treatment and have lower operational costs than above ground irrigation methods, as additional disinfection is not required from a public and environmental health perspective.

The trenching systems available through Arris are outlined in more detail below. By providing a broad range of options, Arris can respond to different soil types, loading rates, treated water quality, general site conditions and size of the system footprint.

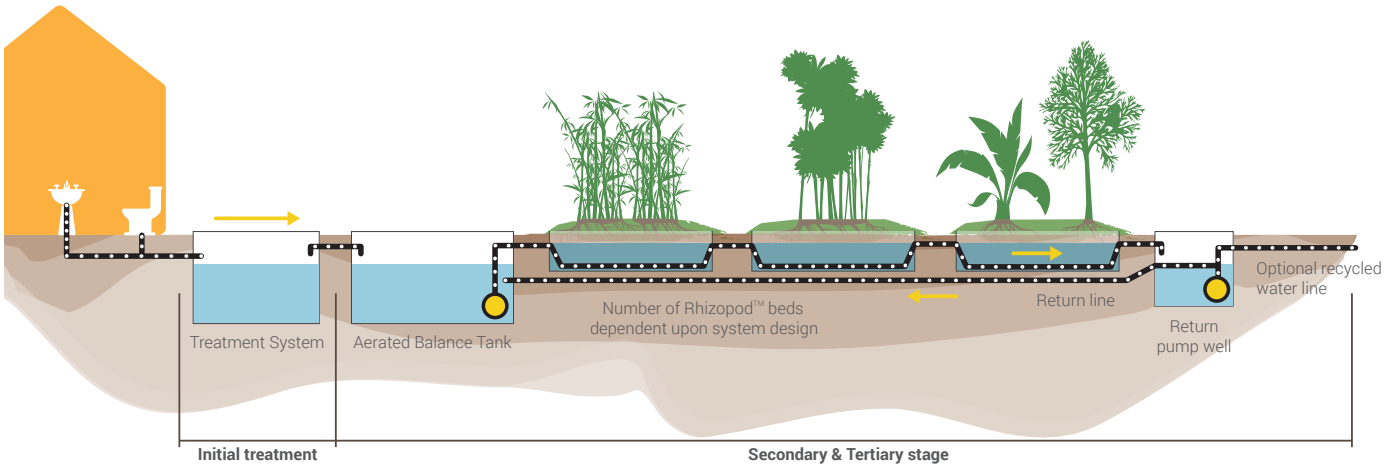
RHIZOPOD™ SYSTEM

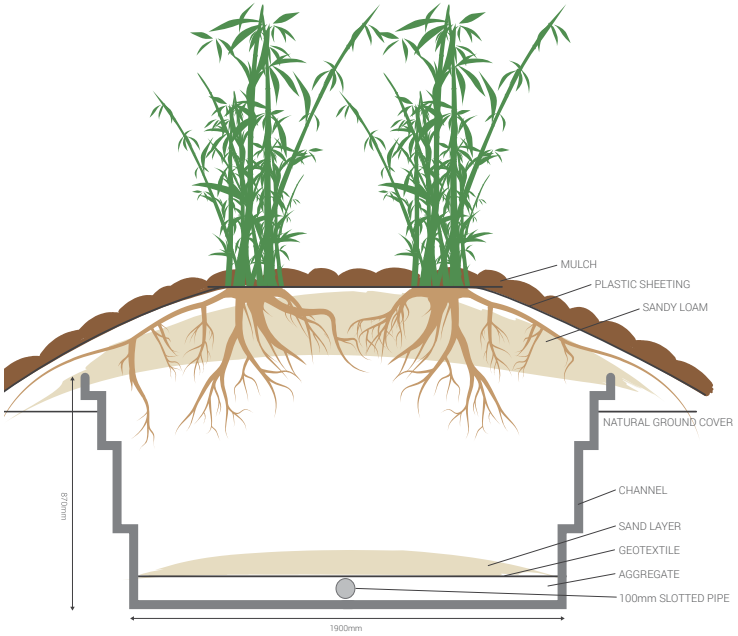
The Rhizopod™ system, or Recirculating Evapotranspiration Trench System, is designed to resemble a raised garden bed, with pre-treatment occurring through septic tanks and/or aerated tanks. The recirculating nature of this treatment method and the use of a holding tank results in a relatively small physical footprint.

Arris has been installing and operating systems using the Rhizopod™ technology since 1998. We can design, construct, maintain, and operate such systems for clients, which continue to be popular for caravan parks and small clusters of houses.

Ben Kele, Director of the Engineered Water Cycle at Arris developed this technology during his Master's degree through research at the Centre for Plant and Water Science at the Central Queensland University. The dual drivers of this unique innovation were the need for a system which could operate independently of local soil types and which treated wastewater in a contained manner.

Many soil types are unsuitable for the long-term management of effluent, whilst some sites are so close to environmentally sensitive areas that the required





set back distances make the development of the land unviable. To address such constraints, Rhizopod™ systems use imported soil suitable for long-term use, treating and reusing the water in a contained environment, minimising applicable setback distances.

Plants grown in the channel also allow all the effluent to be reused, with a holding tank providing storage during wet periods for use when needed in dry times. If required, the technology can be adjusted so that it produces 'fit for purpose' recycled water.

Rhizopod™ installations are approved by the Queensland Regulator as 'no-release' systems, reducing the cost associated with annual licence fees and monitoring. In 2015, the technology also received approval from the South Australian Department of Health.

VAPARHIZE® SYSTEM

The Venturi Aerated Pressure Alternated Rhizozone Evapotranspiration (VAPARhizE®) trenching system amalgamates several recognised 'best practice' design, distribution and dispersal methods. These systems maximise oxygen levels in the water and the soil in the trench, which is highly beneficial for plants grown over the top.

VAPARhizE® uses an alternating pressurised distribution method, in combination with venturi valve and tunnel splash-back aeration. The venturi valves introduce micro-bubbles of air into the water which then have a very large surface area which enables the water and soil to stay in an effective aerobic condition.

VAPARhizE® systems maximise oxygen levels in the water and the soil in the trench, which is highly beneficial for plants grown over the top.

The use of a pressurised tunnel splashback style distribution technique (developed in South Australia) enables pressurised treated water to be forced through a series of measured apertures against the underside of the tunnel. This in turn creates an aerosolising/ vaporising effect which not only provides further passive aeration, but also results in very uniform wetted dispersal over the distribution media for the entire footprint of the tunnel.

These systems are highly energy efficient, as the pressure from the pump provides aeration through the venturi valve, whilst the aeration provides additional treatment, reduces odours, has plant health benefits (particularly for roots) and helps increase soil sustainability.

The VAPARhizE® system is based around the on-site wastewater standard AS/NZS 1547:2012, relevant South Australian Department of Health Codes, as well as components of a number of international standards and published peer reviewed scientific reports.

WISCONSIN MOUNDS

These mound systems are an internationally adopted land application method developed in the USA.

The sand filled mound provides a secondary treatment aerobic sand filter system, which is positioned above the dispersal site. Water is removed by evaporation from sun and wind and/or transpiration from the grasses and ground covers planted over the mounds.

Any effluent that migrates to the base of the mound is regarded as equivalent to secondary treated wastewater and is further treated and dispersed by natural soil absorption processes.

Such mounds are normally only adopted in larger allotments in areas with high water tables, shallow rock or very difficult soil types. They also require pre-treatment, such as through a septic tank followed by a pump chamber.

These systems are capable of handling relatively large flows and sites that have fluctuations in the volume of wastewater generated. These mounds are therefore best suited for clusters of domestic houses, commercial or industrial sites, sports ovals, caravan parks, restaurants and beverage cellar doors.

Mound systems are capable of handling relatively large flows and sites that have fluctuations in the volume of wastewater generated.

ABSORBS PRESSURE-DOSED INFILTRATION TRENCHES

Arris is able to provide an improved version of the conventional trench system in the form of the pressure-dosed infiltration trench. These systems can be used in sandy to loamy soils (Category 1-3 soils) and involve the use of a number of trenches to disperse treated effluent.

The top of the trench is typically planted with a lawn grass, which uses some of the treated water for evapotranspiration.

The unique pressurised distribution system allows for the even dispersal of water along the length of the trench with no pooling and the trenches can be dosed with water in an alternating sequence through a distribution valve.

This allows trenches to dry out in between doses, encouraging healthy aerobic soil conditions. This in turn helps to maximise the evapotranspiration rate and maintain the soil permeability over time.

The pressure-dosed infiltration trench is approved under Australian Standard AS 1547:2012 and is a marked improvement over conventional trench designs.

ETA TRENCHES

Evapo-transpiration-absorption (ETA) trench systems are best suited to sites with heavy or clay soils (such as Category 4-6 soil profiles). The trenches are comprised of a pipe distribution system, sand and aggregate and suitable soil for the long-term application of effluent.

The trenches are designed to be covered by plants, typically a lawn grass.

They are approved under Australian Standard AS 1547:2012 and disperse the treated water through three natural processes:

- Sub-surface infiltration into the soil;
- Evaporation from the sun and wind;
- Transpiration by plants into the atmosphere.

The ETA trenches themselves also provide additional treatment through bio-mat filtration, soil adsorption and the ability of plants to assimilate nutrients and water into their biomass.

An ETA trench has improved performance and a stronger Long Term Acceptance Rate (LTAR) in comparison to conventional trenching.

ABSORBS NATURALLY AEROBIC BOTTOMLESS SAND FILTERS

The ABSORBS filter is an advanced natural treatment and dispersal system designed specifically for difficult sites with Category 1-3 soils. The installation of these requires site-specific engineering and design and pre-treatment through a septic tank and pump chamber are necessary upstream of the filter.

The ABSORBS filter has the smallest dispersal footprint of any system offered by Arris as it is able to achieve a higher treatment quality. Such sand filters, as reported in AS/NZS 1547:2000 (4.2 C5.1), are capable of treatment to 10mg/L of BOD5 and 10mg/L of SS, which compares to the performance of most proprietary Aerated Wastewater Treatment System of 20mg/L of BOD5 and 30mg/L of SS.

Another benefit is that turf can be planted over the filter, helping the system to blend into the landscape.

The ABSORBS aerobic, bottomless, sand filter discharge or control bed operates on a natural aeration dynamic from mass exchange of atmospheric oxygen into the soil/filter.

This means that the entire system is effectively passive once discharged through the pump. If no water is treated/produced, the system remains in stand-by mode and is ready for service at any time, without adverse performance impacts.

A small footprint, in combination with the capacity to handle variable flows and difficult soil types, makes the ABSORBS a versatile, highly effective treatment and dispersal option for sites such as holiday homes or winery and beverage cellar doors.

These systems also do not use any chemicals or require disinfection, as both the secondary treatment and the dispersal train are completely sub-surface.

A highly effective treatment and dispersal option for holiday homes and winery and beverage cellar doors.

FILTER MEDIA

Arris is able to provide and has extensive experience in the use of a wide range of filter media including sand, zeolite, granulated activated carbon, calcite, garnet, green sand, scoria and resins.

Media filters can be used to reduce solids, microorganisms, heavy metals, sodium, nutrients, BOD/COD, colour, hydrocarbons, endocrine disruptors, personal care products, pharmaceuticals, and to adjust pH. They are often used as part of a larger treatment chain.

The Arris team has comprehensively researched filter media types to determine the best blends for specific water treatment applications. By using multiple filters in sequence, Arris can provide a multi-barrier approach to the elimination of contaminants of concern.

We also have experience with different types of filter housings and working at a variety of pressures and levels of automation.

Arris have designed and installed media filters across potable, stormwater and wastewater applications, including for domestic, commercial, industrial, mining, oil and gas applications.

Our media filtration projects range from 1,000 litres per day to 6 million litres per day.

SLUDGE MANAGEMENT

Transporting wet sludge off-site is expensive and inefficient. Through de-watering techniques like geotubes or concrete lined large scale composting bins, liquid can be drained and the volume of sludge greatly reduced. This liquid can then be shandied back into the wastewater treatment plant and the dried sludge can be more easily and cheaply managed.

Arris is able to provide a number of sludge management techniques to clients, including de-watering and composting. These minimise odour and their passive nature means they are energy efficient.

We can also supply traditional technologies, such as belt presses.

Our approach to sludge management has enabled some of our clients to obtain a zero discharge of solids off-site, greatly reducing their operational costs.

ODOUR CONTROL

Wastewater treatment plants that operate directly adjacent to gatherings of people, such as music festivals, often are required to achieve strict odour controls. Arris has a track record of designing, building, operating and maintaining such plants in line with regulatory odour requirements, such as for the annual Woodford Folk Festival in Moreton Bay, Queensland.

Our extensive experience in the control of odours in wastewater treatment enables us to supply effective solutions to clients, including ozone and oxygen generators and passive filter media, such as granulated activated carbon.

Arris is able to also supply and install vents with filter cartridges to remove odours from tanks and storage vessels.

Our ozone and oxygen units have adjustable dosage levels, or be made re-circulatory, so batches of wastewater with stronger odours can receive additional treatment.

Other advanced aeration techniques, involving oxygen and ozone and incorporating micro-bubbles, are quick and highly effective at controlling offensive odours.

These techniques not only control odours, but also reduce BOD's and colours.

WASTE STABILISATION PONDS

Arris has extensive experience and history in the design, build, operation and maintenance of waste stabilisation ponds. We have the construction equipment and capability to construct both unlined or lined ponds.

A variety of aeration technologies for waste stabilisation ponds are also able to be provided by Arris, ranging from floating aerators to bottom diffusers. We can also supply blowers, compressors and oxygen generators.

Oxygen generators provide a quicker reduction in oxidisable contaminants of concern, such as solids and odours, than other techniques and Arris specialises in innovative aeration techniques which are energy efficient, have an increased surface area and can target specific depths in waste stabilisation ponds.

We can automate the aeration sequences and connect equipment to telemetry systems for remote operation and monitoring.

Balance storage in waste stabilisation ponds can enable wet weather storage and buffering capacity for sites with fluctuations in wastewater production volumes.

By incorporating aeration and passive treatment processes, waste stabilisation ponds are a highly cost effective effluent management technique.

OZONE TREATMENT TECHNOLOGY

Ozone is a natural product, created by electrically charging oxygen molecules. It is one of the strongest sterilants known.

New technological advances have transformed ozone water treatment into an increasingly common best practice solution. Ozone has a high oxidation potential, making it more effective than chlorine and UV light. It will eliminate and destroy bacteria, giardia, crypto, e coli, cysts, viruses, mould, algae, fungi, colour, odour, and protozoa.

Arris is the exclusive Australian agent for Primozone ozone water treatment systems (www.primozone.com). From water quality data or a sample, Arris can ascertain treatment effectiveness using our in-house testing capability.

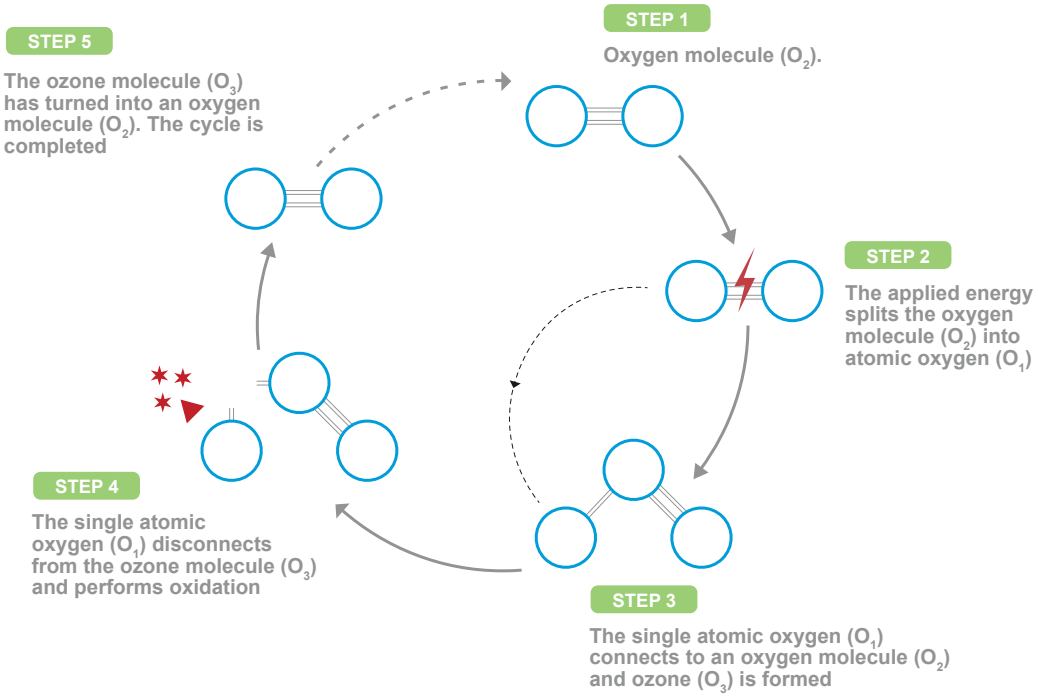
Ozone treatment provides the benefits of eliminating storage or delivery of consumables to site, improved functionality, reduced trade waste disposal costs, increased recycling opportunities, simplified maintenance and increased longevity of capital investment.

The key features of new ozone systems include:

- Ease of installation and ongoing operation;
- Precise delivery output;
- Reduced physical footprint;
- Low power consumption.

We are able to provide systems that can be easily retrofitted into existing infrastructure, providing enhanced performance and a safe operating environment.

The world's major beverage manufacturers use ozone to treat the bottled water you buy every day.



The oxygen - ozone - oxygen cycle. Ozone is made up by oxygen and will revert back into oxygen upon reaction.

Arris can design and supply ozone systems for any size application

By working in partnership with world leading ozone technology providers, Arris can connect clients with access to the latest global technological advances. Examples of the different scale of solutions available through Arris follow.

SMALL - up to 10,000L/day

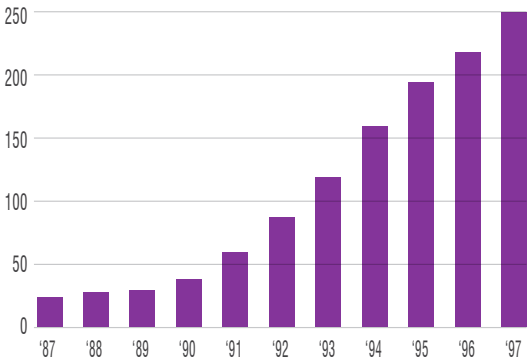
Potable water for your home or business – treating tank, bore, dam, lake or river water. These systems are ideally suited for campgrounds, restaurants, laundries, warehouses and small factories.

MEDIUM - up to 100,000L/day

These systems have application in hotels/motels, hospitals, swimming pools, dairy, industrial/food processing plants, wineries, schools, aquariums, recreational facilities, mining camps and pump stations.

LARGE - upwards of 100,000L/day

Suitable for treating water in mining, oil and gas operations, potable treatment plants, wastewater treatment plants, office buildings, bottled water/beverage/ breweries, municipal infrastructure, golf courses, nurseries, ballast water, parks, apartment buildings and farms.



Growth of US drinking water plants using ozone technology.

Primozone units installed in series at Yorke WWTP.

CLEARFLOW GROUP PRODUCTS

The Clearflow Group was founded in 2005 to respond to the drive towards more sustainable environmental stewardship and stricter regulatory controls. Their team of dedicated and experienced professionals focus on innovation to come up with one-of-a-kind answers to your environmental needs.

Through a strategic partnership with Arris, Clearflow products are now available in Australia for use in:

- Mining water treatment;
- Stormwater treatment - phosphorous removal and metals reduction;
- Soil stabilisation and erosion control;
- Dust suppression;
- Pond dewatering and water polishing;
- Construction.

Clearflow's patented gel flocculant blocks, soils stabilisers, erosion control and dust suppression products are designed to be site-specific and environmentally friendly.

Mining and municipal stormwater solutions

Clearflow Group have spent decades assisting the mining industry and municipal stormwater sectors in meeting existing and future environmental regulations around the world. Mobile mine water treatment systems can begin generating high-quality water as

soon as four hours after arriving on site and can be deployed in a variety of difficult-to-reach and isolated locations.

Through the partnership with Clearflow, Arris is able to support the mining industry to:

- Rapidly treat excess water for reuse;
- Meet local discharge requirements;
- Allow for the proper release of water;
- Improve water recovery, including through minimal and zero liquid discharge (ZLD) standards;
- Treat tailings pit and pond waters*;
- Remove high level of solids and particulates via membrane filtration Protecting Reverse Osmosis (RO) membranes, with pre-treatment, and enable the operation to become less dependent on external water supplies;
- Prevent water channel erosion and control treatment.

Traditionally, effluent and wastewater from the mining industry have been treated using physicochemicals, which are harmful to nature and ecosystems.

Clearflow's zero discharge environmentally friendly gel flocculant products are an excellent option for use in mining, protecting local ecosystem and allowing for water reuse in areas where access to water is limited.

Once installation costs are recovered, zero discharge is the most cost-effective long-term option.

**Please note: Tailings dam water treatment projects require additional insurances, which can be quoted on separately as required.*

Flocculants and coagulants

Industrial activity, such as surface mining, road building and aggregate washing, result in high concentrations of suspended particles (or Total Suspended Solids, TSS) in surface waters which must be removed prior to discharge into natural waterways.

The use of flocculants to improve the efficacy and speed of TSS sedimentation is a common practice, but even small amounts of residual cationic polymer coagulant/flocculant that remains in treated water is highly toxic to fish at low concentrations (LC50 ~ 0.3 mg L−1).

Clearflow gel flocculants are a revolutionary product which use patented 'ready-state' flocculants to dramatically reduce colloidal material, suspended solids, heavy metals and phosphorous from lakes, ponds and streams. This inexpensive amelioration technique prevents cationic polymer toxicity and is a significant advancement in surface and industrial water treatment to prevent fish kills.

A natural water clarification solution which safely cleanses water back to its original healthy composition.

These flocculants are a natural water clarification solution which safely cleanses water back to its original healthy composition. The technology gathers large volumes of sediment which contain metals, chemicals and pollutants which would otherwise impact aquatic life, whilst also accelerating sediment settling.

The gel block uses flow energy, along with particle size, shape and density, to release or strip flocculant.

These blocks come in a ready state form and can be

used straight 'out of the box'. You only need to simply install the gel block flocculant in-situ and, after a brief hydration period, it becomes fully active.

The proprietary chemistry involved with this gel flocculant is unique and is not an independent coagulant nor an independent flocculant. Gel flocculants are also not a liquid or a granular product, like most other coagulant and flocculant products on the market.

Clearflow gel flocculants are a semi-aqueous gel that resembles tightly bound jelly. These are a combination of formulas that the Clearflow Group has invented and patented, combining flocculation and coagulation, thickening and binding all into one form.

A specific gel flocculant formulation has also been created to reduce and neutralise cationic toxicity.

The advantages of the Clearflow gel flocculants compared to other common polymer flocculants and coagulants on the market are:

- A wide functional range in pH from 3 to 12, with no pH spiking required;
- Self-dosing and self-limiting, hence no dosing pumps are required;
- Passive dosing and release based on load factor;
- Zero added energy required to treat water, with only the water flow required;

- A wide functional range in salt laden locations, meaning they work in both fresh and or sea water;
- A wide functional temperature range;
- High removal efficiency for metals, TSS, phosphorus;
- Capacity for each block to typically treat 15,000m3 to 40,000m3 of water in open channel applications.

This means Clearflow gel flocculants:

- Rapidly treat water for reuse - as the blocks begin working in just minutes;
- Simplify the water treatment process – eliminating the need for costly, complex systems, also assisting to enhance downstream filtration or settling;
- Provides safe, scientifically-proven results – a single block treats up to 20,000m3 (5.3 million US gallons) at 190L/min (50 US GPM) of flow, eliminating up to 99% of particular matter.

Clearflow gel flocculant products come in a range of forms.

Gel Floc 300 – the 300 series are negatively charged and cause particles to form large floccules which are more easily separated out from the water.

Gel Floc 400 – the 400 series are used to pretreat suspended solids, making them easier to bind with the 300 series blocks. These are also effective in removing some metals and nutrients from water.

Gel Floc 600 – the 600 series are positively charged and are used to flocculate solids which are organic in origin.

Gel Floc Neutraliser – the Neutraliser is a negatively charged product which releases faster than the standard 300 series. It is used to neutralise the positive charge of 600 series gel flocculants or other cationic flocculants and coagulants.

Erosion control & soil stabilisation solutions

Erosion control and soil stabilisation solutions can also be used to facilitate the water clarifying process and Clearflow has a range of products for easy use in such applications, as follows.

Soil Lynx – a granular powder which adheres to soil and protects it from being washed away. The powder also helps retain up to 25% more water within the soil, enhancing germination and revegetation of the land.

Bio-degradable Treated Silt Collection Mats – this fully biodegradable material captures over 37kg's of sediment per mat and can be seeded and left on-site to create an environmental enhancement, avoiding the need for disposal costs.

Questions?

To find answers to questions like, "What can Clearflow gel flocculant products remove from water?", "Could application of this product harm plants or animals in the environment?" and "What happens to the particles bound by Clearflow products?", please go to the following web address - https://www.clearflowgroup.com/faq.

Reports and documentation

For more detailed information and for safety data sheets, please go to the following address - https://www.clearflowgroup.com/sds-toxicity-lc50-reports.

CONSTRUCTED WETLANDS

Constructed wetlands are an internationally recognised nature-based treatment approach for stormwater and wastewater. This treatment method reduces nutrients, heavy metals, suspended solids, potential pathogens, chemicals, antibiotics and personal care products. Constructed wetlands also use water via evapotranspiration, which can reduce the volume of treated water that needs management.

In wastewater, wetlands are often used as a polishing treatment step after primary and secondary treatment stages, commonly in conjunction with waste stabilisation ponds. In stormwater, constructed wetlands are used to detain runoff and reduce contaminants of concerns, such as suspended solids and heavy metals. They may also be used to treat runoff from impervious surfaces on commercial or industrial sites.

Arris has extensive experience in the design, construction and maintenance of wetland treatment systems in both surface and sub-surface forms.

Modelling programs such as MUSIC and eWater Source are used for the design and sizing of wetlands.

Constructed wetlands are highly energy efficient and have a low maintenance requirement, but do also require a larger footprint area.

A Constructed Wetlands treatment method reduces nutrients, heavy metals, suspended solids, potential pathogens, chemicals, antibiotics and personal care products.

Constructed wetland systems are therefore best suited to clusters of houses and in commercial and industrial applications.

The water treated through constructed wetlands is commonly reused for the irrigation of green space and agricultural crops.

STORMWATER TREATMENT: WATER SENSITIVE URBAN DESIGN

Arris is able to provide a variety of water sensitive urban design (WSUD) techniques for the management of stormwater. These include vegetated swales, rock walls, slope revegetation, bund walls, rock swales, porous pavements, sedimentation basins, sand filters, mixed media filters and constructed wetlands.

We can also incorporate traditional stormwater technologies such as pipes and culverts into WSUD projects.

MUSIC and eWater Source are used as design programs for our stormwater management solutions.

Our stormwater management solutions have been applied in locations ranging from a single lot to sites of over 100 hectares. Our team has experience with stormwater projects across Australia, involving areas of high to low rainfall.

We have worked at commercial and industrial sites where all stormwater from the impervious area needs to be captured and treated. This experience gives Arris the capability to treat stormwater to the appropriate level required by regulators.

We can also design and construct treated stormwater recycling schemes, providing local water re-use opportunities.

RECYCLED WATER IRRIGATION AREAS

In-house experts in soil, water and agricultural production enable Arris to design recycled water irrigation systems for a wide variety of soils types, water qualities and plant species.

We have extensive experience with recycled water irrigation schemes, involving projects from a couple of thousand litres per day to millions of litres per day.

Modelling programs such as MEDLI and HYDRUS are used, in conjunction with soil tests and climate data to design sustainable recycled water irrigation solutions for our clients. We can also construct, operate and maintain such systems as required.

Our experience with collecting and compiling regulatory compliance data for recycled water systems, including groundwater monitoring stations and plant tissue testing, means we can assist our clients to have an irrigation system up and running as quickly as possible.

Arris have experience in working with all classes of recycled water and with many different soil types. We are skilled with diverse types of above ground and sub-surface irrigation and our expert staff have worked with plants such as lawn grass, horticultural crops, endemic native plants and tree plantations to deliver successful projects Australia-wide.

OXYGATION IRRIGATION

Through the use of venturi valves, oxygen generators and ozone units it is possible to substantially increase oxygen levels in irrigation water. These technologies can be used singly or in combination. They are most effective when sub-surface irrigation is used.

Arris has significant expertise in this form of irrigation.

The oxygation techniques can be used in normal water or recycled water irrigation projects. The increased oxygen in the irrigation water is beneficial to soil and plant health. It keeps the rhizosphere, which is the soil immediately surrounding the plant roots, aerated. This has several benefits for the plants, such as increased sugar content in fruit, improved yields, enhanced water efficiency, greater resistance to salinity and increased resistance to diseases.

Increased oxygen in the irrigation water is beneficial to soil and plant health.

The Central Queensland University has independently researched the benefits of oxygation and published the results in peer reviewed scientific journals.

Oxygation techniques are very cost effective and efficient to operate. The benefits of oxygation provide a significant value-add to an investment in sub-surface irrigation.

Oxygation technologies can be retro-fitted into existing irrigation projects.

COMPLIANCE TESTING OF ON-SITE DOMESTIC WASTEWATER SECONDARY TREATMENT SYSTEMS

A state of the art compliance testing facility established by Arris at SA Water's Handorf Wastewater Treatment Plant in South Australia provides Arris with the ability to undertake AS 1546.3:2017 compliance testing of on-site domestic wastewater treatment Secondary Treatment Systems (STSs), with hydraulic treatment capacities of between 1,200 and 5,000L/day.

Australian Standard AS 1546.3:2017 requires a 42 week long combined commissioning and testing period (or a minimum testing period of 34 weeks) conducted under specified conditions in order to demonstrate the performance and reliability of STSs under both a normal 'steady-state' scenario and under 'stress testing' conditions.

The STS testing facility has been operational since March 2019 and has the advantage of being able to provide continuous 24/7 access to raw sewage flow from the Handorf Wastewater Treatment Plant to enable uninterrupted compliance testing.

Being located in climate zone 6, the facility offers the capacity for full cold climate winter testing to verify low temperature performance in compliance with AS 1546.3:2017.

A 40m long concrete bunker with a nominal depth of 2.1m allows STS systems to be installed and backfilled with sand to simulate fully in-ground and in situ operating conditions during testing. Up to 10 domestic treatment units can be tested concurrently at the facility.

The STS units are supplied with macerated raw sewage from a 5,000L balance tank which receives unscreened sewage from the Hahndorf sewer main at the head of the wastewater treatment plant. Sewage dosing and influent and effluent sampling are fully automated and SCADA controlled.

Automated refrigerated autosamplers are housed in the control sheds adjacent to the STS bunker, allowing for programmable and automated grab and composite sampling from influent and effluent lines as required under AS 1546.3:2017.

All samples are analysed by a local NATA-accredited laboratory service provider (Envirolab Services).

A suite of parameter data is monitored and logged by the control shed instrumentation, including:

- STS sewage dosing;
- Volumes and flow rates;
- Feed pipeline pressure;
- Water and ambient air temperature;
- Electricity consumption;
- System alarms.

The facility is also covered by full-span CCTV cameras 24 hours a day, with data recorded and stored in the on-site control centre.

TREATMENT PLANT TROUBLE-SHOOTING AND REFURBISHMENT

Older water and wastewater treatment plants often experience a range of issues over time and, as a result, can struggle to meet regulated water treatment guidelines. In such cases, facility owners and operators are often advised to construct a completely new system.

This is not always necessary and many older systems can often benefit from some trouble-shooting and refurbishment.

Arris has significant experience in providing trouble-shooting and refurbishment advice across a range of systems and to a broad client base. The Arris team can provide you with access to an extensive range of expertise and many years of experience in installing, operating and maintaining a range of technologies and treatment infrastructure to review your needs and recommend pathways for refurbishment.

We have in-house civil, process, electrical and environmental engineers, biologists, chemists, physicists, plumbers, electricians, fitters and turners, boilermakers, machinery operators, drafts-people, economists and communication specialists. The Arris team is highly qualified, including professionals with PhD's and some with over 40 years of in the field experience.

This unique combination of academic and practical knowledge enables us to economically upgrade older infrastructure so that it can meet the required water quality outcomes from treatment. This can involve repairing and replacing broken components or infrastructure, even when the original manufacturer is no longer in business.

Many older systems can often benefit from some trouble-shooting and refurbishment.

It can also include installing new technologies into the existing treatment chain.

Arris has found that targeted refurbishment and/or small upgrades to existing treatment facilities is often the most cost-effective solution for our clients.

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