

# Agriculture



natural waste water treatment

# ARM Group Ltd

## natural wastewater treatment



Whether you're thinking about a new reed bed system, or you just want some timely expert advice about effective operation, we can help.



### Harnessing natural technology

**E**ver since natural waste water treatment systems came of age in the 1980s, ARM Ltd has led the way in reed bed and constructed wetland technology.

Working with the UK water companies, councils, contractors, industrial clients and research institutes, we have designed, built and maintained many hundreds of reed bed systems. These range in size from 10m<sup>2</sup> up to 20,000m<sup>2</sup>, and we have consulted on reed beds of many hundreds of hectares.

Harnessing natural processes, we engineer them to deliver all the advantages of cost-effective, versatile and sustainable wastewater treatment – and we guarantee the performance of every system we design and install.

As the largest dedicated UK company by far in this specialised field, with a reputation dating back to 1947, ARM brings you unique expertise and experience. We can support you at every stage of the process – from initial planning and design through construction and commissioning to ongoing maintenance – ensuring the optimum performance of your reed bed system.

We continue to pioneer new and innovative ideas. Recent developments include an aggregate recycling system to reduce landfill costs and material usage, and a plough to retrofit FBA™ airlines into existing reed beds.

### Why use reed beds?

**T**he Chinese used wetlands more than two thousand years ago for their impressive effluent and water treatment capabilities.

Reed beds provide an ideal environment for a wide range of treatment processes. The combination of micro-organisms, plant roots, rhizomes and substrate matrix remove contaminants in a variety of natural ways.

They treat waste water as it flows through the system just like the process in conventional sewage treatment, but without using energy-intensive machinery.

With low maintenance requirements,

low or zero power consumption and a long, productive lifespan, reed bed systems are both proven and sustainable, enhancing any landscape. Their removal mechanisms include settlement, filtration, biological and chemical action, containment and plant uptake. They can reduce levels of soluble organic matter, suspended solids, ammonia, pathogens, hydrocarbons, and metals.

The various types of reed bed can be used in different configurations to treat a variety of pollutants from industrial or municipal sources.

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## Performance guaranteed

**O**ur reed beds are used at all stages of the sewage treatment process providing primary, secondary and tertiary treatment as well as sludge dewatering.

They can also extend the life of older treatment works by providing a tertiary polish to effluent, bringing it within regulator consent, and saving capital expenditure.

They are increasingly used for tackling industrial effluent. Uses range from treating fire-fighting foam and metal removal from minewater drainage, to reducing ammonia levels in leachate and removing hydrocarbons from groundwater.

Other applications include treatments connected with:

- agriculture
- pharmaceutical
- food processing
- chemicals
- refinery waste
- distillery wastewater
- airport run off
- Sustainable Urban Drainage Systems (SUDS)

They can also be used to create wetland habitats – enhancing bio-diversity.

*Whatever the application, we provide contractual guarantees of effectiveness, performance and quality – so you can be sure you're going to get the results you're looking for.*



## Our comprehensive range of services includes:

**Consultancy:** feasibility studies, process design, site surveys, landscape design, and advice on managing future changes

**Project management:** our experienced managers will look after your entire project from conception through to completion.

**Design and build:** our turnkey service delivers systems on time and within budget, including liaising with regulators and enforcement authorities on your behalf.

**Design and supply of materials and equipment:** a service we provide on request, for example to framework contractors.

**Construction service:** using our design or your own, we make it easy for contractors and save our clients significant amounts of money through design reviews based on experience – without compromising quality or performance.

**Field services for system maintenance:** we extend the life of your system, bring you peace of mind and help you get the best possible results.

**Asset assessment:** we evaluate process efficiency, check your system is operating at top performance, and make recommendations.

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# ARM Group Ltd

## About Us



ARM Group Ltd, a Staffordshire based privately owned company, is the leading designer and constructor of natural waste water treatment systems and associated technologies for the industrial and municipal waste water treatment market in the UK. The Company is noted for its invention and subsequent commercial development of equipment and processes within its chosen markets.

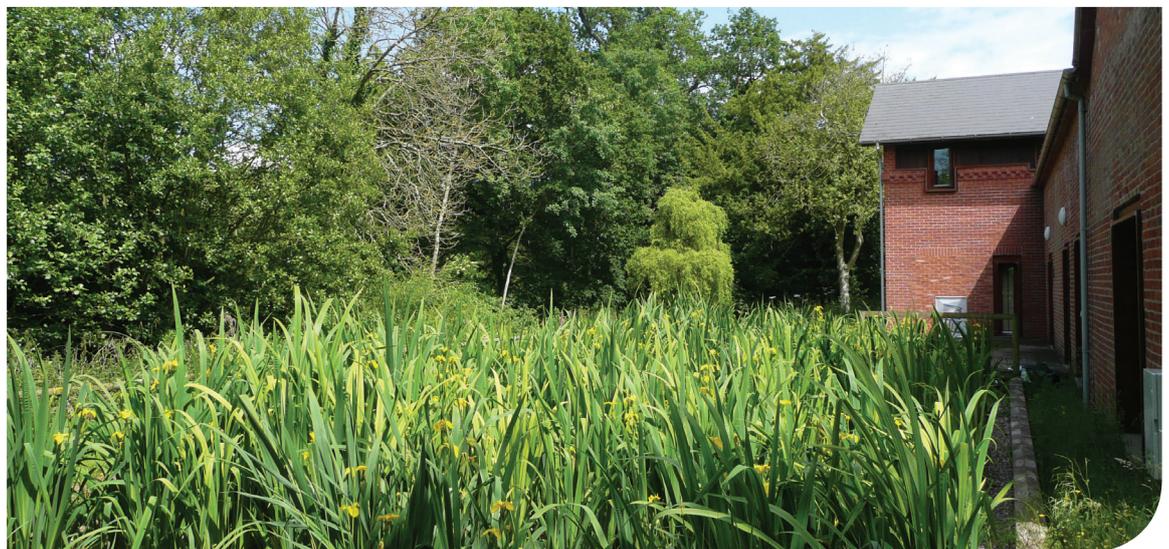
ARM Group Ltd has been trading since 1947 and was originally involved in development, design, manufacture, and construction within Agricultural Engineering. However, in the late 1980s ARM Group Ltd redefined its objectives and moved its customer and product bases into the global market of wastewater treatment specialising in the use of reed bed/wetland systems.

Today the Company operates out of offices in Rugeley, Staffordshire employing 21 people and using Associates and sub-contractors as required.



ARM Group Ltd is broadly divided into seven operating functions these can provide client support either individually, as a team, incorporating the requisite elements, or as a whole providing continuity of support for turnkey solutions from project conception through design construction, commissioning and maintenance, depending on the specific needs of the client. The functions are:

- Sales
- Design
- Project management
- Construction
- Research and Development
- Refurbishment and Maintenance
- Administration





## Experience

For the past 30 years ARM Group Ltd have specialised in reed bed and wetland systems having designed and installed over 700 beds during this period. This provides us with unique and extensive experience of their application, design and construction across the wastewater treatment spectrum. Our experience and knowledge has been accumulated through:

- Design and construction of reed bed systems
- Value engineering optimisation
- Application experience
- Working with academic institutions.
- The international constructed wetlands conference circuit
- Presenting papers
- Personal contact with leading researchers
- Working relationships with leading specialist in specific reed bed applications
- Founder member of the Constructed Wetland Association (CWA)
- Founder member of Global Wetland Technology (GWT)
- Over 1000 reed bed surveys

We have designed and constructed reed beds that provide treatment for:

- Mine water
- BOD and COD reduction
- Methanol removal
- Copper removal
- Pathogens
- Landfill leachate
- Hydrocarbons
- Septic tank waste
- Ammonia
- Surface water run off
- Solids
- Sludge dewatering
- Storm water
- Metals
- Glycol



# R B Organic, Yaxley

## Horizontal subsurface flow: Vegetable wash water



### Project

RB Organic, Cambridgeshire

### Location

Yaxley, Peterborough

### Project type

Design and construct

### Wastewater type

Vegetable wash water

### Completion date

September 2007

### Treatment

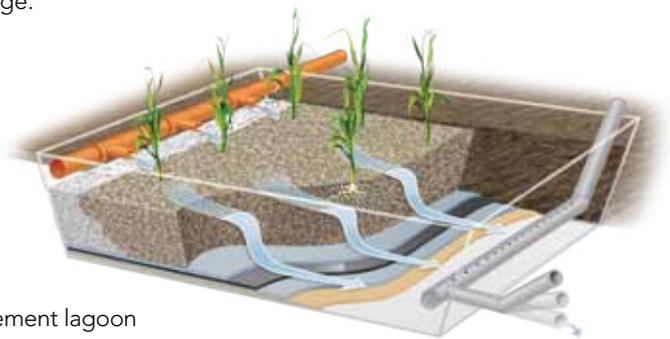
Surface and subsurface  
horizontal flow wetland

### Need

RB Organic process and supply over 30,000 tonnes of organic vegetables every year. As part of the process soil is washed from the vegetables and the resulting dirty water requires treatment prior to discharge. Historically, the water was treated with chemicals and passed, by batch process, through clarifiers where solids were settled out. Being faithful to the philosophy and ideals of organic farming, RB Organic were keen to eliminate the use of chemicals and reduce the level of labour associated with desludging and chemical dosing operations. The site produces 170m<sup>3</sup> of wash water per day which has to meet a standard of less than 30mg/l Suspended Solids and 50 mg/l BOD prior to discharge.

### Solution

ARM designed and constructed a 3 stage wetland treatment system to achieve the required removal of solids and BOD from the vegetable wash water. A settlement lagoon drops out the solids and is followed in series by two 800m<sup>2</sup> wetland systems which provide further settlement of suspended solids and reduction of BOD. The first is a surface flow system with a soil substrate planted with *Typha latifolia* and the second a subsurface flow horizontal reed bed with a gravel substrate planted with *Phragmites australis*.



### Benefits

This system provides RB Organic with a wash water treatment system that operates continuously, eliminating the need for costly ongoing chemical use and reducing operational and maintenance labour requirements whilst securing discharges within consent.





# Forced Bed Aeration (FBA)

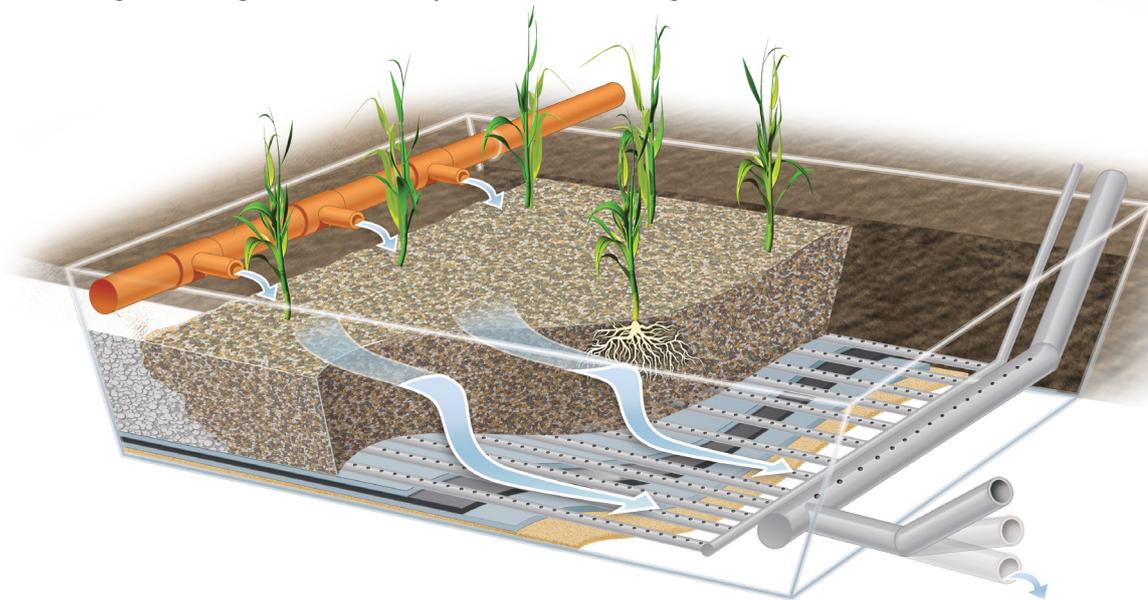
Forced Bed Aeration™ compliments and enhances existing reed bed technology, increasing treatment capacity by up to 15 times.



**F**orced Bed Aeration™ (FBA™) is a new wastewater treatment technology which enhances constructed wetland treatment performance. Significantly higher contaminant removal rates are attained along with an increased consistency of performance. Developed in the USA, by our partners Naturally Wallace, FBA™ can be used in both horizontal and vertical flow constructed wetland systems. Blowing air through the wetland system

makes the system oxygen unlimited increasing the treatment capacity by up to 15 times. This new technology can treat wastewaters high in BOD, SS, NH<sub>4</sub>-N and other organic contaminants.

Forced Bed Aeration™ reed beds can reach performance levels which have been unobtainable in standard reed bed systems with less performance variability. Aeration of horizontal and vertical flow reed beds has multiple advantages.



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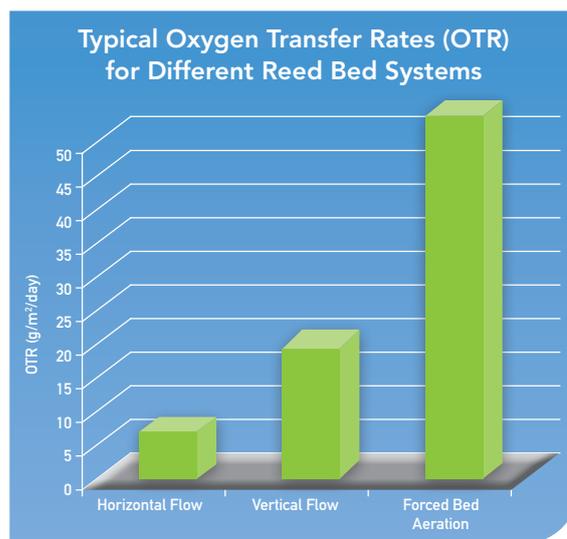


- FBA™ can completely nitrify wastewater
- FBA™ systems can be deeper than conventional reed beds therefore taking up 50% less space than passive systems.
- Plants thrive in FBA™ systems because the introduced oxygen prevents the formation of toxic products that can stunt plant growth in strongly anaerobic, passive system
- FBA™ reed beds can be divided into aerobic and anoxic zones to both nitrify and denitrify.
- FBA™ reed beds are ideal for treating fluctuating loads such as CSO's and locations with variable occupancy.
- Initial studies indicate FBA™ systems have reduced clogging rates extending the operational life of a treatment system.

technology prevents root rhizomes penetrating the emission points.

### Adapting FBA™

FBA™ can be retrofitted to existing reed bed systems, especially those which are overloaded. This prolongs the life of the reed bed and enhance effluent treatment.

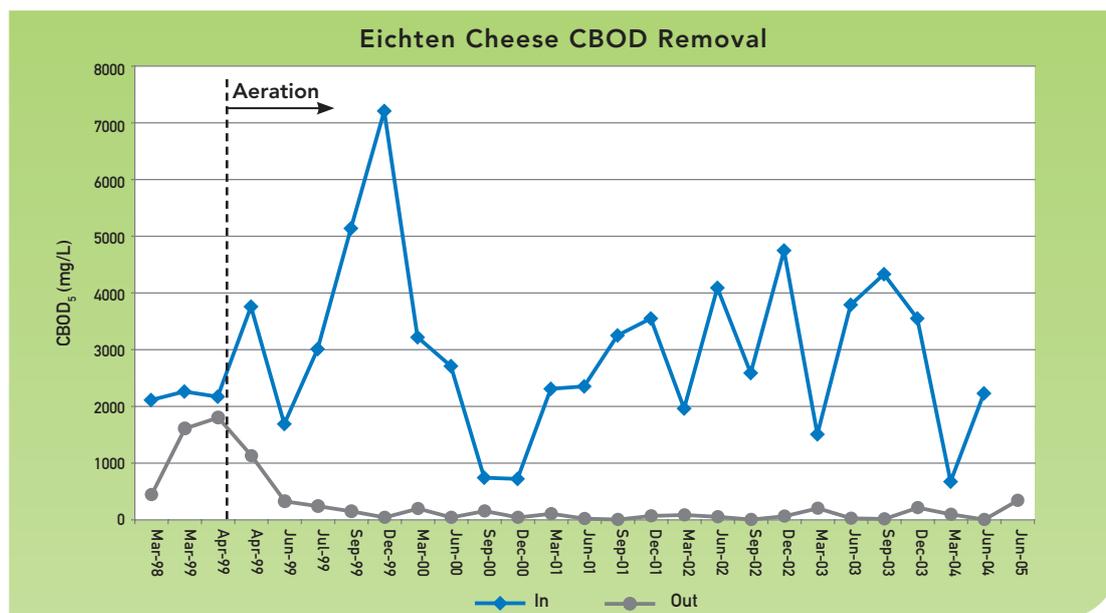


### Pipelines

FBA™ has a unique network of pipelines which provides a constant flow of oxygen into the reed bed. Patented rootguard

### FBA™:

- Improves treatment capability.
- Reduces clogging rates.
- Requires minimum power input.



Graph indicating the treatment performance of an FBA™ wetland system treating cheese production effluent

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# TAYA Technology



TAYA is a unique wastewater treatment system that combines the benefits and simplicity of natural wetland technology with the intensive high load treatment capabilities of mechanical systems.



The result is an operationally efficient, and cost effective intensive wetland solution for treating high strength effluents which provides the following treatment benefits:

- Small footprint
- Low maintenance requirement
- Low labour costs
- Minimal power requirement
- High strength effluent treatment capability
- High Hydraulic load capability

## The Science

Developed from reciprocating wetland technology TAYA has been optimally engineered to maximise the efficiency

of the microbial biomass through nutrient management and **effective natural aeration**. TAYA's proprietary pumping design, maximises the use of gravity during operation, to minimize power consumption, maintenance and operational costs.

## Harmonising Technologies

TAYA is a hybrid technology, integrating aspects of process and biochemistry found in intensive systems, while maintaining the low maintenance and operational costs associated with wetlands. TAYA technology replaces active electro-mechanical wastewater treatment systems, by attaining the **same effluent quality at a significantly lower lifetime cost**.



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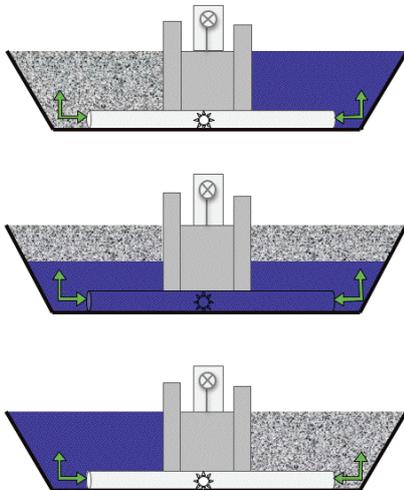


Combining anaerobic pre-treatment with an intensive, yet cost efficient TAYA wetland, provides a reliable solution for clients looking for a proven technology with compelling economics.

### Operation

The TAYA model allows for operational adjustments to optimise performance based on determined pollutant loads, calculated oxygen transfer requirements, retention times and sludge yield. The design of the wetland incorporates the filling and draining of subsurface flow basins. The volume and rate of effluent transfer between the basins can be adjusted to optimise performance. The fluids are pumped from one side to the other using a proprietary pumping arrangement, maintaining the

lowest energy consumption possible. Natural, effective aeration of the biomass permits high oxygen transfer rates, providing the capacity to treat high organic and ammonia loads to tertiary treatment levels.



TAYA reciprocating operation

### Applications

TAYA wetlands have been successfully implemented in a number of municipal and industrial wastewater systems including piggeries, dairies, poultry farms, abattoirs, pickling factories and domestic wastewater. They have proven effective in treating wastewater with high loads of organic matter and ammonia.



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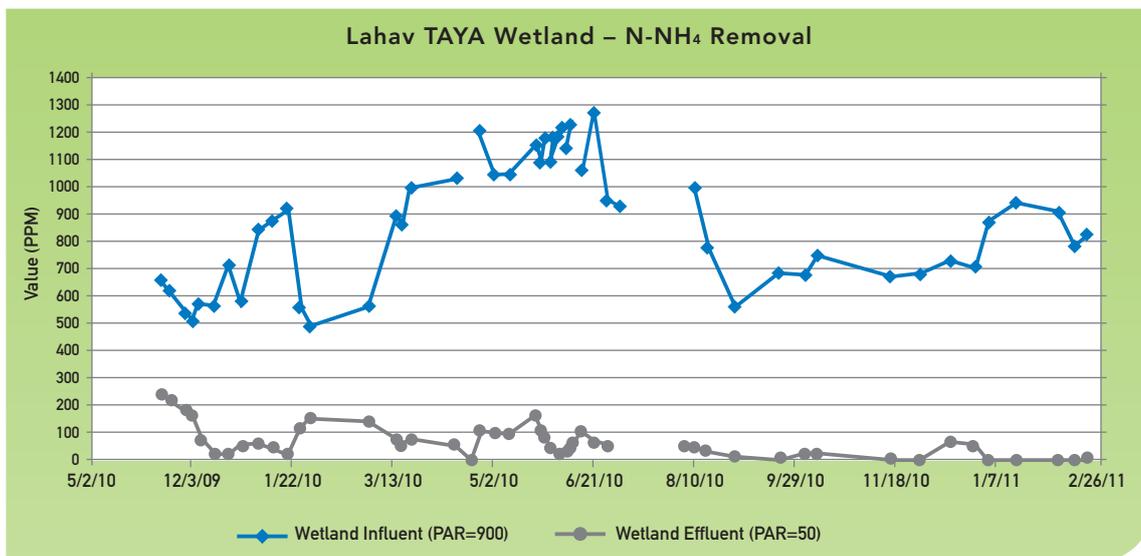
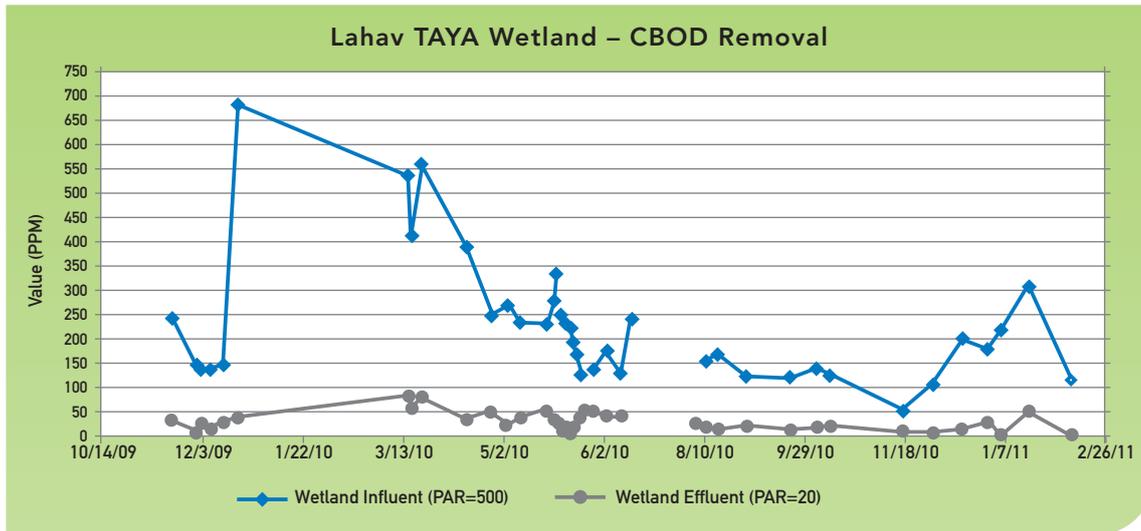


## Performance

In 2007 a TAYA system was installed as a retrofit for an existing water treatment plant at Kibbutz Lahav after the original system failed to comply with existing discharge requirements. The completed system was commissioned in 2009 and treats 300m<sup>3</sup>/day of a complex effluent combining waste water from a piggery, abattoir, and the kibbutz itself. This system has been operating successfully for two years treating to secondary treatment levels and maintaining consent. There are now plans to extend the system to treat a further 300m<sup>3</sup>/day.

Below is the graphed operational

data collected over two years from 2009 to 2011. The upstream heavy loads (20,000 mg/l COD; 15,000 mg/l TSS; 12,000 mg/l BOD; 900 mg/l ammonia) are reduced by the anaerobic pond and delivered to the TAYA system as illustrated below.



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# Lahav Piggery, Israel

## TAYA wetland: Piggery effluent



### Project

Lahav Kibbutz

### Location

Lahav, Israel

### Project type

Refit, design and construction

### Wastewater type

Piggery effluent, meat processing, domestic

### Completion date

Completed 2009

### Treatment

TAYA technology water treatment system

## Overview

In 2007, Triple-T was engaged to design and construct the retrofit of an existing WWTP at Kibbutz Lahav, after the original system built in 2005 failed to comply with existing discharge requirements. Triple-T designed a solution to treat a complex wastewater stream from the piggery, abattoir, meat processing facility and the Kibbutz. This effluent contained high loads of organic matter and ammonia equivalent to a small city of 25,000 inhabitants.

After undertaking a two-year feasibility study, Triple-T constructed a full-scale solution using its patented TAYA technology to expand the facility's capacity and increase its treatment capability. This technology has been operating successfully for two years, at a cost of approximately 1.3 kWh/m<sup>3</sup>.

## The Problem

The effluent discharged from the Kibbutz Piggery needed to undergo secondary treatment including reducing ammonia levels through nitrification to allow the effluent to be used for irrigation purposes.

Parameter	Influent	Effluent discharge consents
BOD	12,000	20
COD	20,000	20
TSS	15,000	30
NH4	900	450
Flow	300 m <sup>3</sup> /d	—





### Solution

The designed upgrade maximized the use of the existing WWTP infrastructure, while reducing the overall land consumption by almost 50%. All three anaerobic basins were redesigned and the process was optimized to reduce retention time and increase treatment effectiveness. Two of the existing horizontal flow (HF) wetlands were converted into Triple-T's TAYA system for removing organic load and ammonia, while a third was used as polishing system. The two remaining HF wetlands and three VF wetlands were not needed in the process and were therefore decommissioned.



Original Design (2005)

- Three anaerobic basins
- Three vertical wetlands
- Four Horizontal flow wetlands



TAYA Design (2009)

- Three anaerobic basins
- Two basin TAYA system

### Performance

In the beginning of 2010, Triple-T began collecting data on the performance of the Lahav TAYA system. The analysis of this data indicated that the system was capable of treating both BOD & TSS to the standards required for field irrigation, while significantly exceeding the standards for nitrification (removal of ammonia).

Parameter	Influent to anaerobic basin (mg/l)	Influent to TAYA (mg/l)	Final Effluent (mg/l)
BOD	12,000	500	20
COD	20,000	500	20
TSS	15,000	250	30
NH4	900	900	40 – 100





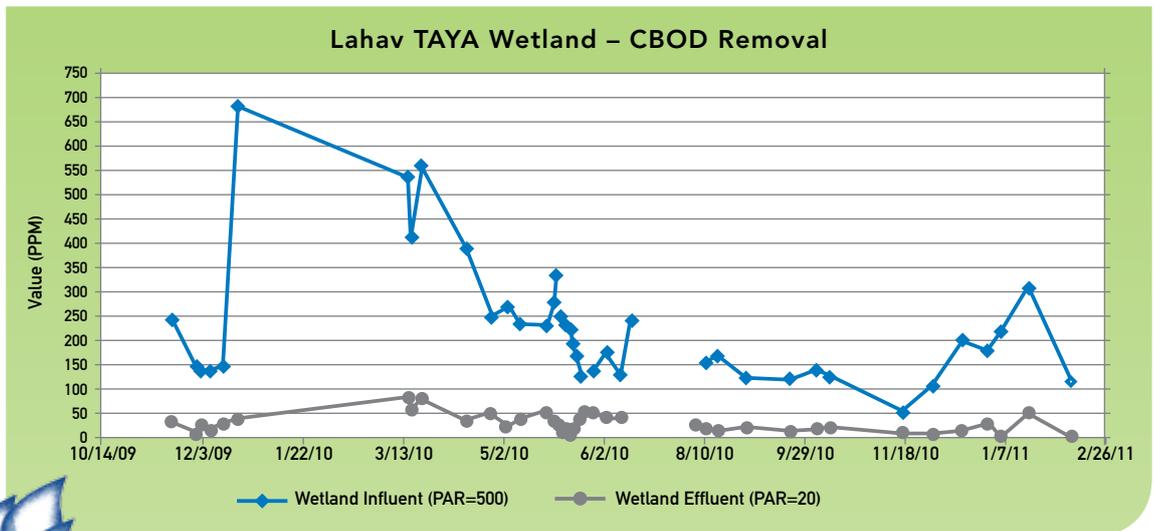
TAYA basin under construction at Lahav piggery.

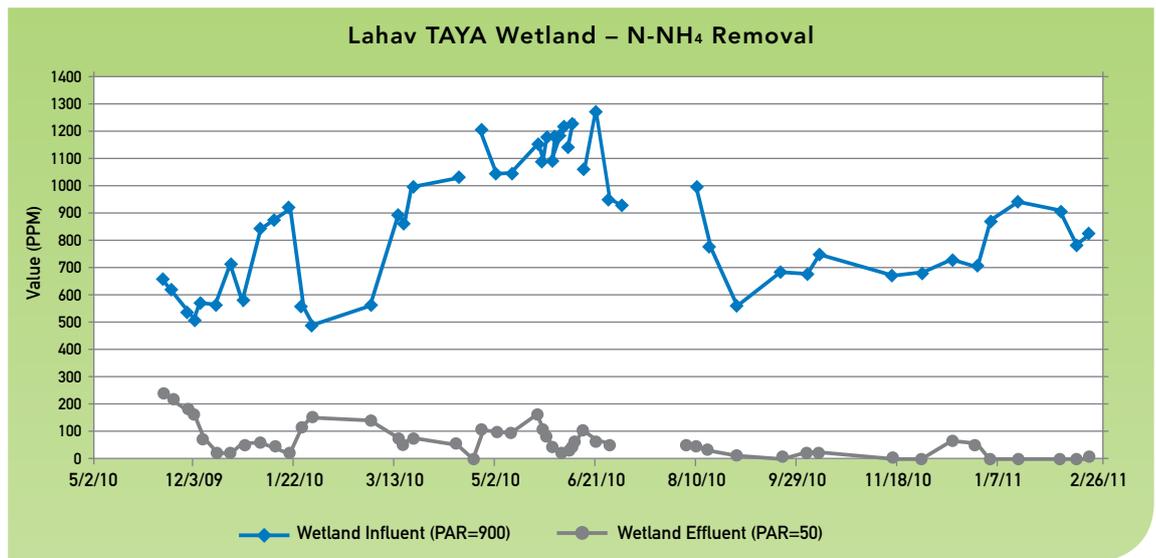
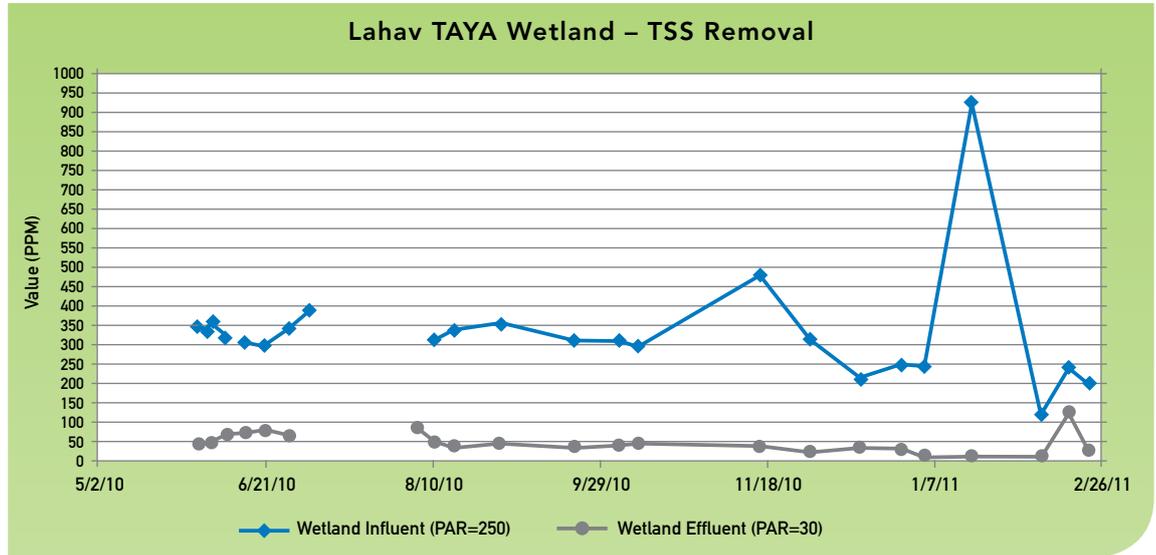


Central control valve operation at completion.

The optimisation of engineered elements within the TAYA system contribute significantly to its performance. These include transferring the effluent along the bottom of the system, the open transfer channel arrangement and the proprietary pumping technology.

Below are graphs of the TAYA operational data set indicating CBOD, total suspended solids and ammonia removal for the Lahav site between 2009 and 2011.





### Benefits

The TAYA system has provided the Lahav Kibbutz with a reliable means of treating their high load piggery effluent to the required discharge standard which was not being achieved by the previous treatment plant. The retrofit used the existing asset, minimising development costs and reduced the footprint of the treatment system by nearly 50%. This subsequently reduced maintenance costs.

### The future

Since 2009, the TAYA wetland at Lahav has continued to stand out as a model solution to treat high loads. Operations continue to run smoothly in 2011, and we are currently working on expanding the facility to treat an additional 300 m<sup>3</sup>/d, and to generate biogas for electricity.



## Asset Assessment & Support Package

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Knowledge and proactive management of assets is a key area where water companies can cut operational and capital expenditure. The optimisation and enhancement of remote reed bed treatment systems can secure performance for many years without the need for full site refurbishment and the associated costs.



In the September 2012 issue of *Water & Wastewater Treatment* it was reported by the editor that knowledge by the majority of water companies of the condition of their assets is poor. According to the report from the consultancy company E C Harris, some 90% of maintenance in the UK water industry is reactive. Yet it is well known that proactive maintenance will cut costs by upwards of 50%.

Although this is not the case with all water companies we thought it would be an ideal opportunity to offer a simple solution. ARM Ltd have been designing, constructing, refurbishing and retrofitting reed beds for many of the UK's water companies

for decades. It is for this reason we feel best placed to offer you our new Asset Assessment and Support Package (**AASP**).

Reed beds are generally tucked away in Sewage Treatment Works and because they provide treatment with minimal maintenance requirements often get overlooked until the works are close to breaching consent. Our Asset Assessment and Support Package will highlight the condition of the system and give an indication of when refurbishment may be required. This allows expenditure to be planned and therefore controlled and ensures the works performs to its full capability.



Our Asset Assessment and Support Package works in two ways:

## 1. Asset Assessment

### Visual Appraisal

- Condition of the reeds
- Extent of sludge build up on and in the gravel matrix
- Condition of the flow path
- Site layout and accessibility
- Photographic evidence

### Fitness for Purpose

- Review design basis, 'as built' drawings and O & M Manual
- Review current and future loads and recent performance data

### Monitoring program

- Sampling and monitoring program to include influent flows/loads and discharge levels to characterise performance

### Reporting

- Verbal and written report of the assessment complete with conclusions, recommendations and indicative prices of any required remedial work

## 2. Support Service

- Asset longevity prediction
- Sampling and monitoring to establish performance
- Refurbish to 'as built'
- Re-engineering to improve performance
- Maintenance
- System operation
- Retrofit with latest technologies to enhance capability

We would be happy discuss any aspects of this service with you and can be contacted at [info@armgrouppltd.co.uk](mailto:info@armgrouppltd.co.uk) or telephone on 01889 583811.