

# Smarter ways to manage water resources

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Innovative, sustainable solutions for integrated water resources management

# Safeguarding the world's water resources

Sustainable water governance is vital to counteract the impacts of population growth and climate change.

#### Growing water resource challenges

Our futures depend on the sustainable management of water. This increasingly precious resource is essential to life and the economic development of every nation in the world. Without it, there can be little progress to reduce poverty and social inequality.

The global population is expected to surpass 10bn in the second half of this century, which presents immense water resource challenges: growing enough food, protecting public health through universal sanitation and water supply coverage, and generating more renewable energy.

As populations grow, water resources are being impacted by the effects of climate change. These impacts are being felt worldwide and are set to intensify.

Rising temperatures and greater evapotranspiration means crops will need more water and soils will dry more rapidly. Rainfall patterns are likely to alter, with arid areas receiving less rain, and wet areas seeing more rain. Temporal weather patterns will also be altered, and increasing variability means droughts will be more frequent, elevating the risk of water shortages.



#### **Balancing supply and demand**

Good governance is critical to managing the world's groundwater and surface water resources sustainably and preventing over-abstraction. It is also more important than ever that demand projections account for likely future consumption.

With our guidance and technical expertise, public authorities, utilities and service providers are better able to estimate the effects of climate change on resources, identify potential deficits, manage demand, optimise current systems and assets, improve water quality, and target investment in existing infrastructure and new water sources.

#### **Creating integrated solutions**

We deliver projects across the three core areas of integrated water resources management: safeguarding water supplies, managing risk to water assets, and balancing the needs of the environment.

Our teams can help you make critical decisions about who has access to water by providing accurate, timely data to calculate the amount of water resources available and forecast demand. We develop efficient, comprehensive solutions to allocate resources in the most effective way – avoiding any adverse environmental effects.

We are at the forefront in these and other fields, working collaboratively with our clients to develop bespoke, integrated water resources management solutions to distribute water safely, sustainably and equitably. It is how we are improving water security around the world.

## Our specialist teams will help you to:

- Establish how much water is available
- Manage water resources sustainably
- Prepare your supply system for future demands
- Understand and mitigate against climate change impacts
- Improve the water quality of your sources
- Increase your drought and flood resilience
- Optimise your current infrastructure
- Protect investments and increase yield
- Preserve habitats and water-dependent ecosystems

# Managing risk to your investments

Meeting the challenge of climate change impacts on hydropower and water supply assets.



#### Accurate analysis

Climate change presents an unprecedented and growing threat to the sustainability of surface water and groundwater resources.

Not evaluating and compensating for the varying impacts of temperature rise and increasingly intense rainfall will lead to inaccurate estimation of the feasibility and future performance of hydropower and water supply projects. This will increase the risk of underperformance and poor economic and social returns, even failure and stranded assets.

Investors, developers and asset owners and operators need robust data and expert advice to fully understand the uncertainties, challenges and risks associated with estimating likely future demand, water availability and flood risk for new and existing infrastructure.

Starting with the most up-to-date climate change projections, we can establish the likely influence of rainfall and temperature variations on river flows and whether this could lead to drought conditions and underperformance of schemes in the future, or extreme flows that put assets at risk.

Through water supply-demand balance analysis, vulnerabilities are identified. We also conduct integrated assessments of the impacts of abstraction on groundwater levels, river flows, water quality and ecology, providing vital information to prevent over-abstraction and safeguard the viability of hydropower and water supply schemes.

#### **Mitigating impacts**

Once water availability and future demand are fully understood, different options to mitigate climate change impacts are appraised based on objective analysis of factors including:

- benefits and costs
- environmental impacts
- water quality
- social support
- technical and operational risks
- resilience

We can design cost-effective engineering solutions, based on adaptation of assets rather than new build projects, and advise on alternative strategies to manage infrastructure efficiently to increase resilience and sustainability.

#### **Proven track record**

We bring together specialists in different fields, from climate change to hydrology, from engineering to ecology, to make clients' investments climateresilient. We have a proven track record of improving the performance of water and generation assets.

Our success is built not only on technical expertise, but also on an in-depth understanding of the commercial factors that underpin an infrastructure project's ability to achieve a long-term return on investment. This is why we were appointed by the World Bank to develop the draft Hydropower Sector Climate Resilience Guide, and we have since supported the International Hydropower Association in the development of the final guidance.

We undertake due diligence reviews at any point in the project lifecycle, providing sponsors, lenders and investors with honest, open advice at the concept stage, during implementation, and when monitoring operational assets.

# Protecting our environment

Holistic, catchment-wide management of our water resources will safeguard them for future generations.



#### Environmental studies

The environmental assessment process is fundamental to the sustainable development of water resources. It identifies whether an environment could be harmed by the abstraction of water or discharge of wastewater as well as how a scheme could impact its surroundings.

These studies are valuable tools during the initial planning and design process, and not just for identifying potential negative impacts on 'sensitive receptors' – be they people, species, habitats or natural systems.

Through searching for opportunities to enhance the environment, it's possible to go beyond mitigation to deliver worthwhile benefits to communities, and at little or no additional cost.

This is how our teams think and work when carrying out environmental impact assessments (EIAs) and writing environmental statements for a wide range of complex and challenging projects.

#### Sustainable abstraction

We are leaders in relating changes in water abstraction and wastewater discharges to actual impacts on wetlands and surface water ecology.

In the UK, our studies have helped water companies to make sure abstractions are environmentally sustainable and meet their legal and regulatory obligations in an evidence-based and cost-effective manner.

Worldwide, we are advising clients on how to implement indirect and direct water re-use and water recycling schemes, as well as aquifer storage, recovery and recharge projects, to reduce dependency on groundwater and surface water abstraction, reducing the risk of over-exploitation of sources.

#### **Managing river catchments**

Catchment management is an environmentally-friendly and potentially low-carbon-impact method of influencing raw water quality at its source by managing rivers, wetlands and land use practices at a catchment scale.

Applying a multisector approach to understanding the sources of water quality issues, surface water and groundwater pathways, and human and environmental receptors, we can help you manage river catchments intelligently, developing sophisticated surface water and groundwater models to understand what can be done in each part of the catchment.

Our specialists provide guidance in conceptualising and modelling diffuse and point sources of pollution, and appraise catchment, societal and engineered mitigation measures – from sustainable drainage systems to natural flood management – to protect coastal water, surface water and groundwater environments from water quality risks.

By looking beyond the direct effects of water quality, our solutions focus on sustainability and are sensitive to external drivers. We evaluate the multiple influences of mitigation measures by integrating our holistic understanding with policy, stakeholder engagement, and assessment of ecosystem services and natural capital.



# Innovation comes as standard

Integrated solutions to water resources management require smart tools and technologies and the skills to apply them.

#### **Digital by default**

Digital technology has a key part to play in water resources management and we have always been among the first to adopt next-generation digital technologies that offer fresh insights and added value.

Drawing on our expertise in distributed hydrological and groundwater modelling, we have developed in-house a suite of digital tools to process and visualise data, link models, and improve efficiency for water resources and contamination modelling projects at local, catchment and regional scales. These bespoke tools are deployed alongside industry-standard 1D, 2D and 3D modelling software applications.

Our advisory and design teams work with leading academic and research institutions to enable clients to take advantage of ground-breaking approaches and apply the latest methodologies. This includes applying stochastic hydrology to better understand how water resources might be impacted by unknown potential droughts resulting from future climate change.

#### Better data, better decisions, better outcomes

Data is changing the way we look at the world. Our smart tools combine information from physical infrastructure with variables such as weather and pollution to reveal opportunities you can't always see. We then add our expertise to find insights that help you make smarter decisions. The outcome? Solutions that give real social, economic and environmental results.

Moata, our cloud-based analytics and visualisation platform, utilises sensors installed at critical locations, collecting information on meteorological and hydrological conditions as well as water and system properties. It provides stakeholders with an accurate picture of how a network or environment is performing in real time, improving capacity, service, water quality and environmental monitoring.

We can also create a 'digital twin' of a river catchment system, giving a realistic digital representation of both infrastructure and natural assets. These models unlock value by providing new insights and enabling scenario planning and optioneering for future development, leading to better interventions and better outcomes in the physical world.

#### Harnessing big data

In regions where water infrastructure is mature or when adding new sources is impractical, water companies and regulators need advice on strategies to manage water resources and services more efficiently.

Once the system – including constraints, water availability and demands – is scoped, sophisticated optimisation tools can be applied to identify the most sustainable way to optimise natural flows in rivers and groundwater sources while limiting environmental impacts.

Working with such tools, and our own smart infrastructure platforms, we support our clients to make key decisions on how best to meet the various competing demands for water.

With increasing volumes of available data, we employ advanced data access technologies, like cloud-based computing, to present information in a way that can be easily understood. We are experts in big data analysis and visualisation, making complex issues accessible to all to support stakeholder engagement.



Moata analyses water quality data for 84 different beaches around Auckland, New Zealand, and shares this information with the public in real time.

# One team, one goal

Whatever your ambitions, needs and challenges, and no matter where you are, we'll align the right combination of capabilities and experience.

At Mott MacDonald, we work as one team centred around a single goal: to deliver results for our clients and the communities they serve. The breadth and depth of our knowledge allows us to deliver innovative and integrated solutions across all sectors and geographies.

For more than 80 years, we have worked with private sector clients, governments and development agencies to help them respond to water resource challenges.

Today there is more demand than ever for our expertise due to increasing pressures on water resources as a result of climate change, urbanisation and population growth.

#### **Opening opportunities**

Our teams proactively look for opportunities to think across boundaries, and around problems, for the benefit of clients and end-users.

We constantly search for ways to add value – technical, economic, environmental and social – and stretch our thinking to deliver lasting outcomes, in line with the UN's Sustainable Development Goals.

It is our detailed understanding of every aspect of water resources management that enables us to give the best-informed advice and find the optimum solutions, helping to safeguard the sustainable use of water resources for all.



### Think water management is just about water? Think again.

#### Project Blue Gold

Location Bangladesh

#### Client

Bangladesh Water Development Board and Bangladesh Department of Agricultural Extension

Expertise Technical advisory services

#### Opportunity

Almost 40% of people in Bangladesh's southwestern coastal region live below the poverty line and face food and water insecurity. Their hardship is exacerbated by cyclones, storm surges, contamination of land and drinking water by salt water, droughts, river siltation and land erosion. Managing the country's abundant water resources and fragile land are crucial to long-term development.

Solution

The Blue Gold programme, covering an area of 115,000ha, is increasing the safety of local people by strengthening dykes and boosting crop productivity by clearing silt from drainage channels. We supported the formation of water management organisations (WMOs) – a third of whose members are women - to give local people control over the water resources affecting their lives. We are building the capacity of WMOs to plan, operate and maintain infrastructure, improve harvest yields and find new markets for produce.

The WMOs have empowered local people, promoting a democratic approach to water management interventions. The new skills taught to villagers have improved the quality and diversity of their produce, and the project has fostered strong linkages between them and the private sector, creating new streams of income, much of which is reinvested to boost the productivity of land. Blue Gold's greatest legacy will be the selfsufficiency of the area's communities once the programme closes.



#### Outcome

Project Location Client HS2 Ltd

#### Expertise

Environmental impact assessment, environmental studies, strategic water resources management, groundwater modelling

# Water resources assessment keeps HS2 on track

HS2 Phase One environmental statement

London to Birmingham, UK



#### Opportunity

Phase One of HS2, from London to Birmingham, is the first 230km section of a new high-speed railway network to connect Britain's major cities and improve capacity. As required by law and parliamentary rules, the government had to provide Parliament with a detailed statement assessing the likely significant effects of the project on the environment. We contributed to this environmental statement by assessing the impact of parts of the new rail infrastructure on water resources and flood risk.

#### Solution

Our specialists carried out water resource assessments and hydraulic and groundwater modelling to assess impacts on sensitive water environments. We engaged with water users to identify solutions to mitigate potential impacts on water resources. This included conducting extensive assessments of potential treatment options with a water company to mitigate for possible effects on the public water supply to London.

#### Outcome

Drawing on the findings of our and other environmental impact assessments, HS2 Ltd designed the project to avoid or reduce adverse impacts on watercourses, groundwater, public water supplies and designated sites. Similarly, structures along the route have been designed to ensure the functionality of watercourses is not adversely affected and, in many cases, even improved. Measures were also identified which will reduce effects on local groundwater levels during excavation and construction works. The environmental statement. and the accompanying public consultation, supported the successful passage of the HS2 Phase One hybrid Bill through Parliament.

# Meeting the water needs of California

#### Project

State-wide water system masterplan

#### Location

Sacramento, Los Angeles, Sonoma, San Diego and Monterey Counties, California, USA

**Client** California American Water

#### Expertise

Water resources planning, hydraulic modelling, buried infrastructure assessment, demand projections, distribution system analysis

#### Opportunity

California American Water (CAW) provides water and wastewater services to nearly 700,000 Californians in 48 communities. CAW selected us to provide masterplanning and capital improvements programme consultancy to ensure the increasing water demands of its customers are met well into the future.

#### Solution

We collated information on the capacity, reliability, condition, water quality and potential expansion of CAW's water systems through site visits and interviews with CAW personnel, hydraulic modelling, buried infrastructure assessments, and by compiling an asset inventory in a GIS database. Next, we produced customer and demand projections, estimated water availability, reviewed the trends of raw water quality parameters, and conducted a water balance analysis of each system to identify deficits based on the required level of service. Our specialists also developed a new planning document, called a condition-based assessment (CBA), which applies industry-accepted asset management principles and GIS as a visualisation and analysis tool to identify and prioritise water mains needing renewal.

#### Outcome

Our analysis and CBA tool will help CAW maintain its infrastructure to deliver clean, safe, reliable and affordable water and wastewater services, and follow strict local authority regulations and federal standards set by the United States Environmental Protection Agency. We worked closely with CAW to identify investments required to address immediate concerns, and then masterplan a list of prioritised, cost-effective short and long-term capital improvements of supply, treatment, production, distribution and storage assets. This investment programme will help to sustain adequate service levels for customers for up to 15 years.



15 years period covered by our investment planning study



#### Project

Hertfordshire Chalk groundwater model

Location Hertfordshire, UK

**Client** Environment Agency

Expertise Groundwater modelling

# Four groundwater models combined into one

#### Opportunity

Prior to this project, four groundwater models represented flows in the Hertfordshire Chalk aguifer between Reading and Cambridge. The Environment Agency identified a need for a combined groundwater model for the aquifer to better represent groundwater flow in this area. Improved simulation of major groundwater abstractions for public water supply was required for regulatory purposes and to analyse impacts of abstraction.

#### Solution

We constructed a new MODFLOW-VKD groundwater model to represent the variation of hydraulic conductivity and storage with depth commonly observed in the aquifer. Data was sourced from the component models and our model incorporates fully refined hydrogeological information and updated time series of hydrological, abstraction and discharge data. Surface water discharges, which generally represent sewage treatment discharges in the model, also simulate flow entering the model at the model boundary using data from gauged flows in the River Thames at Reading.

#### Outcome

By combining the four component models, our model improves hydrogeological understanding of regional groundwater flow, giving the most up-to-date representation of water balances in the region. It will be used to inform regulatory decisions and assess the impacts of abstraction on water bodies, helping to safeguard the environment. By adopting a collaborative approach during the development process and effectively using input from water companies and the Environment Agency, our team ensured the completed model is practical, robust and stakeholder-friendly.

# Pioneering a new approach to water resources planning

#### Project Water Resources East

#### Location East of England, UK

#### Client Anglian Water

Expertise Integrated water resources management

#### Opportunity

The East of England, home to 10.5M people, is predicted to face a gap between water supply and demand of 750,000m<sup>3</sup>/d due to population growth and climate change. Water Resources East (WRE) is pioneering a collaborative approach to water resources planning by bringing together stakeholders from a wide range of industries, along with regulators, to prepare a long-term multisector water resources strategy. Our specialists are working with WRE to help develop a bespoke framework for collaboration and shared decision-making by partners across all sectors.



#### Solution

WRE's approach stresses the importance of recycling and reusing water, water efficiency (by cutting leakage), and catchment management to tackle over-abstraction and diffuse pollution. Other solutions include creating new sources of supply by building reservoirs and desalination plants and water transfer schemes to increase network resilience. The framework we are helping to develop is based on robust decisionmaking principles and will enable stakeholders to define and prioritise the main vulnerabilities across the region, which covers an area of 31,000km<sup>2</sup>, and identify the best options to meet these challenges.

#### Outcome

The aim of the WRE strategy – the first of its kind for the UK – is to deliver a reliable, affordable and sustainable water supply that is resilient to the effects of climate change, economic growth and multiseason drought up to the year 2100. The integrated approach to water resources management and decision-making will support the implementation of the strategy through sharing best practice between sectors, collective ownership of the challenges faced by abstractors, and more efficient planning and use of infrastructure. The strategy will also lead to more affordable investment programmes and, potentially, lower bills for customers.

### Safeguarding supplies of drinking water to 4.3M people

### 27,500 square kilometres covered by our combined water resources model

#### Opportunity

Anglian Water's supplydemand balance is under acute pressure from population growth and climate change, making it increasingly challenging to provide enough water for homes and business while safeguarding the natural environment. Anglian Water needed accurate projections for its latest water resources management plan (WRMP), which UK water companies have to update every five years to demonstrate – to regulators, stakeholders and customers – how they will maintain a sustainable balance between water supplies and demand over the next 25 years.

#### Solution

Using state-of-the-art Aquator modelling software, we produced a combined water resources model covering the entire 27,500km<sup>2</sup> area served by Anglian Water. Emphasis was placed on reservoirs in the model, which were verified against historic drawdown data. Our baseline assessment was compared to a range of scenarios to take account of impacts caused by climate change, stochastic droughts and changes to environmental licences. Varying levels of climate change projections and different return periods for the stochastic droughts were tested. Climate change flow series, projecting impacts over a given period, were produced using HYSIM rainfall/run-off simulation models and UK Climate Projections (UKCP09) data.

produced a clear picture of where there is a water resource surplus or deficit in the region, which enables identification of new resource options, as well as improvements to current infrastructure to allow further movement and sharing of water between water resource zones. This crucial work helped Anglian Water to deliver a WRMP that will meet future water demand for 4.3M customers while also increasing resilience and mitigating the impacts of droughts and extreme weather events.

# Outcome The supply forecast has



Project

Anglian Water WRMP 2019 supply forecast

Location East Anglia, UK

Client Anglian Water

Expertise

Water resource simulation modelling, climate change resilience, stochastic drought resilience, rainfall/run-off modelling

# Managed aquifer recharge in the Middle East

Project

Managed aquifer recharge investigation

Location Middle East

Client Confidential

#### Expertise

Water resources management, hydrogeology, groundwater modelling, borehole construction supervision

#### Opportunity

Treated sewage effluent (TSE) is a valuable irrigation resource in the Middle East. Due to fluctuations in seasonal irrigation demand compared with supply, as well as limitations of the TSE distribution network, large quantities are discharged to the sea. TSE production in the study area is predicted to increase from approximately 200,000m<sup>3</sup>/d currently to 400,000m<sup>3</sup>/d in the medium term. Our client wanted to investigate the feasibility of recharging the aquifers to provide storage of TSE until it is required during the peak irrigation demand periods.

#### Solution

Seasonal variation in demand for TSE may be catered for through a managed aquifer recharge scheme. This involves recharging the aquifer with TSE in the winter months and abstracting it over the summer. A further benefit of aquifer recharge is the potential to reduce saline intrusion caused by over-abstraction of groundwater. Our team investigated potential sites for recharge of TSE into two limestone aquifers, and used groundwater modelling to understand the potential movement of recharged TSE within each aquifer and its potential impact on saline intrusion. We also supervised the drilling and testing of boreholes.

#### Outcome

Our investigation of potential water injection sites collected valuable data on the availability of TSE, risks to potable supply, suitability of hydrogeological conditions, quality of TSE and native groundwater, and potential infrastructure requirements. These findings identified sites suitable for a managed aquifer recharge scheme. A feasibility study was subsequently carried out, encompassing field investigations, environmental impact assessments and identification of the optimum site for a pilot scheme.

### Coastal modelling helps keep beaches clean

#### Project

Coastal investigations programme

Location Wales, UK

#### Client

Dŵr Cymru Welsh Water

#### Expertise

Coastal, sewer network and water quality modelling, compliance assessment, correlation analysis, cloud computation

2700km





#### Opportunity

Keeping the bathing waters of Wales clean and safe will safeguard the significant contribution they make to people's quality of life and the Welsh economy. To assess the environmental impacts of its wastewater treatment works, Dŵr Cymru Welsh Water (DCWW) invested in what's believed to be the biggest coastal modelling investigation ever undertaken by a UK water company. Mott MacDonald Bentley, as part of the DCWW Capital Delivery Alliance, led the project.

#### Solution

The study covered over 2700km of coastline, including 29 designated bathing waters and 20 shellfish waters, and involved field surveys, water quality monitoring and mathematical modelling. Our state-of-the-art 2D/3D computer models – simulating coastal dynamics and pollutant transport – identified pollution sources and assessed the effectiveness of potential mitigation measures. To accommodate the number of model runs required, we used cloud computing to reduce calculation times and meet stringent delivery schedules. This enabled our engineers to complete the equivalent of six months' worth of water quality simulations in the space of just two weeks.

#### Outcome

The data collected is enabling DCWW to make informed decisions to ensure compliance with relevant environmental regulations and obtain the best value for money when prioritising sewer network improvements. The models will be powerful tools that DCWW can use to plan future asset investment and operations in the most sustainable way – and at the same time help Wales to keep its beaches and shellfish waters among the cleanest in the UK.

#### **Project** Watershed management plan

Location Vieux Fort, St Lucia

Client Water and Sewerage Company Inc

#### Expertise

Water resources assessment, soil erosion and fluvial sediment transport, climate change impacts, catchment management, hydrological monitoring



### Modelling optimises sustainability of water supply

#### Opportunity

Vieux Fort's water supply infrastructure is being overloaded by a growing population, new commercial and tourism developments, and the effects of climate change. During the dry season, streamflow at river intakes decreases significantly. During the wet season, raw water quality falls significantly below acceptable levels, exacerbated by agricultural practices. Our client needed a better understanding of water availability and quality to improve catchment management and ensure the long-term sustainability of the water supply.

#### Solution

Our modelling simulated hydrology, land use, agricultural practices, soil erosion and sediment transport, providing the required scientific rigour to identify the benefits from implementing different water and soil conservation measures. Climate change impacts were estimated by incorporating the variation of total rainfall, number of dry days, heavy rainfall amounts and potential evapotranspiration in the 2060s for two emission scenarios, and applying those to the baseline catchment model to forecast variations in water availability.

#### Outcome

We produced a watershed management plan to optimise the availability of water resources in the catchment and mitigate land use impacts on water quality. It includes a better quantification of river flows, under both present and future conditions, informing decision-making about new infrastructure to support the economic development of Vieux Fort, one of St Lucia's most disadvantaged areas. The plan also identified farming practices that had the greatest influence on turbidity, and assessed the benefits associated with various water and soil conservation measures

# Improving irrigation and hydropower generation

#### Opportunity

The Kargi run-of-river hydropower plant on the Kizilirmak River in northern Turkey is a key contributor to the national grid with an installed capacity of 102MW. As well as diverting water for hydropower generation, the reservoir is required to release flows for irrigation. These flows are regulated but, if requested by farmers, additional waters may be released, decreasing the dam's potential generation capacity. The dam's operator needed to determine whether improving the efficiency of how water is used for irrigation could maintain flow releases at current regulated levels, or even reduce them, while ensuring sufficient water supplies for the area's agricultural sector and the river.

Project

Location

Client

Statkraft

Expertise

Irrigation and drainage,

hydrological monitoring

water resources assessment.

Kargi, Turkey

Downstream loss assessment



# 2060s

how far into the future our model estimates climate change impacts

#### Solution

We investigated if upgrades to existing infrastructure and better water management techniques could reduce water release requirements. This involved undertaking an initial scoping exercise to identify studies that might be undertaken to quantify irrigation demands downstream of the hydropower intake and evaluate potential interventions to limit irrigation releases. We were commissioned to undertake further studies including on-site verification and mapping to identify the irrigation areas more precisely, along with cropping patterns and flow demands. Hydrological monitoring was also undertaken to validate river flows and irrigation abstractions.

#### Outcome

Our studies increased knowledge and understanding of land utilisation and agricultural activities in the irrigation areas. We assessed the risks that may increase water release requirements and reduce generation flows, while seeking opportunities that may allow the plant to adjust irrigation flows and improve generation. Our findings concluded that, despite the lack of modern technology, the irrigation infrastructure is well managed by the farming community and only limited investment in infrastructure would be required. An assessment of recent changes in irrigation demand, however, identified an opportunity for potential reductions in water release requirements.



#### Project

Surface water and groundwater catchment management investigations

Location Central England, UK

#### Client

Severn Trent Water

#### Expertise

Catchment management modelling, diffuse pollution. ecosystem services

# Modelling to improve drinking water quality

Opportunity

public water supplies.

Nitrate concentrations

treatment processes to

remove contaminants

are expensive as well

as energy and carbon-

intensive. We worked

water supply sources across central England.

in aquifers supplying

public water supply

#### **Solution**

The use of pesticides is We took a holistic strictly controlled in the approach, gathering all UK, but traces can still find available information on their way into rivers and hydrology, geology, soil, reservoirs, contaminating land use and agriculture to make sure we fully understood the key issues in each catchment. Our teams conducted site boreholes also need to be walkovers and consulted managed. Current water key stakeholders including farmers. We developed a model to simulate how different pesticides are transported in catchments that supply surface water with Severn Trent Water treatment works using to assess the potential of the well-established Soil catchment management and Water Assessment as an alternative method Tool (SWAT). We used of reducing pesticide and groundwater models nitrate concentrations at to evaluate nitrate groundwater and surface transport and trends in groundwater catchments. The models were used to run scenarios to establish if catchment management could sufficiently reduce pesticide and nitrate concentrations in raw water to acceptable levels.

#### Outcome

Catchment management can be a sustainable, low-carbon alternative to upgrading or building new water treatment plants. By identifying the source of pollutants, our modelling establishes catchment management target areas, refining the extent of interventions required to reduce pesticide and nitrate concentrations to below the regulatory limit. We used the results of our investigations to conduct a cost-benefit analysis to help Severn Trent Water utilise its resources in the most effective way to implement catchment management initiatives that will reduce the risk of pesticide and nitrate contamination and improve drinking water quality.

### Improving the resilience of London's water supplies to 2100

#### Opportunity

The River Thames basin is one of the most intensively used water resource systems in the world. Continuous population growth and the requirement to increase drought resilience meant that Thames Water identified a potential water supply shortfall in London of up to  $600,000 \text{ m}^3/\text{d}$  by 2100 if the situation is left unchecked. The company needed to identify the best value solutions to reduce the risk of water scarcity and ensure continuity of supplies to customers while at the same time protecting the environment.

#### Solution

We provided a comprehensive assessment of water resource options to address forecast long-term demand. First, we identified possible options and produced feasibility reports for each one, including raw water transfers, interzonal/company treated water transfers, new reservoirs, wastewater reuse, desalination, direct river abstraction and groundwater abstraction (including aquifer storage and recovery). We also prepared crossoption studies to confirm the system elements required to convey, treat and distribute the new resources to customers. Our team devised a fine screening process that, in addition to capital and operational costs, considered a range of dimensions for each option, including environmental and social impacts, flexibility, deliverability and resilience. For options that passed screening and were included on the constrained list, we prepared conceptual designs, cost estimates, risk assessments and implementation programmes to feed into Thames Water's programme appraisal.

#### Outcome

More than 150 specific options were identified and assessed. These were then narrowed down to about 40 through our screening process. Thames Water can now demonstrate - to customers, regulators, stakeholders and shareholders - it has considered all feasible best value solutions in developing its water resources management plan to the year 2100.



#### Project Water resources option

development

#### Location London and the

Thames Valley, UK

Client Thames Water

Expertise Strategic planning, option appraisal, stakeholder engagement



# Plugging the energy gap in South-East Asia

100 hydropower schemes supported across South-East Asia

#### Project Hydrological support for hydropower schemes

Location Indonesia, Philippines, Malaysia, Vietnam, Laos

Client Multiple

#### Expertise

Feasibility, water resources assessment, hydrological and hydraulic modelling, flood risk assessment, hydrological monitoring installation

#### Opportunity

Demand for power in South-East Asia is outstripping supply, yet there is vast hydropower potential in the region that is untapped. We have evaluated multiple small and large hydropower schemes in five countries to identify, review and develop viable development opportunities. The viability of schemes relies on a solid understanding of the water resource, which is often a challenge in these data-scarce environments.

#### Solution

The first step we take is to maximise the potential of current and historic datasets after a thorough quality review process, using various geospatial datasets to assist in validation. Next, we recommend and implement hydrological monitoring programmes to collect accurate sitespecific hydrological data on river levels, flows, rainfall and sediment transport. We also consider how future climate change and land use change may impact hydrological conditions and the scheme's performance.

#### Outcome

We have provided hydrological support for more than 100 hydropower schemes across Indonesia, the Philippines, Malaysia, Vietnam and Laos. By ensuring confidence in the existing hydrological datasets, alongside implementing hydrological monitoring to gather more data to improve understanding, we boost returns on investment and maximise the efficient and sustainable use of natural resources. This identifies viable hydropower opportunities for development that will benefit each country and help to plug the region's energy gap.



# Developing a sustainable future for Egypt's water sector

#### **Project** National Water Resources Plan

Location Egypt

Client Government of Egypt

#### Expertise

Water resources management and engineering, investment management, information systems

#### Solution

Egypt's population has been booming for decades and is projected to reach 128M by 2030, increasing the risk of water scarcity. A multisector approach to water management is vital if Egypt is to make efficient and effective use of limited water resources. The National Water Resources Plan (NWRP) laid down a strategy for more integrated and coordinated planning, up to 2017. We were tasked with updating the plan within the framework of Egypt's 2050 vision and helping to strengthen the institutions responsible for implementing it.

**Opportunity** 

We developed the NWRP to extend it to 2037 and beyond by harmonising the water resources management plans of the Ministry of Water Resources and Irrigation (MWRI) and partner ministries. Through staff training, we improved the capacity of the MWRI to manage the NWRP and implement communications that will raise public awareness of water conservation and environment-related issues. We provided technical assistance to upgrade systems for co-ordinating integrated water resources planning and investment at national and regional levels, and developed water resources plans in five governorates, covering Upper Egypt, Fayoum and the Nile Delta.

#### Outcome

The updated NWRP will optimise water resource allocation at national and governorate level to provide various customer groups with the water they need, in both quantity and quality. This long-term integrated national strategy will support reforms of the water sector, enabling Egypt to manage its water resources in line with the UN's Sustainable Development Goal 6: to ensure availability and sustainable management of water and sanitation for all. It will also improve protection of public health and the natural environment, and help to maximise economic activity.

# Safeguarding the natural environment

#### Opportunity

Under the UK's National Environment Programme, the Environment Agency instructs water companies to undertake investigations and actions to safeguard the natural environment. Affinity Water was required to quantify the impact of public water supply abstraction on the flows, levels and ecology of the Mid Colne Valley north-west of London – a site of special scientific interest due to its importance for breeding birds. Affinity Water commissioned us to conduct the investigation to ensure collection of valid data and compliance with strict deadlines.

#### Solution

We established an extensive monitoring network to measure water levels and flows in the River Colne, groundwater levels across the catchment and water levels in the local lakes, as well as ecological conditions in the river and lakes. Monitoring took place over a period of four years to record the responses to seasonal variations and extreme weather events. Signal tests were carried out at Affinity Water's groundwater sources using continuous loggers in 27 observation boreholes. These consisted of reducing or ceasing abstraction from each individual site for a number of weeks, while monitoring responses in the river, groundwater and lake.

#### Outcome

Our findings indicated that, although abstraction in the area has a localised impact on groundwater and lake water levels, this does not appear to have an adverse effect on river flow or the hydroecology of the river and most of the lakes in the Mid Colne Valley. The study has helped to improve the understanding of the water environment in the valley and how the hydrological, hydrogeological and ecological systems interact to produce an ecosystem of national importance for flora and fauna, and a rich rural landscape enjoyed by the public. This knowledge will inform future monitoring and a water level management plan aimed at keeping future abstractions within sustainable levels.



#### Project

Mid Colne Valley National Environmental Programme investigation

Location Hertfordshire, UK

Client Affinity Water

**Expertise** Hydroecological investigations and analysis

# 10 ways you can benefit from our expertise



### Understanding the problem

We take a holistic, multidisciplinary approach to each project ensuring that our clients' challenges are fully understood and conceptualised before delivering appropriate solutions.

# 2.

#### Adding value

We bring added value to every project through promoting collaborative working with clients and stakeholders and constantly striving to innovate, generating efficiencies in approach and enhancing confidence in the solution.

# 3.

#### Working with nature

We are skilled in working with nature to design alternative sustainable solutions to traditional engineering schemes. Our experts develop solutions that work with nature in both rural and urban landscapes to boost water and habitat quality. improvement in the science underpinning future climate change predictions, we pride ourselves in leading the application of these predictions to our projects. We develop mitigation that can be adapted in the future, promoting resilience and sustainability in all our outcomes.

Adapting to

climate change

With continuous

# 5.

#### Plan investment wisely

Besides climate change impacts, new developments must account for increased water demand for domestic, industrial and agricultural consumption, as well as changes in catchment land use. Our models and methodologies will help you plan and design infrastructure to meet future needs with confidence, ensuring your money is invested in an optimal way.

# 5.

### Manage catchments sustainably

We can help you manage whole river catchments intelligently and sustainably, developing sophisticated models, including 'digital twins', to identify the most effective interventions to maximise water supply without negatively impacting the environment.

# 7.

#### Improve water policies

Policies need to adapt to changing conditions. In developed countries, we advise governments on how to improve their legal frameworks, and in developing countries we help to set up new regulations.



# 8.

### Protect water ecosystems

Effective planning and good governance will help to prevent contamination and over-abstraction of water resources. Working with ecologists we can establish how much water can be abstracted without damaging ecosystems and recommend best practices to mitigate water quality problems.

# 9.

### Engage with stakeholders

Securing stakeholder buy-in is key to the success of projects. We are experienced in participatory processes for water resources programme management and planning, and can help you to make the most from stakeholder engagement.

# 10.

#### Make smarter decisions

Accurate, timely data is needed to get a better idea of how efficiently water networks and assets are performing. We use the latest field technology and Moata, our cloud-based analytics and visualisation platform, to provide real-time insight into hydrological data and enable better decision-making.

Opening opportunities with connected thinking.

Talk to us. water.resources@mottmac.com

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