STAGE 3 OPPORTUNITY PRIORITISATION

Deciding on priorities frequently involves the assessment of multiple and disparate factors some of which can be monetised and some of which cannot. This complexity can often lead to stagnation and indecision. However, the assessment of priorities can now be facilitated using Multi Criteria Decision Analysis (MCDA) tools. wca, working with the client, can use MCDA techniques to explore the various opportunities available using a range of uncertainty factors. This can produce a priority list of those projects which are likely to be the most successful and have the best rate of return.

RAW WATER AVAILABILITY - Further detail of opportunities

Table 3

Opportunities	Description and Implications	Possible Options
1.1 Abstraction license trading	The Environment Agency and OFWAT are keen to develop a well-functioning market for trading abstraction licences, overcoming the barriers that are currently preventing such trading.	Establish the benefits of a well-functioning abstraction license market for the company. Co-operate with OFWAT and the EA's efforts to remove the current barriers to trading.
1.2 Aquifer Storage and Recovery	Aquifer Storage and Recovery (ASR) involves injecting water (generally treated) into an aquifer through wells or by surface spreading and infiltration and then pumping it out when needed. Injection and abstraction can be via dual-purpose boreholes. The aquifer essentially functions as a water bank. It has been widely adopted in the US and has the added benefit that it can store water in non-potable aquifers (e.g. saline aquifers) as a consequence of the "bubble" effect1. Whilst it has attracted attention in the UK it has not yet been widely adopted. The need for additional water storage (to capture winter flows), without the expense and controversy of large storage reservoirs may make ASR an attractive option in the future, should appropriate aquifers be available. ASR schemes can be linked to effluent re-use.	Further explore the feasibility of ASR, particularly with respect to the capture of winter flows or the storage of recycled effluent.
1.3 Desalination	Whilst generally perceived as not cost-effective for use in the UK, desalination technologies are becoming progressively more energy efficient. Refinements to existing reverse osmosis technology and the development of novel desalinisation methods have been predicted to make potable water obtained via desalination as cost-effective as that obtained via conventional water resources in the near to medium future in the UK2. For example, NanoH20, a US-based start-up, have recently attracted a $15 million investment for their nanocomposite membrane technology that they hope could realise a 20% energy efficiency during reverse osmosis desalination3. NanoH2O are planning to bring their technology to market by 2010. Ammonia-Carbon Dioxide Forward Osmosis, an alternative desalination technology that can be driven by waste heat, has been calculated by scientists from Yale University to result in energy savings of 72 - 85% compared to current desalination technologies on an equivalent work basis4. Membrane distillation also offers advantages to reverse osmosis[5].	Explore the cost-effectiveness of additional desalination in the company area based on the potential of new technologies to realise efficiencies. Invest in companies developing this technology.

1 Gale IN, Williams AT, Gaus I, Jones HK. 2002. ASR-UK: Elucidating the hydrogeological issues associated with Aquifer Storage and Recovery in the UK. UKWIR. London.
2 Rachwal T, Judd S. 2006. A synopsis of membrane technologies in UK municipal potable water treatment: history, status and prospects. Wat. Environ, vol 20, issue 3, pp 110-113.
3 http://www.nanoh2o.com/index.php5.
4 McGinnis RL, Elimelech M. 2007. Energy requirements of ammonia-carbon dioxide forward osmosis desalination. Desalination, vol 207, issue 1-3, pp 370-382.
5 http://www.csiro.au/science/ps36h.html.

HORIZON SCANNING

HOW TO ADD VALUE NOT ADDITIONAL COST

Innovation is the key to business success but is always associated with risks. However, risk aversion can be just as damaging to future success as taking unnecessary risks. Consequently, coherent and holistic business risk management has to be a core component of any business strategy. The pace of scientific discovery, understanding and innovation today is unprecedented. Horizon scanning is a process by which organisations can keep abreast of these developments in order to maximise their potential and mitigate their negative impacts.

Evidence-based Horizon Scanning

Horizon scanning is now widespread in the UK, across business, government departments and agencies (King and Thomas 2007)[1]. In some cases Horizon Scanning has failed to live up to its initial promise and is seen as bureaucratic, resource intensive, remote and unproductive. However, correctly applied, Horizon Scanning can ensure that the right questions are asked at the right time. It can significantly add value to the business by contributing to correctly prioritised research, evidence-based policy, efficient operations and robust planning.

Continuous "Evidence-based" horizon scanning identifies and tracks developments across the breadth of science and technology (e.g. journals, news and opinion articles, blogs, conference proceedings and patent applications), searching for "weak signals" of disruptive innovation, the so-called Black Swans of Black Swan Theory (Taleb 2007)[2], as well as patiently accumulating a weight of evidence to substantiate indicators of more gradual change. This is a "bottom-up" approach, driven by the evidence collected, and the opposite of "top-down" examples of horizon scanning that focus on particular topic areas. wca environment's consultants are practitioners of Evidence-Based Horizon Scanning of Science, Technology, Policy and Regulatory Issues affecting the environment.

Evidence-based horizon scanning is a form of forecasting. Rescher (1998)[3] summarises two main elements of a good forecast - good questions and good answers.

1. Good forecasting questions should be important, interesting, resolvable and difficult. In other words, a question should be about a tractable, non-trivial phenomenon, where much could be gained or lost depending on the answer (Crane 2001)[4].
2. Good forecasting answers should be correct, accurate, relevant and detailed. In other words, an answer should provide a specific, preferably quantitative answer to the question (e.g., when and where, Crane 2001).

Evidence-Based Horizon Scanning falls frequently into the category of "trend projection" with the main aim being to detect a trend at an early stage in its development. The weight of evidence collected is intended to identify and prioritise important trends. Equally it can "test" current trends that are being extrapolated for potential disruptive elements.

1 King, DA, Thomas SM. 2007. Taking science out of the box - foresight recast. Science 316:1701-1702.
2 Taleb NN. 2007.The Black Swan: The Impact of the Highly Improbable 2007. Random House, New York.
3 Rescher N. 1998. Predicting the Future: An Introduction to the Theory of Forecasting. State University of New York Press, Albany, NY.
4 Crane M. 2001. Limits to forecasting in environmental toxicology and chemistry. In: Rainbow PS, Hopkin SP, Crane M (eds.) Forecasting the Environmental Fate and Effects of Chemicals. Wiley, Chichester, UK pp 7-24.

The wca Approach

wca environment adopts a three stage interactive approach to the analysis of emerging issues. Stage one is to contrast a client's business with emerging issues in environmental science, technology, policy and regulation in order to identify the key challenges the client is likely to face during the next 10-20 years. Following discussion with the client, Stage two is to identify the opportunities associated with each challenge, both in terms of options available to mitigate the perceived challenge, or to identify novel areas of business. These are again subject to discussion and agreement with the client. In Stage three, we work with the client to apply Multi Criteria Decision Analysis (MCDA) to identify those challenges and opportunities that should take priority in order to maximise short and medium term business benefit and minimise negative business impact.

The following example shows how the process operates using a generic UK Water Company as a case study.

Table 1

Issue	High Level Challenge
1 Raw water availability	Constraints on the availability of raw water can be expected to increase. Changes in climatic conditions will affect rainfall and stricter limits will be applied to both groundwater and surface water abstraction in order to maintain 'good ecological quality'. Construction of major ground level storage reservoirs is unlikely to be permitted.
2 Raw water quality	Overall quality of raw water should gradually improve as river basin management action plans are implemented. However, improvements in analytical science are likely to show the presence of previously undetected micropollutants and emerging technologies can be expected to produce new challenges.
3 Potable water quality	Regulatory standards for drinking water can be expected to become somewhat more restrictive, following the revision of the EU Drinking Water Directive. In addition, public pressure to 'eliminate' micropollutants, such as pharmaceutical residues will intensify as more substances become detectable. Chemical surveillance monitoring will need to increase as a result.
4 Wastewater Quality	Regulatory standards for waste water discharges can be expected to become considerably more restrictive to meet the requirements of River Basin Management Plans and in order to meet the much tighter environmental quality standards required by Art.16 of the WFD. Further additions to the list of Priority and Priority Hazardous substances, expected at ca. 4 year intervals, will intensify this issue. Much more sophisticated monitoring techniques will be necessary to demonstrate compliance.
5 Sludge Disposal	Disposal of sewage sludge will become more problematic. Tighter micropollutant standards relating to agricultural use of sludge can be expected in the proposed revision to the Sewage Sludge Directive. In addition the revised IPPC Directive 96/61 is expected to impose more stringent conditions on the operation of waste incinerators.
6 Transport & Distribution (inc. water & wastewater)	The Government has committed the UK to a reduction of 80% in its emission of greenhouse gases by 2050, with an interim target that requires emissions to be reduced by 2.8% each year until 2020. As a highly visible company you will be expected to meet a similar target either by improved energy efficiency or decarbonising your energy supplies.
7 Plant Operations	The greenhouse gas reduction targets noted above also apply here. In addition environmental regulations are expected to become more stringent in all areas including emissions to atmosphere as a result of the CAFÉ process, increasing producer responsibilities e.g. packaging, end of life vehicles and WEEE.
8 Resilience	Assets which are vital to the provision of supply (critical infrastructure), such as water treatment works, raw water storage reservoirs, trunk mains, wastewater treatment works and pumping stations should be adequately resilient to the uncertainties of climate change (e.g. flooding as a consequence of extreme rainfall, sea level rise affecting tideway assets).
9 Industry Structure & Regulation	Regulatory model reform could lead to the "unbundling" of the water supply industry (disaggregation of supply, distribution and retail). Creation of "water service companies" to address the perceived short-term disincentive for demand management explicit within the reward mechanism of the current regulatory model. Additional recommendations of the Cave review into competition and innovation in the water industry.
10 Cross Cutting Issues	In addition to the functional areas above there are other challenges to the Company that are cross-cutting across its business, including the requirement to reduce its carbon emissions. Firstly, existing obligations under the current EU-ETS and potential changes scheduled for the 3rd trading period (beginning 2013). Secondly, obligations under the UK Carbon Reduction Commitment (2010).Finally the cost and availability of land in the area for capital projects.

STAGE 1 CHALLENGE ANALYSIS

The first step is to contrast the business operations of the company with the multitude of different environmental challenges that exist today, taking
into account their direction of travel (i.e. is the challenge increasing or decreasing in strength).
Table 1 shows the result of this type of analysis.

STAGE 2 OPPORTUNITY IDENTIFICATION

Following discussion of the challenges with the client the next stage is to identify potential opportunities arising from the challenges. These might be areas where challenges could be reduced or eliminated by proactive actions or where a business opportunity might be exploited. This work is undertaken in two steps: after an initial evaluation of the opportunities (Table 2) further detailed work is undertaken on potentially interesting candidates (see Table 3). It is not unusual for a very wide range of possible opportunities to emerge at this stage in the analysis and the final stage in the analysis is to prioritise these opportunities (and threats).

RAW WATER AVAILABILITY - Further detail of challenges

Table 2

Challenge	Description and Implications	Possible Opportunities
1.1 Climate	The Environment Agency has recently forecast that total annual river flows in England and Wales could reduce by as much as 10-15 % by 2050 as a consequence of climate change. Flows in the South and East were reduced significantly in the autumn relative to the rest of the country. Winter flows were, however, forecast to be greater than baseline flows[1]. The start of the groundwater and reservoir recharge season in the South and East of England, and in Wales could well be delayed relative to baseline conditions. Increased flows in winter could be utilised for ground level storage, but existing infrastructure to do so may need to improved, or new infrastructure built. Separate research has reported that climate change could increase water demand by between 2-4% by 2050[2].	Determine the consequences of reduced autumn river flows for reservoir and groundwater recharge. Investigate the feasibility of capturing and storing augmented winter river flows.
1.2 Irrigation	The Environment Agency has forecast that water demand from agricultural irrigation is likely to increase in the future, particularly over the next 10 years[3]. This is as a consequence of changing agricultural practice (e.g. increased use of potato irrigation) combined with the pressures of climate change (e.g. warmer, dryer summers). The volume of water abstracted for irrigation is relatively small compared to potable use, but can be particularly significant during peak periods.	Establish to what extent trends in irrigation will affect the Company's balance of supply and demand in the future, acknowledging that much irrigation is via agricultural abstraction rather than via water companies. Explore if recycled water (see opportunities section below) could be used for agricultural irrigation, reducing raw water abstraction pressures within catchments, especially during peak demand.
1.3 and 1.4 UK population and household demographics	UK population is projected to increase, with a disproportionate increase in the South-East of England. The population in the supply area has been forecast to increase from ~8.5 million to ~ 10 million by 2035. There is also likely to be a shift towards a greater proportion of people living alone, or in smaller family groups, which are known to have a disproportionate water demand.	Continue to monitor trends and forecasts in UK population and household demographics in the area to improve forecasts.

1 Environment Agency. 2008. Climate change and river flows in the 2050s. SC0700079.
2 Downing TE, Butterfield RE, Edwards B, Knox JW, Moss S, Piper BS, Weatherhead EK, (and the CCDeW project team). 2003. Climate change and the demand for water, Research Report, Stockholm Environmental Institute Oxford Office, Oxford.
3 Environment Agency. 2009. Water for people and the environment. Water Resources Strategy for England and Wales. Environment Agency, Bristol.