Chapter 10

The role of the consultant in supporting sustainable industrial water use

Arthur Umble

Stantec Consulting Services, Inc., Wastewater Treatment Sector, Denver, CO, USA

Keywords: barriers, community, consulting engineer, environmental awareness, regulatory sensitivity, stakeholder, water reuse

10.1 OUR GLOBAL WATER CHALLENGE

The global water, air and terrestrial environments, as we've known them, are being altered at unprecedented rates due to the on-going influences of our changing global climate. Utilities that manage water supplies and industries that rely on water to produce their goods are equally challenged to adapt to what appears to be a 'new normal' in water management. For public utilities, the uncertainties in the coming decades challenge decision-makers to provide sustainable, reliable water services to the public now and for the future. At the same time, industries that rely on water for their production must change their approach to water consumption and disposal in order to remain competitive.

Never before has the need been more critical for holistic water solutions that reach beyond technology and engage the economic, social and political sciences. And at no time in history has the role of environmental consultants been more crucial, or their obligation so great, to provide comprehensive guidance to decision-makers to navigate the complexities ahead. The focus of this chapter is the water consultant's role in helping to shape the future of the water environment.

10.2 THE ROLE OF THE WATER CONSULTANT

The role of the professional consultant with respect to both the private and public clients centers around four primary responsibilities:

(1) identify and deliver effective, sustainable technology solutions;
(2) minimize project environmental impact;

DOI: 10.2166/9781789060676_0105

(3) navigate regulatory complexities; and
(4) broker key stakeholder partnerships to maintain the entity's 'license to operate' in the community.

10.2.1 Technology selection

Water solutions today are more complex than ever. Historically, companies purchased their water from a local purveyor, and while the influent often needed further treatment before use in certain processes, after use the effluent was only treated to the extent mandated by the local sewer authority. Today, however, companies looking to increase their water reliability expect to treat industrial wastewater streams for reuse in plant processes, and for cooling, cleaning, firefighting, dust control and other non-potable purposes. Wastewater can even be purified now to the extent that, when it is blended with the utility water supply, no further treatment is needed for process use. This approach can lower water, energy and chemical costs, alleviate regulatory constraints and even reduce the impact on the local environment. In this case, the optimum technical approach must address both supply and disposal and the consultant's role is to map out the technology alternatives aligned with these desired outcomes. This may involve developing technical criteria for evaluating alternatives, researching technology performance in similar applications, conducting pilot studies and documenting regulatory hurdles. The consultant frequently needs to help the client generate a detailed business case including a 'Triple Bottom Line' analysis to demonstrate that the selected technology can be justified economically as well.

10.2.2 Environmental impact

Supplying, using and discharging used water each have the potential to impact the environment and must be carefully managed. Excessive industrial demand on aquifers can result in declining groundwater levels which in turn can lead to land subsidence, increased salinity or even seawater intrusion in coastal areas. Unless utilities properly schedule their withdrawals from surface water sources, reduction of seasonal water flows can disrupt the aquatic habitat and reduce ecological diversity. At the same time, wastewater discharge can pollute surface or groundwater water sources and erode natural waterways. Water reuse mitigates both types of impacts. The consultant should possess the technical expertise needed to provide the client complete information to make appropriate decisions.

10.2.3 Navigating the regulatory framework

Regulatory frameworks are designed to protect water quality and ensure its continued suitability for all designated uses. Complexity arises, however, due to divergent regulations from multiple jurisdictions (local, State and Federal), with different permit approval processes and even competing surface and groundwater rights. The consultant must be able to chart the regulatory roadmap and, more importantly, have experience navigating it successfully. Regulatory constraints represent significant costs to companies, and an uncertain permitting process makes it difficult for them to know when – or whether – to 'pull the trigger' on investment in water treatment and reuse. Both the private corporation and the public utility rely heavily on the consultant to provide guidance on such decisions.

10.2.4 Stakeholder partnerships

Finally, the consultant can broker crucial stakeholder relationships to help gain support for a company's water use and reuse. These stakeholders can include regulators, Chambers of Commerce and economic development agencies, community service clubs and social service agencies, non-governmental organizations, public health agencies, media, etc. Each of these stakeholders can either support or

challenge the proposed water use, depending on whether they believe the company or utility is acting responsibly as it achieves its environmental and financial goals. Consultants can often bring these stakeholders together by demonstrating their ability to provide acceptable, holistic water solutions. Because the consultant represents the client, however, stakeholders may initially view them as biased. To overcome this suspicion, the consultant must demonstrate respect for stakeholder opinions throughout the life of the project, from planning and design through construction, startup, commissioning and continuing during operation.

10.3 CHARACTERISTICS OF THE RESPONSIBLE WATER CONSULTANCY

How well or inadequately a consultant fulfills these primary responsibilities can be gauged not only by how their projects perform, but also by the relationships that frequently outlast them. In each case, the responsible consultancy looks at the 'big picture' and determines how to meet the client's needs in a way that benefits the community in the long run.

10.3.1 Technical expertise

The professional water consultant is regarded as a technical expert whose knowledge and experience reach deep into the details of water resource management, as well as water and wastewater treatment engineering, science and technology. As a result, the responsible consultant has the expertise and practical experience to design and deliver a wide range of appropriate technical solutions, including conceptually pragmatic 'roadmaps' allowing water to be managed efficiently throughout the watershed – and sometimes between watersheds – with minimum environmental impact.

For example, the consultant must ensure that groundwater and surface water sources are protected from contamination by industrial activity. A sound wellhead protection plan eliminates the potential for groundwater contamination by defining aquifer zones to be kept free of industrial pollution, stormwater or agricultural runoff. Project designs should incorporate the use of green infrastructure where applicable such as grass filter strips along urban streams or specified tillage practices in agricultural areas to treat stormwater runoff.

10.3.2 Environmental awareness

Similarly, the consultant provides the client with solutions that concurrently maximize value while minimizing impact on the environment. Surface water, for instance, can be treated to meet potable water standards in a variety of ways, from sand filtration and chlorination at one end of the technological spectrum to advanced membrane treatment, ultraviolet disinfection and ozonation at the other. Whichever technology is selected, the consultant is obligated to consider impacts from disposal of treatment residuals whether backwash solids from filtration or reverse osmosis brines. This is one reason why, even when highly purified water is needed, a consultant may recommend an alternative to reverse osmosis like ozone with biologically activated carbon (O3/BAC) which can meet reuse standards with lower chemical and energy costs and no residual brines.

10.3.3 Regulatory sensitivity and relationship management

It goes without saying that industrial water projects must be designed to meet all regulatory compliance requirements and perform at a level that is acceptable to both the client and external stakeholders. In many instances, however, the consultant's role does not end there but continues through project optimization, technical training of company staff, and on-going involvement with the community. This is

accomplished best by simply always being responsive in a timely manner. Unlike climate change, which is the cumulative result of diverse actions around the world, water use is local and its impact on the local economy and environment can be linked back directly to the company. For this reason, industrial water users rely on consultants to help them manage the many relationships they enter as responsible water users. Examples of these relationships and the consultant's role in maintaining them are described in the sections that follow.

10.3.3.1 Case study: copper mining in Arequipa, Peru

In today's world, the corporation must make water use decisions that take into account relevant socioeconomic realities of the communities in which they operate. This can require partnerships and investments which may in the short run negatively impact the company's 'bottom line'. In this case, the responsible consultant's job is to help the client build and maintain those relationships and develop projects that provide long-term value to the company. An example of this took place recently in the Arequipa region of southern Peru, an arid territory where water scarcity is a constant issue. A global copper mining company operating in the region – and a significant contributor to the region's economic growth – drew water from local rivers for its mining operations. Meanwhile, the regional water/wastewater utility was struggling to keep up with its growing urban population, and the rivers (which also provided water for local irrigation) were being polluted by untreated sewage discharges. The decline in river water quality increased the company's operating costs just as the company planned to extract even more water to expand its operations, and the both the utility and the mining company were losing public trust.

In this case, the consultant provided a cost-effective technical solution, and worked alongside both the mining company and the public utility to implement the project by gaining approvals from the regional regulatory agencies. The mining company partnered with the regional utility agency to construct a new centralized wastewater treatment plant at a site outside the urban area. The treated effluent improved the local river water quality which made the mining operations more efficient and even increased the safety of locally grown crops. The public began to regard the utility as a leader in improving their quality of life, and the mining company demonstrated its corporate responsibility by financing the much-needed wastewater treatment plant. (The consultant also advised the company on its public relations outreach to ensure that the message of the partnership was articulated effectively and understood.)

10.3.3.2 Case study: high tech water use in the USA

Another example of 'out-of-the-box' engineering took place when a consultant helped a large microelectronic manufacturing firm meet its water needs more sustainably in the rapidly growing Pacific Northwest region of the USA. The firm needed to expand its manufacturing process to maintain its competitive advantage in microchip technology, which required more water and resulted in more industrial wastewater discharged to the local wastewater utility. The role of the consultant in this case was to devise a technical solution to treat the industrial wastewater to a quality such that a large portion could be reused in the manufacturing process, while the rest could be discharged to the municipal wastewater plant in compliance with the municipality's pretreatment regulation.

Because of the uniqueness of the wastewater characteristics, this technical solution required extensive bench and pilot scale research, conducted by the consultant, to prove the treatment approach and provide design criteria for the full-scale system. The consultant also assisted the company in obtaining approval to discharge the treated wastewater by helping to develop an appropriate set of protective effluent discharge limits. This solution required a strong partnership between the company and the public utility,

which was facilitated when the company's use of municipal potable water freed up supply for this rapidly growing suburban area.

10.4 THE BREADTH OF WATER CONSULTANT RELATIONSHIPS

The value a water consultant brings to the water industry depends a great deal on the breadth and depth of established, trusted advisory relationships with stakeholders who hold key interests in the community's sustainable water environment. Perhaps the three most important relationships a consultant has are with their clients, the regulatory authorities, and the academic community.

10.4.1 Client and community relationships

The consultant's relationship with the client centers around being a 'trusted advisor'. The client must be able to trust the consultant's judgments on technical matters that affect the policies and initiatives promoted by the client to best serve their customers. Consultants have the obligation to tell clients the truth about the hard realities they sometimes must face with respect to the reliability of water supplies, and the rising, and often-times hidden costs associated with water and wastewater treatment. Ideally, the consultant has appropriate knowledge about the environmental, economic and social impacts of climate change as it affects water quality and availability, able to provide science-based evidence to support decision-making around water use and reuse. It is the credibility, relevance and timeliness of this evidence that is foundational for the trusted advisor relationship.

Although the client in the following example is a municipal government rather than a private company, the Pure Water San Diego program illustrates how a consultant acting as a trusted advisor can advocate effectively for sustainable water management. For several decades, the city of San Diego, California (USA) sought to develop a potable water reuse project as a component of their holistic water management plan. In the late 1990s, initial efforts to launch a sustainable indirect potable reuse program stalled due to a lack of public support. Despite this setback, the city continued to work with key stakeholders and engaged a number of consultants to continue public outreach initiatives, refine technical solutions, and update *pro forma* financial analyses. Most important, they continued to build and operate demonstration projects to develop science-based evidence to verify project reliability. As a result, in 2014 when the city council launched Pure Water San Diego to provide potable recycled water to the community the public supported it. At this time, construction is underway, and the program is scheduled to be fully implemented by 2035, adding 83 MGD to the water supply through a combination of indirect and direct potable reuse.

10.4.2 Regulatory authorities

In addition to promoting public support for a water treatment project, a consultant can also help regulatory authorities develop sound, science-based regulations. This was demonstrated recently by a public utility seeking to permit an alternative wastewater disinfection technology, but the same task has been undertaken on behalf of corporate clients. A US utility using conventional hypochlorite for wastewater disinfection experienced periodic failures in complying with discharge regulations due to chronic maintenance challenges with the aged infrastructure. The utility evaluated a series of alternatives including chloramination, ultraviolet (UV), and peracetic acid (PAA) disinfection. Desktop evaluations indicated that PAA could meet objectives most effectively, but the regulator had no prior experience with the technology and needed to be certain that it would meet performance objectives without negatively impacting receiving water quality.

In order to demonstrate to the regulatory authority that PAA disinfection would protect receiving water quality and consistently meet permit limits, the utility crafted strategic partnerships with both the technology provider and the Water Research Foundation, through its 'Leaders Innovation Forum for Technology (LIFT)' initiative. A consultant was initially engaged only to review the technology developer's experimental plan and data collection program, but their duties evolved to include direct oversight of data analysis and an independent assessment of the results shared equally with the utility and the regulator. This role brought both transparency and credibility to the pilot program that gave the regulator the necessary confidence to approve the technology. Together the project team designed a three-year, full-scale pilot study of the PAA technology, which the regulator ultimately incorporated into the utility's NPDES (National Pollution Discharge Elimination System) permit as the approved method of disinfection.

10.4.3 Research institutions

A third type of relationship is maintained between the consultant and research institutions. This collaboration enhances the consultant's legitimacy because it demonstrates a commitment to ensuring sound, scientific-based decision-making. It also increases the likelihood that the consultant can recommend a new, improved technology for the industrial water user's application, boosting its competitiveness in the marketplace and enhancing its bottom line.

An example of an academic partnership is the Johns Hopkins Water Institute-Stantec Alliance (JHU-Stantec Alliance), established in 2013 '*to provide innovative, sustainable solutions to global environmental issues and natural resource limitations by conducting desktop-, bench-, pilot- and demonstration-scale investigations needed to support sustainability science*.' Stantec, a global water consultant, collaborates with the Johns-Hopkins University School of Public Health to study a host of global water issues that impact public health and the environment. The research areas include analytical and monitoring methods for contaminant identification in the water environment, mechanisms for contaminant degradation, alternative physical, chemical, and biological treatment schemes, and validation studies for emerging water technologies. The collaboration ranges from bench- and pilot-scale studies to full-scale demonstration projects. This alliance also provides an avenue for industrial clients to fund water research directly pertinent to their operations, and allows young academics (e.g., both doctoral candidates and post-docs) to explore career options in water research disciplines of interest to industry.

10.4.4 Business partners

A client is more likely to invest in a sustainable water project when the consultant can craft a business case with a reasonable payback period, which for private industry is typically 3 years or less. Since the 'market price' of water rarely yields such returns alone, the consultant must look at the full life-cycle cost that considers the value of the reusable water and materials embedded in wastewater. In addition to nutrients like nitrogen and phosphorous (for fertilizers) and organic chemicals (for fuels, bioplastics, pharmaceuticals, etc.), wastewater also contains power from embedded chemical and thermal energy. Each of these products potentially bolsters the economic value of a technical solution that recovers them and returns them to the economy to meet an array of 'fit-for-purpose' options.

The consultant can play a significant role here not only by designing treatment systems to recover these byproducts but also by helping the company either reuse them directly (e.g., energy) or by identifying markets and negotiating contracts with buyers. An example would be a consultant who assisted a utility with the sale of struvite (magnesium ammonium phosphate) generated by its wastewater treatment

process to an agriculture fertilizer distributor. The distributor was able to utilize the struvite directly into a useful fertilizer product, while the long-term revenues helped the client stabilize its annual budget.

The consultant can also help the company's suppliers to enhance the sustainability of the entire supply chain. For example, agriculture is among the largest users of water globally, so a company's commitment to improvements in irrigation and fertilization practices among its agricultural suppliers can increase crop production while simultaneously reducing both demand and water pollution.

10.5 OBSTACLES TO SUSTAINABLE INDUSTRIAL WATER USE

If all consultants have the potential to provide industrial clients with holistic water solutions, why don't more companies use water sustainably? As suggested in the discussion above, industry's reluctance to invest in sustainable water use is not only due to the initial cost of the project but also to a fear of jeopardizing operations by changing water use technology and practice. This is why the consultant focuses on demonstrating the reliability of the recommended technology as well as making a business case for sustainable water use based on its long-term value to the company.

10.5.1 Financial barriers: shareholder vs. stakeholder

In the private sector, the shareholder generally has greater influence over bottom-line management decisions than the external stakeholder. On environmental issues, however, the stakeholder's perspective can override the shareholder's short-term concerns as companies recognize the importance of environmental protection to the communities – and the consumers – they serve. This connection is so unmistakable that in many cases shareholders have become the key stakeholders demanding environmental accountability from the businesses in which they are investing, even when such accountability requires investments that provide no direct monetary return (i.e. no immediate payback). Rather, the company benefits from the on-going endorsement by the community of its 'social license to operate'. This is particularly relevant for companies that require large quantities of water to support their process operations, and not just in regions of water scarcity.

Reducing greenhouse gas emissions, energy efficiency, water reuse, resource recovery – all these environmental initiatives have been implemented in response to demands from company customers and external stakeholders. Initial objections that these measures were too expensive, that they weren't required by regulation, that their payback period was too long, or their return on investment too low to be acceptable to the shareholder are eventually overcome when companies see how they have been implemented successfully by 'early adopters'. In this case the consultant plays a pivotal role by identifying the broad range of benefits associated with sustainable water use practices and including them in a more comprehensive cost-benefit analysis so that their value is reflected in the business case.

10.5.2 Fortitude barriers: making the first move

Just as the public utility is often the last to invest in a new technology, so many private companies resist changing processes, especially in areas like water treatment and reuse that are outside their 'core competency. Since water treatment equipment can be costly and no one wants to be left with expensive, stranded assets, it is understandable why public utilities and private companies both find themselves in a 'race for second place' when it comes to investing in new technology. While it may be prudent to wait to observe the results of someone else's trial before embarking down a similar path, one unintended consequence of this inertia is that it favors incumbent systems, further delaying advances in the industry. Here again the consultant can accelerate change by investigating advances in the field and keeping

clients informed about best practices and methods, connecting them with other companies that are overcoming the barriers, sharing knowledge and technology.

10.6 OBSTACLES TO CONSULTANT ADVOCACY

Clients are not alone in their need to confront their concerns about the cost of adopting sustainable practices. Consultants, too, must face up to the challenge of advocating for sustainable solutions. Expertise in the advancing field of sustainable technology requires a significant investment in personnel and training. At the same time, giving a client the 'big picture' perspective when asked for a simpler, less appropriate solution might pose the risk of losing a client. Both these challenges require consultants to make a meaningful commitment to sustainable practice.

10.6.1 Financial barriers: the cost of competency

A consultant's expertise in sustainable, holistic technology water solutions for the water industry requires investment in staff and staff training. This generally means hiring PhD-level professionals to direct research and development initiatives – thought leadership – around sustainable technology. Consultants must collaborate with universities and research institutions to conduct further research and publish results to stay abreast so they can advise clients on best practices for managing their water resource. It also means discussing emerging technology and sharing the insights gained from sustainability research with regulators, professional associations, non-governmental organizations, elected officials and the general public. Publishing technical papers, presenting at conferences, preparing and circulating on-line videos, podcasts, blogs, webinars all take time and money, which must be taken from the consulting company's operating budget. On the other hand, to effectively communicate the value of sustainable practices, the consultant must change the historical view that wastewater is 'something to be gotten rid of' rather than reuse. This perception can only be overcome with proactive, timely and consistent communication of the benefits these recycled products provide to the public.

10.6.2 Fortitude barriers: keeping an eye on the future

While the consultant may clearly see the advantages of sustainable water use, the client may only be focused on its quarterly costs and revenues or its regulatory requirements. These immediate needs may eclipse the question of how the company might perform most profitably in the future. The consultant must listen carefully to the client's views and understand their current concerns in order to develop a strong relationship with the client. Based on this trust, the consultant can then provide constructive feedback to expand the client's perception of the value of sustainable water use.

To be blunt, encouraging clients to consider holistic solutions can sometimes mean stepping away from a potentially lucrative contract because the solution is simply 'the right thing to do' for the public and environmental good. While the value of integrating all aspects of the water cycle can be considerable, exercising this opportunity requires considerable planning. It often necessitates the development of a water management 'roadmap' that includes a triple bottom line (environmental, economic and social) analysis of benefits and costs to the company and key decision points in the implementation of water improvements. The goal is to ensure that each strategic decision is a 'no regrets' decision, meaning contingencies are in place to fall back on if the decision's outcomes differ from that which was intended or expected. Implementation of new technology can also call for the construction of pilot projects to prove the concept before advancing to full-scale application. This involves a risk that the pilot may fail to perform as intended, requiring an alternate solution to be found.

From this perspective one can see how a consultancy, eager to meet its own business targets, might be tempted to propose design and construction of a less sustainable solution which uses a conventional technology that is well-proven but consumes excessive amounts of energy and chemicals or produces more residuals. Nonetheless, it is incumbent on the responsible consultant to help the client look beyond short-term economics to appreciate the many benefits of a holistic solution.