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KEY POINT: *The number and types of permits for a desal facility will vary by project location and other specifics, but generally fall into three broad categories: (1) where and how the source water is obtained; (2) how the desal-generated water will be used; and (3) how the brine concentrates will be managed.*

SUMMARY OF ISSUES

- The implementation of a desal project typically requires multiple permits from federal, state, and local agencies. In general, the regulatory programs and associated permitting processes revolve, and can be broadly classified, around the three streams involved in the process (Stratus Consulting 2006):
  - **Source water** (or feedwater stream) permits address the location and means of obtaining the source water used by the desal facility.
  - **Potable water** (or finished water stream) permits address the use of the finished water produced by the desal facility.
  - **Waste** (concentrate and other associated waste stream) permits address the treatment or discharge of the waste streams, including concentrate, chemical wastes from cleaning processes, and any other waste associated with the operation of the facility.
- Of these three categories, the regulatory issues related to the permitting of the concentrate and other waste streams are typically the most involved for inland facilities. Key federal permit requirements are related to the Clean Water Act. To obtain the permits, extensive environmental impact analyses may be required, depending on the specific disposal method proposed (NRC 2008).
- Other required permits (e.g., building, site work, roadway crossings) are similar to those required for construction of other types of water treatment facilities and are not addressed here.
- In some states (e.g., CA), as many as seven state or federal permits are needed before one can receive final permission to begin the planning/design/construction of a desal facility. Several of these permits may, in turn, entail consultations and approvals from various other state, local, or federal entities before the issuing agency signs off. Where federal

funding is involved, planned facilities are also subject to review under the National Environmental Policy Act (NEPA).

- In general, water agencies and other practitioners have indicated that permitting can be a lengthy, uncertain, and arduous process. It is not the fact that numerous permits are often required that poses the greatest obstacle to implementing a desal project. Rather, the greatest challenge may arise from the manner in which the permits applications are evaluated. Desal is a relatively new and uncharted territory for regulators, and desal facilities (and their potential impacts and wastestreams) are atypical of the type of operations that regulators normally monitor and permit. In other words, desal may be a round peg in regulatory settings that are set up with square holes to address square peg operations (Stratus Consulting 2006).

- Some state and local authorities may require permits in addition to those discussed below. For a detailed discussion of state and local requirements in key desal states (California, Florida, Texas) see Appendix E of the accompanying Water Research Foundation report.

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STRATEGIES

The following sections provide an overview of key federal permit requirements (and some typical state requirements), and discuss strategies for facilitating the overall process (based on Stratus Consulting 2006).

Source Water (Feedwater) Permits

Inland groundwater is easily accessed through wells and may not require significant regulatory review and approval (unless water rights and/or pumping permits are an issue).

In addition, because desalting groundwater may often be pursued in concert with an environmental restoration effort [e.g., where total dissolved solids (TDS) and other contaminant levels in the aquifer are elevated due to irrigation, agricultural run-off, or other activities], it can be viewed as part of an environmental improvement regime (i.e., making contaminated waters usable, and/or creating a barrier to limit the intrusion of lower quality water into other systems).

Therefore, compared to seawater desal, desalting inland groundwater can be relatively easy to arrange with regulators, is less likely to engender public concerns, and in fact may often be portrayed and seen as an environmental plus. Permitting and public perception, however, may present challenges for the management of concentrate from inland desal facilities (see below).

Potable Water Permits

Most desal-generated waters are expected to provide water to enhance potable supplies, and as such will require permitting as a drinking water treatment plant (i.e., require a potable water permit from the Safe Drinking Water Act (SDWA) primacy agent, typically the state public health or environmental protection agency). This should not pose any unusual challenges for water suppliers. This permit is not required if the desalted water is used for nonpotable (e.g., irrigation) purposes.

The potable water permit requires periodic compliance monitoring. One unique aspect of this permit for desal is the need to identify the monitoring points in the treatment process for filtration efficiency and turbidity compliance.

Permits for the Discharge of Brine Concentrates and Associated Wastes

Currently there are multiple levels associated with the regulation of concentrate management, including federal, state, and often local agencies with specific requirements. For inland applications, permit requirements depend on the method of disposal, as well as site-specific characteristics.

At present, desal concentrate is regulated through a default classification as an industrial waste under the Clean Water Act because the Act does not specifically address byproducts from drinking water treatment plants. However, in the State of Florida, concentrate has been given some regulatory distinction, as it is now called a "potable water byproduct" if produced by plants of size 189 m^3/day (50,000 gal/day) or smaller. Pending state legislation may extend this to plants of larger size (Mickley 2006). Nationally, separate classification of drinking water treatment plant by-products would require an amendment of the Clean Water Act.

The federal laws associated with the management of concentrate and associated wastes from desalting plants are described below.

Surface water discharge and discharge to sewer

- A CWA section 404 permit for the outfall, since placing a pipe in the water is considered "fill." This is administered by the ACE, but typically requires buy-in and approval from other agencies, such as NFWS, which have jurisdiction over fisheries and other water resource impacts.

- State primacy or federal regulators will impose federal CWA NPDES permits on inland facility surface water discharges. Presumably, reasonable pilot testing and periodic monitoring should identify if any impacts of concern may arise. However, a potential

hurdle for desal facilities may arise where concentration-based limits (or bio-monitoring) are set and measured at challenging compliance locations that do not reflect coastal conditions (e.g., inside the discharge pipe).

- Rivers and Harbors Act (Section 10) permit for the outfall pipe. This too is administered by the ACE, but the Corps will typically not issue such a permit unless other agencies (e.g. National Fish and Wildlife Service) are consulted and sign off.

- Permitting surface water discharge from inland facilities may prove challenging, depending on the nature of the concentrate and the targeted receiving waters. In some locations, however, agencies may have circumstances that allow for innovative approaches that eliminate the need for a discharge permit. For example, in Coachella Valley, the desalter is planned to feed a constructed salt marsh, and then the outflow from the marsh will flow to the Salton Sea – thus providing environmental benefits (and, possibly, eliminating the need or basis for an NPDES permit).

- Discharge to sewers (i.e., indirect discharge to a municipal wastewater treatment plant) does not require an NPDES permit, but compliance with Environmental Protection Agency Pretreatment Control Program standards and state pretreatment programs may be required. Engineering studies may be required by states for reuse-based concentrate management methods (e.g., land application, spray irrigation).

Deep well injection

As noted above, desal concentrate is considered an "industrial waste" under the Clean Water Act. As a result, concentrate is disposed of via deep well injection is subject to the SDWA's Underground Injection Control (UIC) regulations for Class I wells. This regulatory framework restricts the number of compliant well sites and requires more conservative well construction, which can increase the cost associated with this method of concentrate management.

Texas has investigated the possibility of injecting concentrate via Class II (oil and gas wells) and Class V wells (well used for some non-hazardous waters, non-industrial waters). Class II and Class V wells do not have the above mentioned Class I requirements. As of 2009, in Texas, concentrate can be injected into Class II wells for the purpose of enhanced oil recovery and into Class V wells if the concentrate is 1) of lower salinity than the reservoir salinity and 2) meets primary water quality standards.

Deep well injection is not permitted in every state, but those that do allow it, including California, Florida, Texas and New Mexico, require permits, monitoring wells, and completions in deep contained aquifers. To date, deep well injection for municipal concentrate management has been seldom used outside of Florida (where over half the desal facilities utilize this method of concentrate management), which has some of the best-suited geology (Mickley 2006).

When issuing permits, regulators will seek hydro-geologic evidence that indicates the injected wastes will remain physically isolated from other groundwater systems. Issues may also arise about whether the concentrate is a hazardous waste (or perhaps whether MCLs apply to the waste to be injected). Water supply agencies will want some assurance that the concentrate will not clog the pores of the target underground system, and thus limit the volume of concentrate that can be injected over time.

Alternative disposal options

Evaporation ponds may also be an option for managing concentrate disposal. However, the area of land required, the climate/location-specific net evaporation rate, and the likely requirement for lining (and probably double-lining) limits the feasibility of this method. Permits for evaporation ponds are not specifically required under either the NPDES or UIC programs. Permits may be prudent (or even required) if the potential exists for leakage to either surface water or a drinking water aquifer and no secondary containment method exists. A permit is recommended because it is very difficult to prove that a leak will not contaminate a potential source water (Mickley 2006).

An NPDES permit may be required for spray irrigation if the potential exists for runoff to reach a receiving water. To avoid this requirement, the facility must prove beyond reasonable doubt that no runoff can possibly travel to a receiving water, or it must provide secondary containment. Proving that runoff will never reach a receiving water is generally more costly and time consuming than obtaining a permit (Mickley 2006).

High recovery (including ZLD) processing is used in non-municipal industries and recently has received considerable interest in the municipal community as an alternative means of managing and disposing of concentrate. ZLD is a processing option and a subcategory of the more general term of high recovery processing. Due to its only recent consideration in municipal desal it is considered a concentrate management option rather than a processing option. ZLD means no water leaves the plant boundary. From its earliest use at power plant sites ZLD processing included the use of evaporation ponds as a final processing step, as well as processing of the brine to produce mixed solids.

Historical ZLD technologies involve brine concentrators, crystallizers, and spray dryers that convert concentrate to highly purified water and either a concentrated brine to be disposed of in an evaporation pond or solid dry mixed salt product suitable for landfill disposal. More recent ZLD systems include an RO (or EDR) step to reduce the volume going to the thermal processing steps or in place of them as some membrane-based ZLD systems do not contain any thermal (brine concentrators, crystallizer, spray dryer) processing steps.

In the situation where membranes are employed in high recovery processing, the resulting higher salinity concentrate usually eliminates the possibility of surface water discharge, discharge to

sewer, and land application. This leaves evaporation ponds and deep well injection as the remaining conventional disposal options. The higher salinity and higher concentration of constituents result in increased concern for the impact on groundwater from pond leakage, increased concerns with wildlife-pond interactions, and increased concerns for associated with brine-aquifer water interactions that might lead to downhole precipitation.

In the case where high recovery processing involves thermal evaporative equipment, , such as through the use of brine concentrators and crystallizers, the waste produced can be a sludge-like material or dry salts. Solids disposal methods are required including final disposal in an impervious area to eliminate the potential for contamination of surface and ground water.

Additional permitting requirements

In addition to the key permitting requirements listed above, NRC (2008) notes that the following federal laws that should also be considered:

- Resource Recovery and Conservation Act (RCRA). The by-products of desal plants are typically not considered RCRA wastes; however, it is the utility's responsibility to confirm if the concentrate produced meets the definition of a hazardous waste under RCRA.
- Solid Waste Disposal Act. This law applies to nonhazardous solid waste disposal and would apply to desal plants using a solid waste disposal method.
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This law is applicable only if the desal plant has stored, treated, or disposed of a hazardous waste as defined by RCRA. This law might apply to desal concentrate from groundwater that contains high levels of toxic elements exceeding drinking water standards.
- Hazardous Materials Transportation Act. This law applies if any hazardous residuals (e.g., cleaning waste) are transported offsite.
- Toxic Substances Control Act (TSCA). This law, which controls the sale of toxic chemical substances, applies if concentrate is defined by the TSCA chemical inventory as toxic and sold for reuse (e.g., blended with treated wastewater for reuse).
- If the waste contains technologically enhanced naturally occurring radioactive materials (TENORMs) exceeding certain levels, disposal or storage may require additional permits. Numerous state and federal regulations govern the disposal of waste that contains radionuclides, although there are currently no federal regulations that specifically address TENORMs (EPA 2005).

Working with regulators and addressing key issues

The number of permits and approvals, and the associated number of government entities to be engaged, may seem daunting for a desal project. However, it is not the fact that numerous permits are often required that poses the greatest potential obstacles to implementing a desal project. Rather, the greatest challenge to desal project implementation may arise from the time-consuming manner in which the permits applications are evaluated. This is because regulatory permitting is often implemented in a manner that does not reflect or accommodate the specific circumstances that pertain to a desal facility in terms of its location and/or its planned mode of operating.

In 2006, Stratus Consulting conducted interviews with water agency leaders and other practitioners to identify key barriers to desal implementation. A central theme to emerge from these conversations pertains to the inter-related issues of (1) how regulators view and address desal, and (2) how water agencies work with the regulators. Desal is a relatively new and uncharted territory for regulators, and desal facilities (and their potential impacts and wastestreams) are atypical of the type of operations that regulators normally monitor and permit. For example, some traditional regulatory approaches and protocols – such as issuing NPDES permits for wastewater discharges – may not be relevant for key aspects of desal operations. In other words, desal may be a round peg in regulatory settings that are set up with square holes to address square peg operations.

There are two approaches (at least) that can be used concurrently as a way of working constructively with regulators in the "round peg – square hole" context of desal facilities and operations:

- First, there needs to be an open, advance dialogue with regulators (perhaps aimed at the higher management levels of key agencies, so that cooperative signals flow down to field staff) that explains the desal issues and needs, and tries to set up a reasonable set of protocols for permit approval.

- Second, research that generates key findings, or establishes desal-suitable testing/monitoring protocols, will help give comfort and reassurance to regulators that find themselves facing permitting issues in desal's unfamiliar territory.

One example is the discharge of concentrates to the estuary from which the water was originally extracted. NPDES permits, driven by the total maximum daily load (TMDL) process, tend to set *concentration-based* discharge limits. This may make sense for industrial facilities that are using or formulating various chemical or other materials, and discharging wastewaters that introduce these compounds into the effluent entering the receiving waters. However, for a desal facility, concentrate disposal is simply returning to the bay the same elements already present in the source water; it is returning slightly less mass of these compounds, but at higher concentrations than in the source water. While the amount of dilution and dispersion of concentrated brines in

the vicinity of the outfall is a matter of legitimate environmental concern and should be considered, does it make sense to have concentration-based rather than *mass-based* limits at the point of discharge for a desal facility returning matter to its source? This is one example of how a desal facility may be a round peg in a regulatory framework designed for square pegs.

Finally, it is interesting to note how different states appear to be addressing the desal issue. In Texas, the state's Commission on Environmental Quality, and the Texas Water Development Board, have taken a fairly open and supportive view of desal, and the latter agency's website offers useful guidance for water agencies considering desal options. In contrast, State of California agencies have a varied and generally more skeptical view of desal.

Design parameters

The California Desalination Handbook (CDWR 2008) provides a number of facility design options and/or characteristics that can help to facilitate the permitting process. These suggestions are based on the idea that designing a proposed project using the applicable regulatory requirements as design constraints can help complete the project successfully.

CDWR recognizes that the following suggestions are not feasible for every facility, however, under conditions where they are applicable, the following may facilitate the permitting process:

- Inland facilities or facilities away from the shoreline are typically easier to permit than coastal facilities.
- Subsurface seawater intakes are likely easier to permit than open-water intakes.
- Publicly-owned facilities are likely easier to permit than privately-owned.
- Facilities with known service areas are likely easier to permit than facilities with unknown or extensive service areas.
- Facilities that are part of a coordinated local or regional water portfolio are likely easier to permit than facilities proposed by a single, independent entity.
- Proposed desal projects that have undertaken a thorough, transparent planning process will more likely be easier to permit than those which have not
- Early and ongoing coordination with permitting agencies and the public is likely to make the process easier than with little or no coordination.

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BENEFITS & COSTS

Benefits

- Existing permitting processes are in place to protect the public trust, local communities, residents and business in service areas, and environmental resources.
- Early and ongoing coordination with permitting agencies and the public is likely to facilitate the permitting process, decrease associated costs, and increase public acceptance.

Costs

- The compliance process for all of the aforementioned permits is complex and necessitates a detailed review in the planning phase. Overall, the costs and time involved in the permitting process are significant and, regardless of the capacity of the facility, the regulatory requirements involved in the process are approximately similar.

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KEY UNCERTAINTIES

Desal is a relatively new and uncharted territory for regulators, and desal facilities (and their potential impacts and wastestreams) are atypical of the type of operations that regulators normally monitor and permit. Some traditional regulatory approaches and protocols – such as issuing NPDES permits for wastewater discharges – may not be relevant for key aspects of desal operations. In other words, desal may be a round peg in regulatory settings that are set up with square holes to address square peg operations.

Therefore, regulators may feel the need to stick with tried and true permitting approaches that simply do not fit the real world circumstances that pertain to desal operations. Thus, some regulators may need education, suitable protocols, and credible technical assurances that if they take a different tact with desal (compared to how they might regulate other entities), then they are well justified in doing so.

Ultimately, it seems like a useful objective to try to define some standardized approaches to desal permitting and other regulatory issues, using credible and appropriate approaches to address legitimate concerns (and avoiding unnecessary or irrelevant steps and procedures).

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ADDITIONAL RESOURCES

CDWR (California Department of Water Resources). 2008. California Desalination Planning Handbook. 2008. Prepared by: California State University, Sacramento Center for Collaborative Policy. Available: http://www.owue.water.ca.gov/recycle/docs/Desal_Handbook.pdf

EPA. 2005. A Regulators' Guide to the Management of Radioactive Residuals from Drinking Water Treatment Technologies. EPA 816-R-05-004. Available: http://www.epa.gov/radiation/docs/tenorm/816-r-05-004.pdf. Accessed December 21, 2007.

Mickley, M.C. 2006. *Membrane Concentrate Disposal: Practice and Regulation (2nd Edition). Desalination & Water Purification Research & Development Program Report #123*. Denver, Colo.: USBR. Available: http://www.usbr.gov/pmts/water/publications/reportpdfs/report123.pdf.

NRC (National Research Council). 2008. *Desalination: A National Perspective*. Washington, D.C.: National Academy Press. Available: http://www.nap.edu/catalog/12184.html

Stratus Consulting. 2006. Institutional Issues in Desalination and Water Purification Technologies, Final Report. Prepared for Joint Water Reuse and Desalination Task Force, AWWA Research Foundation, Sandia National Laboratory, U.S. Bureau of Reclamation, WateReuse Foundation. Boulder, Colo.: Stratus Consulting Inc.

Xu, P., T. Cath, G. Wang, J.E. Drewes, and S. Dolnicar. 2009. *Critical Assessment of Implementing Desalination Technology*. Denver, Colo.: Water Research Foundation.

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