Testimony of Heather Cooley before the Assembly Select Committee on Coastal Protection "Seawater Desalination Impacts"

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Good morning Chair Stone and members of the Assembly Select Committee on Coastal Protection. My name is Heather Cooley, and I am Director of the Water Program at the Pacific Institute. Thank you for having this hearing today and inviting me to offer testimony.

The Pacific Institute is nonprofit research institute based in Oakland, California. In June 2006, we released the first comprehensive assessment of the advantages and disadvantages of seawater desalination for California. At that time, there were 21 active seawater desalination proposals along the California coast. More recently, in 2011, the Pacific Institute began a new research initiative on seawater desalination. As part of that effort, we conducted some 25 one-on-one interviews with industry experts, environmental and community groups, and staff of water agencies and regulatory agencies to identify some of the key outstanding issues for seawater desalination projects in California. We released four separate studies on these issues, including on the proposed desalination plants, cost and financing, energy and greenhouse gas emissions, and marine impacts.

In this earlier panel, I will focus my remarks on seawater intakes. In a later panel, I will touch on the broader policy perspectives.

Marine Impacts of Seawater Intakes

On average, seawater desalination plants withdraw two gallons of water for every gallon of freshwater produced. As noted in a 2005 California Energy Commission analysis, "seawater… is not just water. It is habitat and contains an entire ecosystem of phytoplankton, fishes, and invertebrates."[1] As a result, the intake of seawater from the ocean results in the impingement and entrainment of marine organisms. Impingement occurs when fish and other large organisms are trapped on the intake screen, resulting in their injury or death. Entrainment occurs when organisms small enough to pass through the intake screens, such as plankton, fish eggs, and larvae, are killed during processing of the salt water.

The impacts of impingement and entrainment from desalination plants on the marine environment are not well understood. Much of what is known has been drawn from studies on

[1] York, R. and M. Foster. (2005). *Issues and Environmental Impacts Associated with Once-Through Cooling at California's Coastal Power Plants*. California Energy Commission. Sacramento, California.

coastal power plants that use once-through cooling (OTC) systems. These studies have found that impingement and entrainment at California's coastal power plants vary considerably based on the location, year, and even time of year.[2] Further, they have found that while it is widely acknowledged that OTC systems damage the marine environment, the full extent of these impacts may never be fully understood due to a lack of comprehensive monitoring and evaluation of marine ecosystems.

Minimizing Marine Life Impacts from Intakes

The majority of desalination plants in operation around the world employ surface intakes. For these intakes, there are several design and operational measures to reduce impingement and entrainment. These include:

- reducing the size of the desalination plant, thereby withdrawing less water from the marine environment;
- improving the recovery rate, such that less water is withdrawn per unit water produced;[3]
- locating the intake in areas of low biological productivity;
- installing low-velocity intakes that allow some organisms to swim out of the current; and
- temporarily reducing pumping or intake velocity during critical periods for marine organisms, such as during spawning or important larval stages.

There are also several technological measures to reduce impingement and/or entrainment from surface intakes. Physical barriers, e.g., mesh or wedgewire screens, block fish passage into the desalination plant and may be coupled with some sort of fish collection and return system. Behavioral deterrents, e.g. strobe lights or velocity caps, provide a signal to keep fish and other organisms away from the intake area or prevent them from crossing a threshold where they may be impinged.

Subsurface intakes offer an alternative to open water intakes. Subsurface intakes extract seawater from beneath the seafloor or a beach and provide several important advantages over surface intakes. By using sand and sediment as a natural filter, they eliminate impingement and entrainment. Subsurface intakes also reduce the complexity of the pre-treatment system, lowering energy requirements and improving the operational reliability of the plant, e.g., by avoiding production losses that could occur during algal blooms. While the capital costs of

[2] For example, Diablo Canyon and San Onofre nuclear generating plants withdrew similar quantities of water, yet in an average year, San Onofre entrained three times as many fish and fish larvae and impinged 9,000 times more fish than Diablo Canyon.

[3] Typically seawater desalination plants are designed to recover (turn into freshwater) 45% to 55% of the seawater collected by the intake. Designing the plant to operate closer to the upper limits of recovery (i.e., 50 to 55%) would require withdrawing less water and as a result, would reduce both impingement and entrainment.

subsurface intakes can be slightly to significantly higher than surface intakes, the overall operating costs are 5% to 30% lower, resulting in significant cost saving over operating periods of 10 to 30 years.

A small but growing number of desalination plants are using subsurface intakes. While a full inventory of plants using this technology is not available, available data show that subsurface intakes are being used in plants with a capacity of 2.4 million gallons per day (MGD) to 21 MGD (Table 1). While subsurface intakes are limited to areas with proper geology and sediment characteristics, with new drilling technologies, e.g., directional drilling, suggest that it is possible to find a pocket with the right conditions surrounded by generally unfavorable ones. When the appropriate site conditions are present, the advantages are clear.

Table 1. Partial list of seawater desalination plants using subsurface intakes.

Plant	Location	Capacity (MGD)	Type	Date Installed
Sur	Oman	21	Vertical wells	2009
Pinatar	Spain	17	Horizontal wells	2003
Alicante IV	Spain	17	Vertical wells	2008
La Tordera	Spain	16	Vertical wells	2009
Fukuoka	Japan	13	Offshore gallery	2005
Alicante II	Spain	10	Horizontal wells	2008
Pembrooke	Malta	7	Vertical wells	1994
Santa Barbara	Curacao	6.6	Onshore karst pit	2012
Ghar Lapsi	Malta	6.5	Vertical wells	1983
W.E.B.	Aruba	6.3	Vertical well	2011
Los Cabos	Mexico	5.5	Vertical wells	2006
Salina Cruz	Mexico	4.0	Radial well	2000
Ibiza	Spain	3.3	Vertical wells	2009
Blue Hills	Bahamas	2.9	Vertical wells	2008
Windsor	Bahamas	2.5	Vertical wells	1997
North Side	Cayman	2.4	Vertical wells	2009
Castillo	Cayman	2.4	Vertical wells	1987

Source: Water Desalination Report. September 2014. Volume 50, Number 33.

Conclusions

Seawater desalination, like other major industrial processes, has environmental impacts that must be understood and mitigated. One of the key environmental impacts of seawater reverse-osmosis desalination plants is associated with their intakes. The majority of desalination plants extract water directly from the ocean through open water intakes which have a direct impact on marine life. Impacts on the marine environment are not fully understood but are likely to be species- and site-specific.

Several operational, design, and technological measures are available to reduce and even eliminate impingement and entrainment from seawater intakes. These options measures should be adopted in California. In particular,

- intake pipes should be located outside of areas with high biological productivity and be designed to minimize impingement and entrainment; and
- project proponents should thoroughly investigate the feasibility of subsurface intakes, including the evaluation of alternative siting and reduced design capacity of the project.

Given the likely continued uncertainty about the marine impacts of seawater intakes, monitoring of existing and proposed desalination plants is vital to improving our understanding of the sensitivity of the marine environment and can help to promote more effective operation and design to minimize ecological and biological impacts.

- Regulators should require desalination plant operators to develop adequate monitoring programs that include multiple sites, adequate replication of samples, and baseline data. Moreover, monitoring data should be subject to third-party validation and be made easily available at no cost by internet in an accessible format (e.g., data files rather than PDF summaries where appropriate) to all concerned parties, including the general public.

Thank you for the opportunity to speak before you today, and I am happy to answer any questions.