Abbreviated Executive Summary

SUBSURFACE INTAKE FEASIBILITY STUDY

The City of Santa Barbara's desalination plant is supplied with seawater through a screened open ocean intake and is permitted for 10,000 acre-feet per year (AFY) of finished water. According to the City's Long-Term Water Supply Plan, seawater desalination is a water supply used during and immediately after periods of extended drought. In 2014, the City of Santa Barbara initiated a study to meet requirements set forth by City Council and the Regional Water Quality Control Board to evaluate the feasibility, cost, and timeline of converting the offshore screened open ocean intake facility into a subsurface desalination intake (SSI). To do this, the water supply must provide 15,898 gallons per minute (gpm) of seawater. This executive summary summarizes the findings of this study.

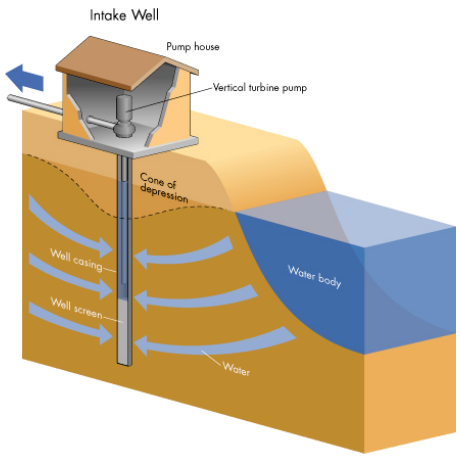
For this study, the following six SSI technologies were considered; each of these technologies is presented in Figure 1.

1) Vertical wells.
2) Lateral beach wells (i.e., onshore infiltration galleries).
3) Horizontal collector wells (i.e., Ranney Wells, Radial Collector Wells).
4) Slant wells.
5) Subsurface infiltration galleries (SIG) located offshore.
6) Horizontal directionally drilled (HDD) wells (i.e., Neodren).

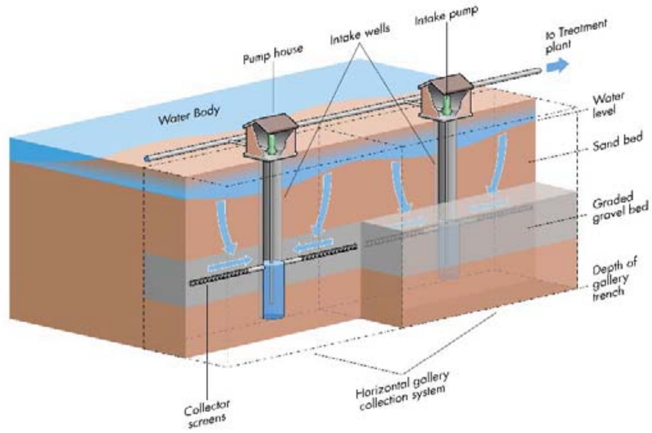
The study included a technical advisory panel (TAP) to provide an independent, third part review of the feasibility evaluation at key intervals throughout the project duration. The TAP had the following three objectives: 1). Provide timely review of project work products by subject matter experts to advise and guide the study; 2). Facilitate input from project stakeholders that can be used to inform the City's comparison of alternatives; and 3). Create a record of the review and stakeholder process to be included as an appendix to the feasibility study report. The City retained the services of the National Water Research Institute (NWRI) to administer the TAP, including soliciting public comments and providing complete documentation of the technical review and comment process on the project website.

To evaluate these technologies, several criteria were established based on geotechnical, hydrogeologic, and oceanographic factors as well as the presence of sensitive habitats and any design and construction constraints. Technologies were then classified as "not feasible," "potentially feasible but does not meet current study goals," or "potentially feasible." Only "potentially feasible" technologies would be evaluated further for their social, environmental, and economic feasibility.

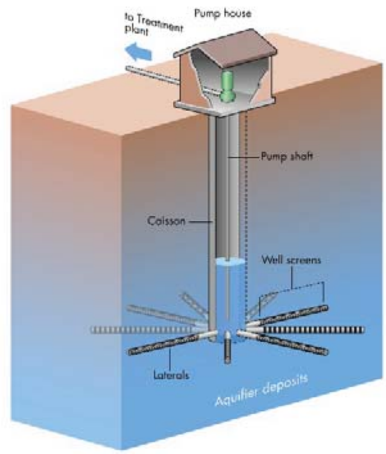
Figure 2 presents a summary of the potential water yield from each of the SSI alternatives. For the initial screening analysis, conceptual designs were developed for technologies that met basis of design requirements established in the study. For example, a conceptual design was not developed for constructing a SIG because it was not feasible at any project site due to the presence of geologic faults and its inability to protect against filter bed erosion. Technologies that did not meet the study goals (e.g., able to produce 15,898 gpm) still had conceptual designs developed based on the greatest production capacity that could be obtained given the hydrogeological or land area restrictions.



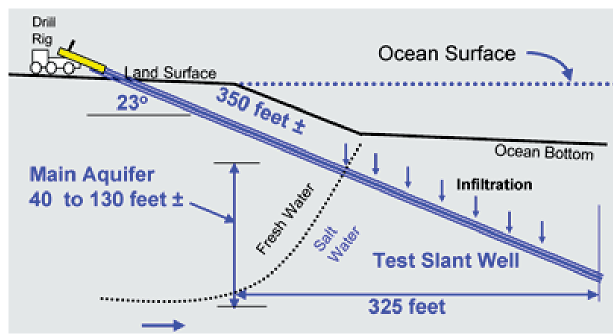
Vertical Wells



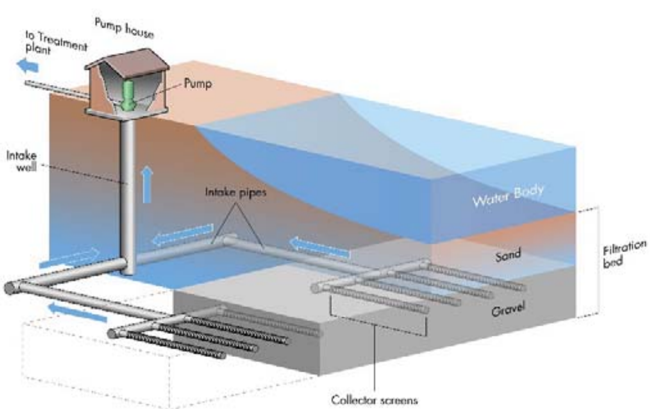
Lateral Beach Wells
(Onshore Infiltration Galleries)



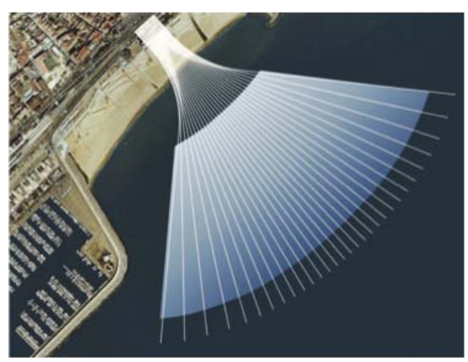
Horizontal Collector Wells
(i.e., Ranney Wells)



Slant Wells



SIG - offshore



HDD Wells
(i.e., Neodren)

Figure 1 - Subsurface Intake Technology Alternatives

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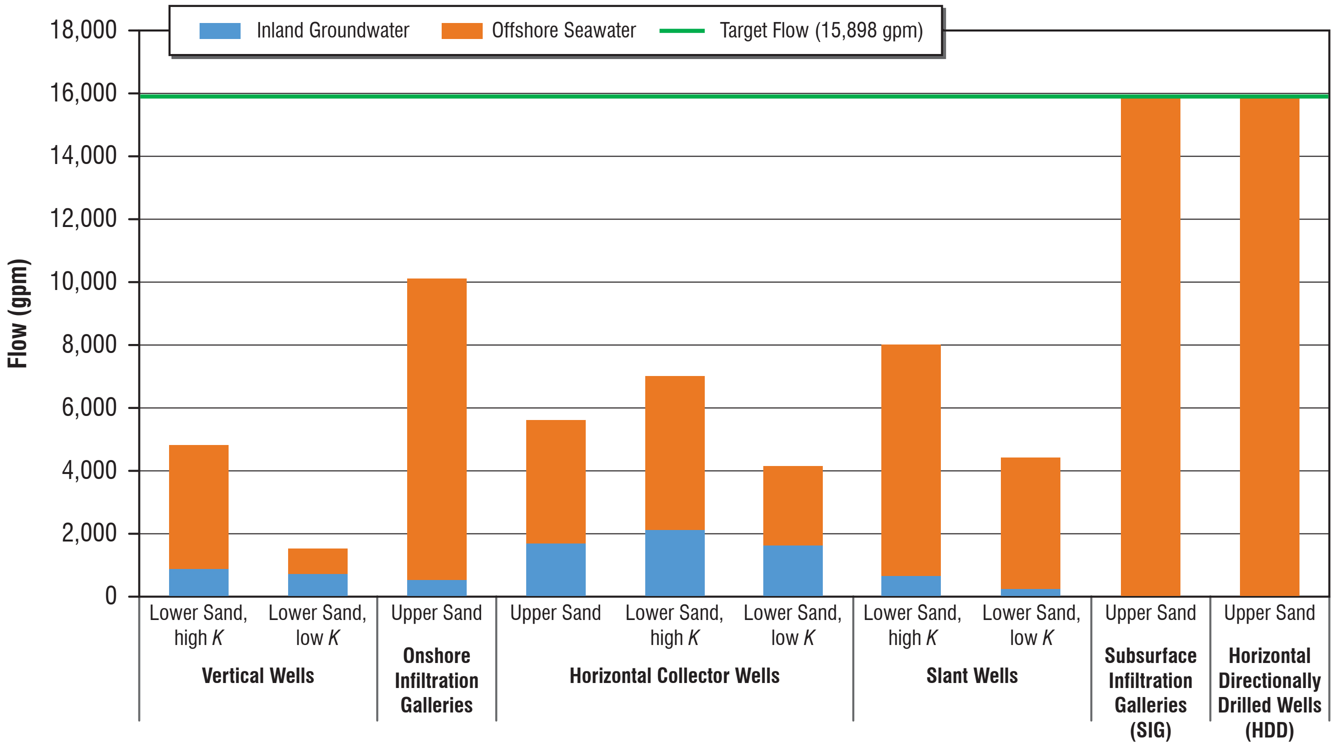

NOTES:

1. Lower sand and upper sand represent the aquifer unit where the subsurface intake would be constructed.
2. *K* represents hydraulic conductivity and is representative of how easily water can pass through soil.
3. Inland groundwater is freshwater withdrawn from local, non-seawater aquifers.
4. Flow from some subsurface intakes would be a combination of freshwater and seawater as shown above.
5. SIG and HDD wells are able to produce a flow of 15,898 gpm, and are the only two alternatives that derive all of their flow from offshore sources.

Figure 2 - Water Yield From Subsurface Intake Alternatives

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Table 1 presents the results of the initial screening analysis. As the table shows, no technologies evaluated were deemed "potentially feasible" given the study objectives.

Of the technologies evaluated, only SIG and HDD wells met the requirement of adequate capacity within the City-owned beachfront. These technologies also only derive flow from offshore sources and do not affect onshore groundwater resources. In contrast, the other technologies evaluated can only produce between 9 and 64 percent of the required flow and may affect inland groundwater.

However, SIG failed technical feasibility screening in several categories, including the inability to mitigate and protect against seismic hazards and erosion. HDD wells did pass all initial screening criteria, but they ultimately failed because they lacked prior successful precedent in a similar application. With time, HDD well technology is likely to improve and may become more reliable. At present, though, the City cannot have its water supply depend on an unproven or unreliable technology.

Although no SSI alternative passed the initial screening analysis, the information developed and presented in the report will be used to inform future studies.

Table 1 Subsurface Desalination Intake Initial Screening Results

Initial Screening Criteria		Subsurface Intake Alternative					
		Vertical Beach Wells	Onshore Infiltration Gallery	Radial Collector Wells	Slant Wells	Subsurface Infiltration Galleries	HDD Wells
Geotechnical Hazards							
1	*Seismic Hazard*						
a.	Project facilities would cross a known fault line, or be exposed to a seismic hazard that could otherwise not be protected from loss by design	PF	PF	PF	PF	NF	PF
Hydrogeological Factors							
2	*Impact on existing freshwater aquifers, local water supplies, or existing water users*						
a.	Volume of groundwater in storage is reduced due to subsurface intake pumping, impacting drought supply and requiring additional desalination to make up for loss of groundwater.	PF	PF	PF	PF	PF	PF
b.	Operation of subsurface intake causes salt water intrusion into groundwater aquifers.	PF	PF	PF	PF	PF	PF
3	*Impact to sensitive habitats such as marshlands, drainage areas, etc.*						
a.	Operation of subsurface intake drains surface water from sensitive habitat areas or adversely changes water quality.	PF*	PF*	PF*	PF*	PF	PF
4	*Insufficient length of beach available for replacing full yield derived from existing open ocean intake*						
a.	Small individual facility yield, large number of facilities required, and minimum spacing between facilities requires more shoreline than is available.	PF*	PF*	PF*	PF*	PF	PF
Benthic Topography							
5	*Land type makes intake construction infeasible.*						
a.	Depth to bedrock too shallow (i.e., less than 40-feet deep); rocky coastline; cliffs	PF	PF	PF	PF	PF	PF
Oceanographic Factors							
6	*Erosion, sediment deposition, sea level rise, or tsunami hazards*						
a.	Oceanographic hazards make aspects of the project infrastructure vulnerable in a way that cannot be protected and/or would prevent the City from being able to receive funding or insurance for this concept.	PF (5)	PF (4) (5)	PF (5)	PF (5)	NF (5)	PF (5)

Initial Screening Criteria		Subsurface Intake Alternative: Vertical Beach Wells	Onshore Infiltration Gallery	Radial Collector Wells	Slant Wells	Subsurface Infiltration Galleries	HDD Wells
Presence of Sensitive Habitats							
7	*Proximity to marine protected areas*						
a.	Location would require construction within a marine protected area.	PF	PF	PF	PF	PF	PF
Design and Construction Constraints							
8	*Adequate Capacity*						
a.	Subsurface material lacks adequate transmissivity to meet target yield of at least 15,898 gpm (i.e., build-out intake capacity necessary to produce 10,000 AFY).	PF*	PF*	PF*	PF*	PF	PF
9	*Lack of adequate linear beach front for technical feasibility*						
a.	Length of beachfront available is not sufficient for construction of the required number of wells of all or portion of intake to meet target yield.	PF*	PF*	PF*	PF*	PF	PF
10	*Lack of adequate land for required on-shore facilities*						
a.	Surface area needed for on-shore footprint (i.e., pump house) of an intake unit is greater than the available onshore area.	PF	PF	PF	PF	PF	PF
b.	Requires condemnation of property for new on-shore intake pumping facilities.	PF	PF	PF	PF	PF	PF
11	*Lack of adequate land for required on-shore construction staging*						
a.	The amount of land available to stage construction does not meet need.	PF	PF	PF	PF	PF	PF
12	*Precedent for subsurface intake technology*						
a.	Intake technology has not been used before in a similar seawater or fresh water application at a similar scale.	PF	PF	PF	PF	PF	PF
Passes Initial Screening? Yes (Y) or No (N)		N	N	N	N	N	N

Notes:

(1) NF = Not Feasible

(2) PF = Potentially Feasible

(3) PF* = Potentially Feasible, but does not meet current study goals

(4) Potentially feasible at Leadbetter and West Beach only. Sediment transport conditions at East Beach make the implementation of an onshore infiltration gallery infeasible (refer to Section 3.4.2).

(5) Refer to Section 3.4. Beach facilities would be susceptible to inundation and erosion as a result of tsunami and would also be increasingly impacted by seawater rise over the 20 year project life. Electrical buildings and wet wells will need to be constructed in a manner that provides flood protection.