List of Inputs

West Basin

Required Inputs	Unit	Number of inputs	Input Required for Criteria #
Land type (beach, bay, estuary, cliffs, rocky coastline)	beach, bay, estuary, cliffs, rocky coastline	1 per project	1, 11
Required Capacity	MGD	1 per project	2, 3, 19, 21
Land take per unit (linear beach front)	ft	1 per SSI	2, 3
Land take per unit (area of beach front)	sf	1 per SSI	
Number of units	no.	1 per SSI	2, 3, 22
Available beach front	ft	1 per project	2
Available land (offshore and onshore)	acre	1 per project	3
CEQA approved?	Y/N	1 per SSI	4
Available area for drilling	sf	1 per project	5
Topography of the construction zone	flat/moderately uneven/uneven	1 per project	7
Slope of the construction zone	high slope/moderate slope/low slope	1 per project	7
Significant wave height	ft	1 per project	8, 14
Depth to seabed	ft	1 per project	9
Transmissivity	gpd/ft	1 per SSI	11
Overlying conductance	1/d	1 per SSI	11
SSI infrastructure is located in 30 year potentially impacted area and is below the 30 year predicted sea level rise	Y/N	1 per project	12
Rate of change of beach width over 30 years (based on historical aerial	%	1 per project	13
Saturation Index of selected precipitates	none	1 per project	14
Sedimentation Rate	mm/yr	1 per project	14
Silt Density Index	none	1 per SSI	15
Feedwater will be considered extremely impaired source by DDW	Y/N	1 per project	16
Protected species/habitats present	Y/N	1 per project	17
Potential for conflict with existing land use	Y/N	1 per SSI	18
Existing/planned production rate of nearby aquifer	mgd	1 per project	19
Presence of contaminant plume(s) in the vicinity	Y/N	1 per project	20

Draft SSI Feasibility Framework
Level 1
West Basin

FATAL FLAWS

ID	Fatal Flaw	Required Inputs	Comments	Vertical Wells	Slant Wells	Radial Collectors (Ranney Wells)	Horizontal Wells	Beach Infiltration Gallery	Seabed Infiltration Gallery	Water Tunnel	References
				SSI specific threshold	SSI specific threshold	SSI specific threshold	SSI specific threshold	SSI specific threshold	SSI specific threshold	SSI specific threshold	
1	Land type makes construction of SSI infeasible	Land type (beach, bay, estuary, cliffs, rocky coastline)		Rocky coastline (shallow bedrock)	Cliffs	Rocky coastline (shallow bedrock)	Cliff	Cliff, rocky coastline	None	None	1
2	Not sufficient beach front available to construct SSI	Required capacity, Land take per unit, number of units needed, available beach front		Length of beach front needed for construction of SSI is >80% of available beach front	Length of beach front needed for construction of SSI is >80% of available beach front	Length of beach front needed for construction of SSI is >80% of available beach front	Length of beach front needed for construction of SSI is >80% of available beach front	Length of beach front needed for construction of SSI is >80% of available beach front	not applicable	not applicable	2, 3 ,18, 19, 22, 23, 26, 33, 34, 45, 49
3	Not sufficient land (onshore or offshore) available to construct SSI	Required capacity, Land take per unit, number of units needed, available land		Surface area needed for total # of units (onshore and offshore) is > 80% of available area	Surface area needed for total # of units (onshore and offshore) is > 80% of available area	Surface area needed for total # of units (onshore and offshore) is > 80% of available area	Surface area needed for total # of units (onshore and offshore) is > 80% of available area	Surface area needed for total # of units (onshore and offshore) is > 80% of available area	Surface area needed for total # of units (onshore and offshore) is > 80% of available area	Surface area needed for total # of units (onshore and offshore) is > 80% of available area	3
4	SSI project will not be approved through CEQA	CEQA analysis		SSI cannot be approved through CEQA	SSI cannot be approved through CEQA	SSI cannot be approved through CEQA	SSI cannot be approved through CEQA	SSI cannot be approved through CEQA	SSI cannot be approved through CEQA	SSI cannot be approved through CEQA	6

SIGNIFICANT CHALLENGES SCORING (0=Not challenging/slightly challenging, 1=Moderately challenging, 2=Highly challenging)																				
ID		Challenge	Required Inputs	Comment		Vertical Wells		Slant Wells		Radial Collectors (Ranney Wells)		Horizontal Wells		Beach Infiltration Gallery		Seabed Infiltration Gallery		Water Tunnel		References
5	**Construction**	Limited area available for drilling equipment	Available area (in square feet), number of wells	Actual area requifed depends on drilling method.		**Available Area** per well to drill is: < 10,000 ft^2 (2) 10,000 – 50,000 ft^2 (1) > 50,000 ft^2 (0)		**Available Area** per well to drill is: < 10,000 ft^2 (2) 10,000 – 50,000 ft^2 (1) > 50,000 ft^2 (0)		**Available Area** per well to drill is: < 10,000 ft^2 (2) 10,000 – 50,000 ft^2 (1) > 50,000 ft^2 (0)		**Available Area** per well to drill is: < 10,000 ft^2 (2) 10,000 – 50,000 ft^2 (1) > 50,000 ft^2 (0)		**Available Area per well to drill:** NA		**Available Area per well to drill:** NA		**Available Area per well to drill:** NA		35
6		General complexity of construction	none required			**General Construction Complexity (in any settings)**: Assume Low for all cases (0)		**General Construction Complexity (in any settings):** Assume Medium for all cases (1)		**General Construction Complexity (in any settings)**: Assume Medium for all cases (1)		**General Construction Complexity (in any settings):** Assume Medium for all cases (1)		**General Construction Complexity (in any settings):** Assume Medium for all cases (1)		**General Construction Complexity (in any settings):** Assume High for all cases (2)		**General Construction Complexity (in any settings):** Assume High for all cases (2)		20, 35, 39, 46, 51, 52
7		Uneven topography will make construction challenging	Topography (highly uneven, moderately uneven, flat), slope			**Topography**: Highly uneven (2) Moderately Uneven (1) Flat (0)		**Topography**: Highly uneven (2) Moderately Uneven (1) Flat (0)		**Topography**: Highly uneven (2) Moderately Uneven (1) Flat (0)		**Topography**: Highly uneven (2) Moderately Uneven (1) Flat (0)		**Slope in the surf zone:** High (2) Medium (1) Low (0)		**Slope of the seabed:** High (2) Medium (1) Low (0)		**Slopes/Topography:** NA		
8		Wave energy will make construction challenging	Significant wave height, Hs (in feet).	Hs is average of highest 1/3 of wave heights. See US Army Corps of Engineers Wave Information.		**Wave energy:** NA		**Wave energy:** NA		**Wave energy:** NA		**Wave energy:** NA		**Energy in the breaking wave zone is (based on significant wave height Hs)**: High (> 9 ft) (2) Medium (3 ft - 9 ft) (1) Low (< 3 ft) (0)		**Energy in the construction zone is (based on significant wave height Hs)**: High (> 9 ft) (2) Medium (3 ft - 9 ft) (1) Low (< 3 ft) (0)		**Only applies if offshore construction is necessary. Energy in the construction zone is (based on significant wave height Hs)**: High (> 9 ft) (2) Medium (3 ft - 9 ft) (1) Low (< 3 ft) (0)		53
9		Depth to seabed will make construction challenging	Depth to seabed			**Depth to seabed:** NA		**Depth to seabed:** NA		**Depth to seabed:** NA		**Depth to seabed:** NA		**Depth to seabed:** NA		**Depth to seabed:** > 50 ft (2) 15 - 50 ft (1) < 15 ft (0)		**Only applies if offshore construction is necessary. Depth to seabed:** > 50 ft (2) 15 - 50 ft (1) < 15 ft (0)		52
10		Land type will make construction challenging	Land type (beach, bay, estuary, cliffs, rocky coastline)			**Land type:** Cliff (2)		**Land Type:** Cliff (2) Rocky coastline (1)		**Land Type:** Cliff (2) Rocky coastline (1)		**Land Type:** Cliff (2) Rocky coastline (1)		**Land Type:** NA		**Land Type:** NA		**Land Type:** NA		

SIGNIFICANT CHALLENGES SCORING (0=Not challenging/slightly challenging, 1=Moderately challenging, 2=Highly challenging)

ID		Challenge	Required Inputs	Comment		Vertical Wells		Slant Wells		Radial Collectors (Ranney Wells)		Horizontal Wells		Beach Infiltration Gallery		Seabed Infiltration Gallery		Water Tunnel		References
11	**Operation (Intake)**	Geologic conditions will limit intake rate	Transmissivity of SSI intake interval (aquiifer: hydraulic conductivity and thickness), and hydraulic conductance (K'/b') of intervening material between the the SSI intake interval and the sea (vertical hydraulic conductivity divided by thickness). Reference 22	The highest score in any of the subcriteria will be applied as the score for the criteria Technical challenges cannot be overcome therefore a conservative scoring system is used here with the highest score applied for the criteria		**Transmissivity:** > 88,000 gpd/ft (11,764 ft^2/d) (0) 25,000 gpd/ft to 88,000 gpd/ft (1) < 25,000 gpd/ft (2)		**Transmissivity:** > 88,000 gpd/ft (11,764 ft^2/d) (0) 25,000 gpd/ft to 88,000 gpd/ft (1) < 25,000 gpd/ft (2)		**Transmissivity:** > 88,000 gpd/ft (11,764 ft^2/d) (0) 25,000 gpd/ft to 88,000 gpd/ft (1) < 25,000 gpd/ft (2)		**Transmissivity:** > 88,000 gpd/ft (11,764 ft^2/d) (0) 25,000 gpd/ft to 88,000 gpd/ft (1) < 25,000 gpd/ft (2)		**NA for engineered fill**		**NA for engineered fill**		**Transmissivity:** > 88,000 gpd/ft (11,764 ft^2/d) (0) 25,000 gpd/ft to 88,000 gpd/ft (1) < 25,000 gpd/ft (2)		22
						Overlying Conductance [units of (ft/d)(1/ft) = 1/day] >10 (0) 1 to 10 (1) <1 (2)		**Overlying Conductance [units of (ft/d)(1/ft) = 1/day]** >10 (0) 1 to 10 (1) <1 (2)		**Overlying Conductance [units of (ft/d)(1/ft) = 1/day]** >10 (0) 1 to 10 (1) <1 (2)		**Overlying Conductance [units of (ft/d)(1/ft) = 1/day]** >10 (0) 1 to 10 (1) <1 (2)		**NA for engineered fill**		**NA for engineered fill**		**Overlying Conductance [units of (ft/d)(1/ft) = 1/day]** >10 (0) 1 to 10 (1) <1 (2)		7,8, 21, 27, 36, 37, 38, 44, 47
12		Significant measures will be required to protect SSI against anticipated sea level rise	SSI infrastructure is located in 30 year potentially impacted area and is below the 30 year predicted sea level rise (Y/N)	Weighting of scoring (see weighting matrix) accounts for relative importance of sea level rise for different SSIs (e.g. sea level rise is more imporant for vertical wells on the beach than for horizontal wells, which usually would start further back from the sea at a higher elevation).		**Vulnerability to sea level rise** is Low = SSI infrastructure is not located in 30 year potentially impacted area and/or is above the 30 year predicted sea level rise (0) High = SSI infrastructure is located in 30 year potentially impacted area and is below the 30 year predicted sea level rise (2)		**Vulnerability to sea level rise** is Low = SSI infrastructure is not located in 30 year potentially impacted area and/or is above the 30 year predicted sea level rise (0) High = SSI infrastructure is located in 30 year potentially impacted area and is below the 30 year predicted sea level rise (2)		**Vulnerability to sea level rise** is Low = SSI infrastructure is not located in 30 year potentially impacted area and/or is above the 30 year predicted sea level rise (0) High = SSI infrastructure is located in 30 year potentially impacted area and is below the 30 year predicted sea level rise (2)		**Vulnerability to sea level rise** is Low = SSI infrastructure is not located in 30 year potentially impacted area and/or is above the 30 year predicted sea level rise (0) High = SSI infrastructure is located in 30 year potentially impacted area and is below the 30 year predicted sea level rise (2)		**Vulnerability to sea level rise** is Low = SSI infrastructure is not located in 30 year potentially impacted area and/or is above the 30 year predicted sea level rise (0) High = SSI infrastructure is located in 30 year potentially impacted area and is below the 30 year predicted sea level rise (2)		not applicable		not applicable		30, 42, 54, 58, 59, 60
13		Significant measures will be required to protect or restore intake works from erosion or scour.	Rate of change of beach width over time Significant wave height (ft)	The highest score in any of the subcriteria will be applied as the score for the criteria. Weighting of scoring (see scoring worksheet) accounts for relative importance of this criteria for different SSIs (e.g. erosion/scouring is more imporant for horizontal wells, which screen could be exposed following significant erosion, than for vertical wells).		Based on historical aerial photos, **rate of beach erosion** is Low = unnoticeable change of coastline (< 10% of beach width over 30 years) between historical photos and present (0) Medium = noticeable change (10% - 25% of beach width over 30 years) of coastline between historical photos and present (1) High = significant change (> 25% of beach width over 30 years) of coastline between historical photos and present (2)		Based on historical aerial photos, **rate of beach erosion** is Low = unnoticeable change of coastline (< 10% of beach width over 30 years) between historical photos and present (0) Medium = noticeable change (10% - 25% of beach width over 30 years) of coastline between historical photos and present (1) High = significant change (> 25% of beach width over 30 years) of coastline between historical photos and present (2)		Based on historical aerial photos, **rate of beach erosion** is Low = unnoticeable change of coastline (< 10% of beach width over 30 years) between historical photos and present (0) Medium = noticeable change (10% - 25% of beach width over 30 years) of coastline between historical photos and present (1) High = significant change (> 25% of beach width over 30 years) of coastline between historical photos and present (2)		Based on historical aerial photos, **rate of beach erosion** is Low = unnoticeable change of coastline (< 10% of beach width over 30 years) between historical photos and present (0) Medium = noticeable change (10% - 25% of beach width over 30 years) of coastline between historical photos and present (1) High = significant change (> 25% of beach width over 30 years) of coastline between historical photos and present (2)		Based on historical aerial photos, **rate of beach erosion** is Low = unnoticeable change of coastline (< 10% of beach width over 30 years) between historical photos and present (0) Medium = noticeable change (10% - 25% of beach width over 30 years) of coastline between historical photos and present (1) High = significant change (> 25% of beach width over 30 years) of coastline between historical photos and present (2)		Not Applicable		Not Applicable		41
						Potential for scouring of the seabed is: NA		**Potential for scouring of the seabed is:** NA		**Potential for scouring of the seabed is:** NA		**Scour potential** is related to wave energy and significant wave height (Hs): High (> 9 ft) (2) Medium (3 ft< x < 9 ft) (1) Low (< 3 ft) (0)		**Scour potential** is related to wave energy and significant wave height (Hs): High (> 9 ft) (2) Medium (3 ft< x < 9 ft) (1) Low (< 3 ft) (0)		**Scour potential** is related to wave energy and significant wave height (Hs): High (> 9 ft) (2) Medium (3 ft< x < 9 ft) (1) Low (< 3 ft) (0)		**Potential for scouring of the seabed is:** NA		53
14		Characteristics of feedwater and potential mixing are conducive to precipitating materials that will cause frequent and significant clogging of intake works	Saturation Index for mangangese oxides, iron oxides, calcium carbonate **[NEED TO DEFINE PRECIPITATES TO CONSIDER]** Sedimentation Rate	The highest score in any of the subcriteria will be applied as the score for the criteria.		potential for materials to precipitate out of feedwater and clog intake works is (based on **Saturation Index** (SI) for manganese oxides, iron oxides, calcium carbonate) High = SI > 1 (2) Moderate= 0 < SI < 1 (1) Low = SI < 0 (0)		potential for materials to precipitate out of feedwater and clog intake works is (based on **Saturation Index** (SI) for manganese oxides, iron oxides, calcium carbonate) High = SI > 1 (2) Moderate= 0 < SI < 1 (1) Low = SI < 0 (0)		potential for materials to precipitate out of feedwater and clog intake works is (based on **Saturation Index** (SI) for manganese oxides, iron oxides, calcium carbonate) High = SI > 1 (2) Moderate= 0 < SI < 1 (1) Low = SI < 0 (0)		potential for materials to precipitate out of feedwater and clog intake works is (based on **Saturation Index** (SI) for manganese oxides, iron oxides, calcium carbonate) High = SI > 1 (2) Moderate= 0 < SI < 1 (1) Low = SI < 0 (0)		not applicable		not applicable		potential for materials to precipitate out of feedwater and clog intake works is (based on **Saturation Index** (SI) for manganese oxides, iron oxides, calcium carbonate) High = SI > 1 (2) Moderate= 0 < SI < 1 (1) Low = SI < 0 (0)		12, 24, 55, 56, 57
						Sedimentation rate: NA		**Sedimentation rate:** NA		**Sedimentation rate:** NA		**Sedimentation Rate:** < 1 mm/yr (0) 1-5 mm/yr (1) >5 mm/yr (2)		**Sedimentation Rate:** < 1 mm/yr (0) 1-5 mm/yr (1) >5 mm/yr (2)		**Sedimentation Rate:** < 1 mm/yr (0) 1-5 mm/yr (1) >5 mm/yr (2)		**Sedimentation rate:** NA		31,32, 43, 55, 61

Draft SSI Feasibility Framework
Level 1
West Basin

SIGNIFICANT CHALLENGES SCORING (0=Not challenging/slightly challenging, 1=Moderately challenging, 2=Highly challenging)

ID		Challenge	Required Inputs	Comment		Vertical Wells		Slant Wells		Radial Collectors (Ranney Wells)		Horizontal Wells		Beach Infiltration Gallery		Seabed Infiltration Gallery		Water Tunnel		References
15	**Operation (Treatment)**	Water quality issues likely to cause frequent and significant fouling of treatment works	Silt Density Index (SDI)			**Silt Density Index of feedwater (SDI15) is** SDI < 2 (0) 2 < SDI < 5 (1) SDI > 5 (2)		**Silt Density Index of feedwater (SDI15) is** SDI < 2 (0) 2 < SDI < 5 (1) SDI > 5 (2)		**Silt Density Index of feedwater (SDI15) is** SDI < 2 (0) 2 < SDI < 5 (1) SDI > 5 (2)		**Silt Density Index of feedwater (SDI15) is** SDI < 2 (0) 2 < SDI < 5 (1) SDI > 5 (2)		**Silt Density Index of feedwater (SDI15) is** SDI < 2 (0) 2 < SDI < 5 (1) SDI > 5 (2)		**Silt Density Index of feedwater (SDI15) is** SDI < 2 (0) 2 < SDI < 5 (1) SDI > 5 (2)		**Silt Density Index of feedwater (SDI15) is** SDI < 2 (0) 2 < SDI < 5 (1) SDI > 5 (2)		14, 15, 16, 17
16		Potential for poor feedwater quality to impose additional permitting requirements in order to be used as a sourcewater for drinking water	Chemicals in feedwater exceed 10 times an MCL or action level (AL) based on chronic health effects (Y/N) Chemicals in feedwater exceed 3 times an MCL or AL based on acute health effects (Y/N) Feedwater is a surface water that requires more than 4 log Giardia/5 log virus reduction (Y/N) Feedwater is extremely threatened with contamination due to proximity to known contaminating activities (Y/N) Feedwater contains a mixture of contaminants of health concern (Y/N) Feewater is designed to intercept known contaminants of health concern (Y/N)	Not considering seawater constituents such as chloride. DDW (Division of Drinking Water) definition of extremely impaired source: -exceeds 10 times an MCL or action level (AL) based on chronic health effects, -exceeds 3 times an MCL or AL based on acute health effects, -is a surface water that requires more than 4 log Giardia/5 log virus reduction, -is extremely threatened with contamination due to proximity to known contaminating activities -contains a mixture of contaminants of health concern -is designed to intercept known contaminants of health concern.		Feedwater meets at least one of the criteria listed by DDW for extremely impaired source (2) Feedwater would not be considered an extremely impaired source per DDW (Division of Drinking Water) standards (0)		Feedwater meet at least one of the criteria listed by DDW for extremely impaired source (2) Feedwater would not be considered an extremely impaired source per DDW (Division of Drinking Water) standards (0)		Feedwater meet at least one of the criteria listed by DDW for extremely impaired source (2) Feedwater would not be considered an extremely impaired source per DDW (Division of Drinking Water) standards (0)		Feedwater meet at least one of the criteria listed by DDW for extremely impaired source (2) Feedwater would not be considered an extremely impaired source per DDW (Division of Drinking Water) standards (0)		Feedwater meet at least one of the criteria listed by DDW for extremely impaired source (2) Feedwater would not be considered an extremely impaired source per DDW (Division of Drinking Water) standards (0)		Feedwater meet at least one of the criteria listed by DDW for extremely impaired source (2) Feedwater would not be considered an extremely impaired source per DDW (Division of Drinking Water) standards (0)		Feedwater meet at least one of the criteria listed by DDW for extremely impaired source (2) Feedwater would not be considered an extremely impaired source per DDW (Division of Drinking Water) standards (0)		9
17	**Potential Environmental Impacts**	Potential impact to protected species or habitats will make CEQA approval challenging	Is(are) protected species/habitat(s) present at the proposed site (Y/N)			There is (are) protected species/habitat(s) at the proposed site (2)		There is (are) protected species/habitat(s) at the proposed site (2)		There is (are) protected species/habitat(s) at the proposed site (2)		There is (are) protected species/habitat(s) at the proposed site (2)		There is (are) protected species/habitat(s) at the proposed site (2)		There is (are) protected species/habitat(s) at the proposed site (2)		There is (are) protected species/habitat(s) at the proposed site (2)		
18		Potential to conflict with existing land use will make CEQA approval process challenging	Is there a potential for the SSI conflict with existing land use? (Y/N)			There is a potential for the SSI to conflict with existing land use (2)		There is a potential for the SSI to conflict with existing land use (2)		There is a potential for the SSI to conflict with existing land use (2)		There is a potential for the SSI to conflict with existing land use (2)		There is a potential for the SSI to conflict with existing land use (2)		There is a potential for the SSI to conflict with existing land use (2)		There is a potential for the SSI to conflict with existing land use (2)		4
19		Potential to disrupt existing/planned groundwater pumping or injection will make CEQA approval challenging	Required capacity of SSI, existing/planned production rate of nearby aquifer	Required capacity of SSI of 45% was considered fatal flaw in ISTAP Report	5	Required capacity of SSI is >= 25% of total existing/planned production from same aquifer (2)		Required capacity of SSI is >= 25% of total existing/planned production from same aquifer (2)		Required capacity of SSI is >= 25% of total existing/planned production from same aquifer (2)		Required capacity of SSI is >= 25% of total existing/planned production from same aquifer (2)		NA		NA		NA		5
20		Potential to mobilize contaminant plumes will make CEQA approval challenging	Are there contaminant plumes in the vicinity of the SSI? (Y/N)			There are existing contaminant plumes in the vicinity (5000 ft) of the SSI (2)		There are existing contaminant plumes in the vicinity (5000 ft) of the SSI (2)		There are existing contaminant plumes in the vicinity (5000 ft) of the SSI (2)		There are existing contaminant plumes in the vicinity (5000 ft) of the SSI (2)		NA		NA		NA		
21	**Risk (Uncertainty)**	Lack of demonstrated success of SSI in similar setting to produce a similar capacity imposes significant risk and design challenges to the project	Required capacity			An SSI system exists that has produced X% of required capacity x > 100% (0) 50% < x < 100% (1) x < 50% (2)		An SSI system exists that has produced X% of required capacity x > 100% (0) 50% < x < 100% (1) x < 50% (2)		An SSI system exists that has produced X% of required capacity x > 100% (0) 50% < x < 100% (1) x < 50% (2)		An SSI system exists that has produced X% of required capacity x > 100% (0) 50% < x < 100% (1) x < 50% (2)		An SSI system exists that has produced X% of required capacity x > 100% (0) 50% < x < 100% (1) x < 50% (2)		An SSI system exists that has produced X% of required capacity x > 100% (0) 50% < x < 100% (1) x < 50% (2)		An SSI system exists that has produced X% of required capacity x > 100% (0) 50% < x < 100% (1) x < 50% (2)		10, 11, 13, 25, 28, 40, 48, 50
22			Number of units			An SSI system exists with X% of the required number of SSI units x > 100% (0) 50% < x < 100% (1) x < 50% (2)		An SSI system exists with X% of the required number of SSI units x > 100% (0) 50% < x < 100% (1) x < 50% (2)		An SSI system exists with X% of the required number of SSI units x > 100% (0) 50% < x < 100% (1) x < 50% (2)		An SSI system exists with X% of the required number of SSI units x > 100% (0) 50% < x < 100% (1) x < 50% (2)		An SSI system exists with X% of the required gallery area. x > 100% (0) 50% < x < 100% (1) x < 50% (2)		An SSI system exists with X% of the required gallery area. x > 100% (0) 50% < x < 100% (1) x < 50% (2)		An SSI system exists with X% of the required number of SSI units x > 100% (0) 50% < x < 100% (1) x < 50% (2)		10, 13, 25, 29, 40, 37, 50

Notes

SSI = Subsurface Intake

CEQA = California Environmental Quality Act

Hs = significant wave height (Hs), which is the average of the highest one third of wave heights for 30 year record

SI =Saturation Index

mm/yr = millimeter per year

MCL = Maximum Contaminant Level

AL = Action Level

Draft SSI Feasibility Framework
Scoring Matrix
West Basin

The scoring matrix below generates a single score for each SSI for each of the challenge categories. The wieghting accounts for relative importance of specific criteria to different SSIs. For instance a higher weight is used for the clogging criteria for SSI's which are difficult to maintenance (e.g. higher weight for horizontal wells thank for vertical wells).

The raw score for each category is obtained by multiplying the score entered in the feasibility matrix with the corresponding weight below and summing the scores for each category.

The normalized scores allow for clear comparison across SSIs and challenge cateories. They are calculated by dividing the raw for each category by the maximum possible score for that category for each SSI and multiplying by 5. For example a score of 6 for construction for verical well corresponds to a normalize rating of 5, a score of 3 to a normalized rating of 2.5 and a score of 1 to a normlalized rating of 0.8.

The total normalized score for each SSI is obtained by summing the normalized scores for each category; a total normalized score of 25 being the most challenging. All normalizaed scores are shown on the "Normalized Scoring Results" tab

SSI's the are eliminated due to a fatal flaw do not receive a challenge score because they are considered infeasible.

SSI Significant Challenge Raw Score Calculation Matrix

			Vertical Wells		Slant Wells		Radial Collectors (Ranney Wells)		Horizontal Wells		Beach Infiltration Gallery		Seabed Infiltration Gallery		Water Tunnel	
ID	Category	Challenge	Weight	Score	Weight	Score	Weight	Score	Weight	Score	Weight	Score	Weight	Score	Weight	Score
5	Construction	Area available for drilling	1		1		1		1		0		0		0	
6		General complexity	1		1		1		1		1		1		1	
7		Topography	1		1		1		1		1		1		0	
8		Wave energy	0		0		0		0		1		0		1	
9		Depth to seabed	1		0		0		0		0		1		1	
10		Land type	1		1		1		1		0		0		0	
Raw Score																
11	Operation (Intake)	Geologic conditions	2		2		2		2		2		2		2	
12		Sea level rise	2		1		2		1		0		0		0	
13		Erosion/scouring issues	1		2		2		2		2		2		0	
14		Clogging Issue	1		1		1		2		1		2		2	
Raw Score																
15	Operation (Treatment)	Feedwater quality	2		2		2		2		2		2		2	
16		Division of Drinking Water Requirements	1		1		1		1		1		1		1	
Raw Score																
17	Potential Environmental Impacts	Protected species	1		1		1		1		1		1		1	
18		Existing land use	1		1		1		1		1		1		1	
19		Existing Pumping	1		1		1		1		0		0		0	
20		Contaminant plumes	1		1		1		1		0		0		0	
Raw Score																
21	Risk (Uncertainty)	Demonstrated examples (Capacity)	1		1		1		1		1		1		1	
22		Demonstrated examples (# of units)	1		1		1		1		1		1		1	
Raw Score																

Summary of Max Scores for each SSI

	Vertical Wells	Slant Wells	Radial Collectors	Horizontal Wells	Beach	Seabed	Water Tunnel
Construction	**6**	**7**	**7**	**7**	**5**	**6**	**6**
Operation (Intake)	**12**	**12**	**14**	**14**	**10**	**12**	**8**
Operation (Treatment)	**6**	**6**	**6**	**6**	**6**	**6**	**6**
Potential Impacts	**8**	**8**	**8**	**8**	**4**	**4**	**4**
Risk	**4**	**4**	**4**	**4**	**4**	**4**	**4**
Totals (max score)	**36**	**37**	**39**	**39**	**29**	**32**	**28**

DRAFT SSI Feasibility Framework
Normalized Challenge Score
West Basin

Normalized Challenge Score 0=least challenging 5=most challenging							
	Vertical Wells	**Slant Wells**	**Radial Collectors (Ranney Wells)**	**Horizontal Wells**	**Beach Infiltration Gallery**	**Seabed Infiltration Gallery**	**Water Tunnel**
Construction							
Operation (Intake)							
Operation (Treatment)							
Potential Impacts							
Risk							
Totals (25 = most challenging)							
Reason for infeasibility							

Draft SSI Feasibility Framework
Level 2 and 3 Analyses
West Basin

FATAL FLAWS

ID	Fatal Flaw	Required Inputs	Vertical Wells	Slant Wells	Radial Collectors (Ranney Wells)	Horizontal Wells	Beach Infiltration Gallery	Seabed Infiltration Gallery	Water Tunnel
			Tests/Analysis	Tests/Analysis	Tests/Analysis	Tests/Analysis	Tests/Analysis	Tests/Analysis	Recommended Test/Analysis
1	Land type makes construction of SSI infeasible	Land type (beach, bay, estuary, cliffs, rocky coastline)	No additional tests/analyses required	No additional tests/analyses required	No additional tests/analyses required	No additional tests/analyses required	No additional tests/analyses required	No additional tests/analyses required	No additional tests/analyses required
2	Not sufficient beach front available to construct SSI	Required capacity, Land take per unit, number of units needed, available beach front	**Level 2:** Characterization of Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of site-specific potential SSI construction requirements. **Level 3.** Installation and pilot testing.	**Level 2:** Characterization of Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of site-specific potential SSI construction requirements. **Level 3.** Installation and pilot testing.	**Level 2:** Characterization of Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of site-specific potential SSI construction requirements. **Level 3.** Installation and pilot testing.	**Level 2:** Characterization of Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of site-specific potential SSI construction requirements. **Level 3.** Installation and pilot testing.	**Level 2:** Characterization of Subsurface Geometry and Hydraulic Properties. Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing) Hydraulic Calculations. Review of site-specific potential SSI construction requirements. **Level 3.** Installation and pilot testing.	**NA if using engineered fill, but if using existing seafloor sediment the following apply** **Level 2:** Characterization of Subsurface Geometry and Hydraulic Properties: Grain-Size Analysi s/ Hydraulic Conductivity / Transmissivity Testing and Evaluation Hydraulic Calculations/Groundwater Modeling. Review of site-specific potential SSI construction requirements. **Level 3.** Installation and pilot testing.	**Level 2:** Characterization of Subsurface Geometry and Hydraulic Properties. Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing) Hydraulic Calculations. Review of site-specific potential SSI construction requirements. **Level 3.** Installation and pilot testing.
3	Not sufficient land (onshore or offshore) available to construct SSI	Required Capacity, Land take per unit, number of units needed, available land							
4	SSI project will not be approved through	CEQA analysis	see CEQA section below	see CEQA section below	see CEQA section below	see CEQA section below	see CEQA section below	see CEQA section below	see CEQA section below

Draft SSI Feasibility Framework
Level 2 and 3 Analyses
West Basin

SIGNIFICANT CHALLENGES

ID		Challenge	Required Inputs	Vert Wells	Slant Wells	Radial Collectors (Ranney Wells)	Horizontal Wells	Beach Infiltration Gallery	Seabed Infiltration Gallery	Water Tunnel
				Tests/Analysis	Tests/Analysis	Tests/Analysis	Tests/Analysis	Tests/Analysis	Tests/Analysis	Recommended Test/Analysis
5	**Construction**	Limited area available for drilling equipment	Available area (in square feet), number of wells	**Available Area** No additional tests/analyses required	**Available Area** No additional tests/analyses required	**Available Area** No additional tests/analyses required	**Available Area** No additional tests/analyses required	**Available Area** No additional tests/analyses required	**Available Area** No additional tests/analyses required	**Available Area** No additional tests/analyses required
6		General complexity of construction	none required	**General Construction Complexity (in any settings)**: No additional tests/analyses required	**General Construction Complexity (in any settings)**: No additional tests/analyses required	**General Construction Complexity (in any settings)**: No additional tests/analyses required	**General Construction Complexity (in any settings)**: No additional tests/analyses required	**General Construction Complexity (in any settings)**: No additional tests/analyses required	**General Construction Complexity (in any settings)**: No additional tests/analyses required	**General Construction Complexity (in any settings)**: No additional tests/analyses required
8		Uneven topography will make construction challenging	Topography (highly uneven, moderately uneven, flat)	**Topography**: **Level 2**: preliminary design assessment	**Topography**: **Level 2**: preliminary design assessment	**Topography**: **Level 2**: preliminary design assessment	**Topography**: **Level 2**: preliminary design assessment	**Slope in the surf zone**: **Level 2**: preliminary design assessment	**Slope of the seabed**: **Level 2**: preliminary design assessment. Geophysical bathymetric survey	**Topography/Slope:** NA
9		Wave energy will make construction challenging	Significant wave height, Hs (in feet). Hs is average of highest 1/3 of wave heights. See US Army Corps of Engineers Wave Information.	**Wave energy:** NA	**Wave energy:** NA	**Wave energy:** NA	**Wave energy:** NA	**Wave energy:** **Level 2**: preliminary design assessment. Historical Aerial Photo survey. Compilation and review of USACOE & NOAA data etc. **Level 3**: Coastal Evolution Modeling	**Wave energy:** **Level 2**: preliminary design assessment. Historical Aerial Photo survey. Compilation and review of USACOE & NOAA data etc. **Level 3**: Coastal Evolution Modeling	**Wave energy (Only applies if offshore construction is necessary)** **Level 2**: preliminary design assessment. Historical Aerial Photo survey. Compilation and review of USACOE and NOAA data etc. **Level 3**: Coastal Evolution Modeling
10		Depth to seabed will make construction challenging	Depth to seabed	**Depth to seabed:** NA	**Depth to seabed:** NA.	**Depth to seabed:** NA.	**Depth to seabed:** NA.	**Depth to seabed:** NA.	**Depth to seabed:** **Level 2 & 3**. Review bathymetric data. Geophysical bathymetric survey	**Depth to seabed (Only applies if offshore construction is necessary):** **Level 2 & 3**. Review bathymetric data. Geophysical bathymetric survey
11		Land type will make construction challenging	Land type (beach, bay, estuary, cliffs, rocky coastline)	**Land type:** No additional tests/analyses required	**Land type:** No additional tests/analyses required	**Land type:** No additional tests/analyses required	**Land type:** No additional tests/analyses required	**Land type:** NA	**Land type:** NA	**Land type:** NA
12	**Operation (Intake)**	Geologic conditions will limit intake rate	Hydraulic conductivity, aquifer type, (confined, semi-confined, unconfined), sediment thickness	**Transmissivity:** **Level 2 & 3:** Characterization of Subsurface Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests)	**Transmissivity:** **Level 2 & 3:** Characterization of Subsurface Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests)	**Transmissivity:** **Level 2 & 3:** Characterization of Subsurface Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests)	**Transmissivity:** **Level 2 & 3:** Characterization of Subsurface Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests)	**Transmissivity: NA if engineered fill.**	**Transmissivity**: **NA if engineered fill.**	**Transmissivity:** **Level 2 & 3:** Characterization of Subsurface Hydraulic Properties: Grain-Size Analysis / Hydrauic Conductivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing). Correlation between on and offshore stratigraphy hydraulic properties.
				Overlying Conductance [units of (ft/d)(1/ft) = 1/day] **Level 2 & 3**: Characterization of Subsurface Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. borings, laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests, geophysical surveys)	**Overlying Conductance** [units of (ft/d)(1/ft) = 1/day] **Level 2 & 3**: Characterization of Subsurface Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. borings, laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests, geophysical surveys)	**Overlying Conductance** [units of (ft/d)(1/ft) = 1/day] **Level 2 & 3**: Characterization of Subsurface Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. borings, laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests, geophysical surveys)	**Overlying Conductance** [units of (ft/d)(1/ft) = 1/day] **Level 2 & 3**: Characterization of Subsurface Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. borings, laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests, geophysical surveys)	**Overlying Conductance:** **NA if engineered fill.**	**Overlying Conductance:** **NA if engineered fill.**	**Overlying Conductance** [units of (ft/d)(1/ft) = 1/day] **Level 2 & 3**: Characterization of Subsurface Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. borings, laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests, geophysical surveys)
13		Significant measures will be required to protect SSI against anticipated sea level rise	SSI infrastructure would be located in 30 year potentially impacted area (Y/N) SSI infrastructure would be located above 30 year predicted sea level rise (Y/N)	No additional tests/analyses required	No additional tests/analyses required	No additional tests/analyses required	No additional tests/analyses required	No additional tests/analyses required	No additional tests/analyses required	No additional tests/analyses required
14		Significant measures will be required to protect or restore intake works from erosion or scour.	Rate of change of beach width over time Wave energy	**Rate of erosion** No additional tests/analyses required	**Rate of erosion** No additional tests/analyses required	**Rate of erosion** No additional tests/analyses required	**Rate of erosion** No additional tests/analyses required	**Rate of erosion** No additional tests/analyses required	**Rate of erosion** No additional tests/analyses required	**Rate of erosion** No additional tests/analyses required
				Potential for scouring of the seabed: NA	**Potential for scouring of the seabed:** NA	**Potential for scouring of the seabed:** NA	**Potential for scouring of the seabed:** **Level 2**: Historical Aerial Photo Survey. Compilation and review of NOAA data etc. **Level 3**: Coastal Evolution Model	**Potential for scouring of the seabed:** **Level 2**: Historical Aerial Photo Survey. Compilation and review of NOAA data etc. **Level 3**: Coastal Evolution Model	**Potential for scouring of the seabed:** **Level 2**: Historical Aerial Photo Survey. Compilation and review of NOAA data etc. **Level 3**: Coastal Evolution Model	**Potential for scouring of the seabed is:** NA
15		Characteristics of feedwater and potential mixing are conducive to precipitating materials that will cause frequent and significant clogging of intake works	Saturation Index for mangangese oxides, iron oxides, calcium carbonate **[NEED TO DEFINE PRECIPITATES TO CONSIDER]** Sedimentation Rate	**Saturation Index (SI)** **Level 2:** Geophysical Surveys. Groundwater samples and chemical analysis. Geochemical modeling. **Level 3:** Pilot testing and chemical analyses. Advanced geochemical modeling.	**Saturation Index (SI)** **Level 2:** Geophysical Surveys. Groundwater samples and chemical analysis. Geochemical modeling. **Level 3:** Pilot testing and chemical analyses. Advanced geochemical modeling.	**Saturation Index (SI)** **Level 2:** Geophysical Surveys. Groundwater samples and chemical analysis. Geochemical modeling. **Level 3:** Pilot testing and chemical analyses. Advanced geochemical modeling.	**Saturation Index (SI)** **Level 2:** Geophysical Surveys. Groundwater samples and chemical analysis. Geochemical modeling. **Level 3:** Pilot testing and chemical analyses. Advanced geochemical modeling.	**Potential for materials to precipitate out of** **NA**	**Potential for materials to precipitate out of** **NA**	**Saturation Index (SI)** **Level 2:** Geophysical Surveys. Groundwater samples and chemical analysis. Geochemical modeling. **Level 3:** Pilot testing and chemical analyses. Advanced geochemical modeling.
				Sedimentation rate: NA	**Sedimentation rate: NA**	**Sedimentation rate: NA**	**Sedimentation rate:** **Level 2.** Borings and dating of seafloor sediment profile **Level 3.** Coastal Evolution Model	**Sedimentation rate:** **Level 2.** Borings and dating of seafloor sediment profile **Level 3.** Coastal Evolution Model	**Sedimentation rate:** **Level 2.** Borings and dating of seafloor sediment profile **Level 3.** Coastal Evolution Model	**Sedimentation rate: NA**

Draft SSI Feasibility Framework
Level 2 and 3 Analyses
West Basin

SIGNIFICANT CHALLENGES										
ID		Challenge	Required Inputs	Vert Wells	Slant Wells	Radial Collectors (Ranney Wells)	Horizontal Wells	Beach Infiltration Gallery	Seabed Infiltration Gallery	Water Tunnel
				Tests/Analysis	Tests/Analysis	Tests/Analysis	Tests/Analysis	Tests/Analysis	Tests/Analysis	Recommended Test/Analysis
16	Operation (Treatment)	Water quality issues likely to cause frequent and significant fouling of treatment works	Silt Density Index (SDI)	**Silt Density Index of feedwater (SDI15):** **Level 2**. Sample and analyze groundwater from coastal wells. **Level 3**. Intall well and pilot test.	**Silt Density Index of feedwater (SDI15):** **Level 2**. No level 2 tests/analyses available **Level 3**. Intall well and pilot test.	**Silt Density Index of feedwater (SDI15):** **Level 2**. No level 2 tests/analyses available **Level 3**. Intall well and pilot test.	**Silt Density Index of feedwater (SDI15):** **Level 2**. No level 2 tests/analyses available **Level 3**. Intall well and pilot test.	**Silt Density Index of feedwater (SDI15):** **Level 2**. No level 2 tests/analyses available **Level 3**. Intall well and pilot test.	**Silt Density Index of feedwater (SDI15):** **Level 2**. No level 2 tests/analyses available **Level 3**. Intall well and pilot test.	**Silt Density Index of feedwater (SDI15):** **Level 2**. No level 2 tests/analyses available **Level 3**. Intall well and pilot test.
17		Potential for poor feedwater quality to impose additional permitting requirements in order to be used as a sourcewater for drinking water	Chemicals in feedwater exceed 10 times an MCL or action level (AL) based on chronic health effects (Y/N) Chemicals in feedwater exceed 3 times an MCL or AL based on acute health effects (Y/N) Feedwater is a surface water that requires more than 4 log Giardia/5 log virus reduction (Y/N) Feedwater is extremely threatened with contamination due to proximity to known contaminating activities (Y/N) Feedwater contains a mixture of contaminants of health concern (Y/N) Feewater is designed to intercept known contaminants of health concern (Y/N)	**Level 2**. Sample and analyze groundwater from coastal wells. **Level 3**. Install well, pilot test and analyze samples.	**Level 2**. Sample and analyze groundwater from coastal wells. **Level 3**. Install well, pilot test and analyze samples.	**Level 2**. Sample and analyze groundwater from coastal wells. **Level 3**. Install well, pilot test and analyze samples.	**Level 2**. Sample and analyze soil from seabed **Level 3**. Install well, pilot test and analyze samples.	**Level 2**. Sample and analyze soil from beach **Level 3**. Install, pilot test and analyze samples.	**Level 2**. Sample and analyze soil from seabed **Level 3**. Install, pilot test and analyze samples.	**Level 2**. Sample and analyze soil from seabed **Level 3**. Install, pilot test and analyze samples.
18	Potential Environmental Impacts	Potential impact to protected species or habitats will make CEQA approval challenging	Is(are) protected species/habitat(s) present at the proposed site (Y/N)	**Level 2**: Site-specific ecological characteriation. Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis/Hydrauic Conductivity/Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of site-specific potential SSI construction and operation requirements and potential ecological impacts. **Level 3**: Installation and pilot testing to evaluate potential impact. (e.g. pumping impact to coastal margin wetlands).	**Level 2**: Site-specific ecological characteriation. Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis/Hydrauic Conductivity/Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of site-specific potential SSI construction and operation requirements and potential ecological impacts. **Level 3**: Installation and pilot testing to evaluate potential impact. (e.g. pumping impact to coastal margin wetlands).	**Level 2**: Site-specific ecological characteriation. Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis/Hydrauic Conductivity/Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of site-specific potential SSI construction and operation requirements and potential ecological impacts. **Level 3**: Installation and pilot testing to evaluate potential impact. (e.g. pumping impact to coastal margin wetlands).	**Level 2**: Site-specific ecological characteriation. Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis/Hydrauic Conductivity/Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of site-specific potential SSI construction and operation requirements and potential ecological impacts. **Level 3**: Installation and pilot testing to evaluate potential impact. (e.g. pumping impact to coastal margin wetlands).	**Level 2**: Site-specific ecological characteriation. Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis/Hydrauic Conductivity/Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of site-specific potential SSI construction and operation requirements and potential ecological impacts. **Level 3**: Installation and pilot testing to evaluate potential impact.	**Level 2**: Site-specific ecological characteriation. Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis/Hydrauic Conductivity/Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of site-specific potential SSI construction and operation requirements and potential ecological impacts. **Level 3**: Installation and pilot testing to evaluate potential impact.	**Level 2**: Site-specific ecological characteriation. Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis/Hydrauic Conductivity/Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of site-specific potential SSI construction and operation requirements and potential ecological impacts. **Level 3**: Installation and pilot testing of single offshore well to evaluate potential impact
19		Potential to conflict with existing land use will make CEQA approval process challenging	Is there a potential for the SSI conflict with existing land use? (Y/N)	**Level 2**: Zoning and planning review. Public meetings. Review of site-specific potential SSI construction and operation requirements.	**Level 2**: Zoning and planning review. Public meetings. Review of site-specific potential SSI construction and operation requirements.	**Level 2**: Zoning and planning review. Public meetings. Review of site-specific potential SSI construction and operation requirements.	**Level 2**: Zoning and planning review. Public meetings. Review of site-specific potential SSI construction and operation requirements.	**Level 2**: Zoning and planning review. Public meetings. Review of site-specific potential SSI construction and operation requirements.	**Level 2**: Zoning and planning review. Public meetings. Review of site-specific potential SSI construction and operation requirements.	**Level 2**: Zoning and planning review. Public meetings. Review of site-specific potential SSI construction and operation requirements.
20		Potential to disrupt existing/planned groundwater pumping or injection will make CEQA approval challenging	Required capacity of SSI, existing/planned production rate of nearby aquifer	**Level 2**: Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of existing groundwater pumping or injection in the same basin or aquifer system. Hydraulic Calculations/Groundwater Modeling to evaluate potential impact. **Level 3**: Pilot test pumping and evaluation of influence.	**Level 2**: Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of existing groundwater pumping or injection in the same basin or aquifer system. Hydraulic Calculations/Groundwater Modeling to evaluate potential impact. **Level 3**: Pilot test pumping and evaluation of influence.	**Level 2**: Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of existing groundwater pumping or injection in the same basin or aquifer system. Hydraulic Calculations/Groundwater Modeling to evaluate potential impact. **Level 3**: Pilot test pumping and evaluation of influence.	**Level 2**: Subsurface Geometry and Hydraulic Properties: Grain-Size Analysis / Hydraulic Conductivity / Transmissivity Testing and Evaluation (e.g. laboratory grain-size analysis and permeability testing, CPT pore pressure dissipation testing, specific capacity, aquifer tests) Hydraulic Calculations/Groundwater Modeling. Review of existing groundwater pumping or injection in the same basin or aquifer system. Hydraulic Calculations/Groundwater Modeling to evaluate potential impact. **Level 3**: Pilot test pumping and evaluation of influence.	Not applicable	Not applicable	Not applicable
21		Potential to mobilize contaminant plumes will make CEQA approval challenging	Are there contaminant plumes in the vicinity of the SSI? (Y/N)	**Level 2**: Review of groundwater contamination plume in the same basin or aquifer system. Hydraulic Calculations/Groundwater Modeling to evaluate potential influence of SSI pumping on plume. **Level 3**: Installation and pilot testing to evaluate potential impact on plume migration	**Level 2**: Review of groundwater contamination plume in the same basin or aquifer system. Hydraulic Calculations/Groundwater Modeling to evaluate potential influence of SSI pumping on plume. **Level 3**: Installation and pilot testing to evaluate potential impact on plume migration	**Level 2**: Review of groundwater contamination plume in the same basin or aquifer system. Hydraulic Calculations/Groundwater Modeling to evaluate potential influence of SSI pumping on plume. **Level 3**: Installation and pilot testing to evaluate potential impact on plume migration	**Level 2**: Review of groundwater contamination plume in the same basin or aquifer system. Hydraulic Calculations/Groundwater Modeling to evaluate potential influence of SSI pumping on plume. **Level 3**: Installation and pilot testing to evaluate potential impact on plume migration	Not applicable	Not applicable	Not applicable
22	Risk (Uncertainty)	Lack of demonstrated success of SSI in similar setting to produce a similar capacity imposes significant risk and design challenges to the project	Required capacity, number of units/area of gallery	**An SSI system exists that has produced the required capacity** No additional tests/analysis required	**An SSI system exists that has produced the required capacity** No additional tests/analysis required	**An SSI system exists that has produced the required capacity** No additional tests/analysis required	**An SSI system exists that has produced the required capacity** No additional tests/analysis required	**An SSI system exists that has produced the required capacity** No additional tests/analysis required	**An SSI system exists that has produced the required capacity** No additional tests/analysis required	**An SSI system exists that has produced the required capacity** No additional tests/analysis required
			Use inputs from ID 2 and 3 for required number of units/area	**An SSI system exists with X% of the required number of SSI units.** No additional tests/analyses required	**An SSI system exists with X% of the required number of SSI units.** No additional tests/analyses required	**An SSI system exists with X% of the required number of SSI units.** No additional tests/analyses required	**An SSI system exists with X% of the required number of SSI units.** No additional tests/analyses required	**An SSI system exists with X% of the required gallery area.** No additional tests/analyses required	**An SSI system exists with X% of the required gallery area.** No additional tests/analyses required	**An SSI system exists with X% of the required number of SSI units.** No additional tests/analyses required

Notes
SSI = Subsurface Intake
CPT = Cone Penetration Test
CEQA = California Environmental Quality Act
NOAA = National Oceanic and Atmospheric Administration
SI =Saturation Index

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Ref ID	Reference	Citation and Hyperlinks
1	Water Research Foundation, 2011	Table 4.2 in Water Research Foundation
2	Water Research Foundation, 2011	"The yield from a vertical well can range up to approximately 1 mgd (Pankratz 2006)" Water Research Foundation, p.18
3	Independent Scientific Technical Advisory Panel (ISTAP), 2014	Table 5-1 in ISTAP report
4	California State Water Resources Control Board, 2013	Ocean Plan shows location of some protected areas
5	ISTAP, 2014	in ISTAP, 45% was considered fatal flaw (p.55)
6	California State Water Resources Control Board, 2008	"If existing municipal water production wells will be impacted by the plume a minimum of one year earlier than under pre-existing conditions, or if significant quantities of additional groundwater (more than 5,000 acre-feet) will become contaminated withi
7	WateReuse Association Desalination Committee, 2011	"The most favorable condition for costructing subsurface intakes is highly permeable geological formation (…) with hydraulic conductivity that exceeds 1,000 gallons/day/ft2 [130 ft/d] and depth of at least 45 feet " Watereuse report p.8
8	Water Research Foundation, 2011	"The well depth usually does not exceed 250 ft (76 m)" Water Research Foundation p. 18
9	California Department of Health Services, 1997	criteria defined by DDW to qualify an extremely impaired source
10	Missimer et al., 2013	existing vertical well facilities referenced in Missimer et al., 2013 (Table 2)
11	Missimer et al., 2013	existing facilities referenced in Missimer et al., 2013
12	ISTAP, 2014	"The greatest risk of clogging occurs where there is mixing of dissimilar waters or a change in water chemistry" ISTAP report p. 52
13	ISTAP, 2014	"Only one slant well has been successfully constructed to date, although a major installation to provide 20 MGD of feedwater capacity is under consideration in the Monterey Bay area. The successfully completed well is at Dana Point. When it was built and tested in 2006, it was test pumped at 2000 gpm" ISTAP report p.37
14	Missimer et al., 2013	"Typical seawater SDI values commonly are greater than 10 (both SDI10 and SDI5)" Missimer et al., 2013
15	Bartak et al., 2012	"In RO desalination, a feedwater SDI<2□3 is desirable, but values <4□5 are acceptable" Bartak et al., 2012
16	ISTAP, 2014	"SDI is an abbreviation for Silt Density Index. This is a parameter used by membrane manufacturers and consultants to determine the potential for membrane fouling. It is commonly used in SWRO plant design, especially for pretreatment systems." ISTAP report p.33
17	ISTAP, 2014	"high-quality water with SDI values less than 2" ISTAP report p. 33
18	ISTAP, 2014	"Only one slant well has been successfully constructed to date, although a major installation to provide 20 MGD of feedwater capacity is under consideration in the Monterey Bay area. The successfully completed well is at Dana Point. When it was built and tested in 2006, it was test pumped at 2000 gpm" ISTAP report p.37
19	Water Research Foundation, 2011	"A general rule of thumb for comparison is that a slant well has about 1.5 times the yield of a vertical well", Water Research Foundation, p.24
20	Missimer et al., 2013	"In coastal aquifers consisting of lithified rock, angle well construction is essentially no more complex than conventional well construction, but within unconsolidated sediments, dual-rotary drilling equipment may be required so that a filter pack can be can be installed with screens inside of a temporary steel casing that is subsequently withdrawn before well development" Missimer et al., 2013
21	Water Research Foundation, 2011	For submerged intakes to be practical, it is recommended that the transmissivity be >0.088 mgd/ft (1,100 m3/d/m= 11,764 ft2/d) (Schwartz 2000, cited in Voutchkov and Bergman 2007) for a depth of ≥45 ft (≥14 m) (Voutchkov and Bergman 2007). Water Research Foundation, p.10
22	ISTAP, 2014	5 MGD assumed per collector in ISTAP report p.62
23	Water Research Foundation, 2011	"A general rule of thumb for comparison is that horizontal well has a yield of about 5 to 10 times (average of 7) that of a vertical well.", Water Research Foundation, p.24

Ref ID	Reference	Citation and Hyperlinks
24	Missimer et al., 2013	"great care must be taken in use of horizontal wells beneath the seafloor in terms of water quality because the well may pass through zones of sediments containing varying oxidation conditions along the axis of the well." Missimer et al., 2013
25	Missimer et al., 2013	"The only known operating collector well system used for a SWRO intake is located at the PEMEX Salina Cruz refinery in Mexico (…),which has three wells eachwith a capacity of 15,000 m3/d [4 MGD]" Missimer et al., 2013
26	ISTAP, 2014	"2.7 MGD average rate per drain for Alicante, Spain system," ISTAP report p.62
27	Missimer et al., 2013	"If the aquifer to be used is semi-confined or not well connected vertically to the overlying sea, then the wells may not be effective in producing high, sustainable yields." Missimer et al., 2013
28	ISTAP, 2014	"Alicante, Spain; designed for 34 MGD, operating at 17 MGD" ISTAP report p.61
29	Díaz-Caneja et al., 2004	San Pedro del Pinatar (Murcia) Desalination Plant main characteristics. Table 2
30	ISTAP, 2014	HDD Wells have low sensitivity to sea level rise in ISTAP report, p.60
31	Missimer et al., 2013	"horizontal well technology should be evaluated if the seafloor does not have a high rate of muddy sedimentation" Missimer et al., 2013
32	Fransworth and Warrick, 2007	Figure 40 in Fransworth and Warrick, 2007
33	ISTAP, 2014	"10 MGD / acre," ISTAP report p.62 = 0.15 gpm/ft^2
34	WateReuse Association Desalination Committee, 2011	"The design surface loading of the filter media is typically between 0.05 and 0.10 gpm/ft2" Watereuse, p.12
35	Water Research Foundation, 2011	"construction complexity is high due to the high-energy breaking wave conditions in the surf zone" ISTAP report p.57
36	scwd2 Desalination Program, 2011	"The infiltration collector pipes may be buried approximately 10 to 15 feet below the seafloor". SCWD Intake Techinical Feasibility Study p. 65
37	scwd2 Desalination Program, 2011	"The infiltration gallery [in Japan] is approximately 1,100 feet long, 2010 feet wide and 10 feet deep". SCWD Intake Techinical Feasibility Study p. 67
38	Missimer et al., 2013	"The thickness of the filter media would be likely greater than that for a seabed gallery" Missimer, et al., 2013
39	Missimer et al., 2013	"The use of beach galleries for intakes is compelling because of the lower construction cost compared to seabed galleries" Missimer et al., 2013
40	Missimer et al., 2013	"no large-scale beach gallery intakes have been constructed to date" Missimer et al., 2013
41	Missimer et al., 2013	"The beach should be relatively stable." Missimer et al., 2013
42	ISTAP, 2014	"Intakes that require inundation (e.g., galleries and off-shore water tunnels) would not be sensitive to a rise in sea level" ISTAP report, p.51
43	Missimer et al., 2013	"Beach gallery intakes may be preferred over seabed galleries because they can be designed and constructed to be essentially self-cleaning" Missimer et al., 2013
44	Missimer et al., 2013	"Beach galleries can be constructed successfully only on sandy or gravelly beacheswith sufficient thickness of sediment to protect the underlying screens" Missimer et al., 2013
45	ISTAP, 2014	"5 MGD / acre," ISTAP report p.62 = 0.075 gpm/ft^2
46	Missimer et al., 2013	"In offshore locations where the bottom sediment is unconsolidated, construction requires the use of sheet piling, dredging and temporary dewatering to allow the placement of the bottom intake screens and the filter media" Missimer et al., 2013
47	West Basin Municipal Water District, 2013	"Locate the system below the deepest predicted depth of wave-induced scour and sediment transport." West Basin Desalination Master Plan p. 110
48	Missimer et al., 2013	"The capacity of the Fukuoka gallery is 103,000 m3/d [27 MGD]" Missimer et al., 2013
49	ISTAP, 2014	"2,600 GD/ft2," ISTAP report p.62
50	ISTAP, 2014	Table 5-1 in ISTAP report, p.62
51	scwd2 Desalination Program, 2011	"The infiltration gallery is located […] in the Sea of Japan in about 35 ft of water depth" SCWD Intake Technical Feasibility Study, p.67
52	Note	Consideration for cranes and equipment, either ancred on the seabad or need to use barges
53	Wave Information Studies	http://wis.usace.army.mil/
54	National Research Council, 2012	
55	ISTAP, 2014	"Clogging is of greatest concern where rehabilitation is complex and expensive" ISTAP report p.52
56	Water Research Foundation, 2011	"Well maintenance on vertical wells and collector wells follows industry standards" Water Research Foundation, p.23
57	Water Research Foundation, 2011	"well screen maintenance in slant and HDD wells may require specialized maintenance techniques in order to access and rehabilitate the full length of the screened interval effectively" Water Research Foundation, p.23
58	Missimer et al., 2013	Vertical well needs to be placed close the the shore. "Wells located at significant distances from the shoreline can also cause adverse impacts to wetlands or produce water that has salinity higher than that in the adjacent sea." Missimer et al., 2013
59	ISTAP, 2014	Low sensitivity to sea level rise in ISTAP report for galleries, horizontal wells, and water tunnel, p.60
60	ISTAP, 2014	"Intakes that require inundation (e.g., galleries and off-shore water tunnels) would not be sensitive to a rise in sea level" ISTAP report, p.51
61	ISTAP, 2014	"Beach gallery intakes may be preferred over seabed galleries because they can be designed and constructed to be essentially self-cleaning" Missimer et al., 2013