Appendix 12
Comparison of 316(b) Data

ESA

Site Selection for West Basin Desalination Project: Comparison of 316(b) Data From Santa Monica Bay, California.

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August 2019

Introduction and Background

West Basin Municipal Water District is proposing an Ocean Desalination Project (Project) that would produce 20 million gallons per day (MGD) of potable drinking water, requiring an intake of approximately 41 MGD of seawater. Depending on regional water need, this project could potentially be expanded in the future to produce 60 MGD of potable water, requiring an intake of approximately123 MGD of seawater. The project is to be located at the site of the El Segundo Generating Station (ESGS), just south of Los Angeles International Airport, in the city of El Segundo, Los Angeles County, California. The Project would make use of existing intake and discharge pipelines associated with the once-though cooling system of the now-decommissioned units of the ESGS, to draw water from Santa Monica Bay. The existing intake and discharge structures would be upgraded to include new HDPE pipelines, 1 mm slot width wedgewire intake screens with a through-screen velocity of no more than 0.5 foot per second to prevent impingement and to reduce entrainment, and discharge diffusers to enhance the mixing and dilution of discharged brine with ocean water.

Santa Monica Bay (SMB) is situated in the middle of the Southern California Bight in the Pacific Ocean and measures 27 miles across from Point Dume in the north to Palos Verdes Point in the South. It is characterized by a gently sloping continental shelf that extends seawards to a depth of 80 meters. The major features of SMB include the Santa Monica and Redondo submarine canyons and a number of artificial reefs (rock groins) that were originally constructed for the purpose of beach stabilization (Fig. 1). In addition to these artificial reefs, King Harbor marina in Redondo Beach also provides a large artificial rocky reef that has been identified as an important source of reef fish larvae (Stephens and Pondella 2002). As a result, the King Harbor region has a greater total abundance of fish larvae than other regions of SMB, in part due to the higher abundances of larvae associated with reef species such as Clingfishes and Combtooth blennies (MBC and Tenera 2007).

There are ecological and environmental advantages associated with locating the Project at a site with existing seawater intake and discharge structures. The principal advantage is that underwater construction would be minimized and thereby potentially adverse impacts to intertidal and subtidal marine resources would be limited during the construction period. However, with respect to operational impacts over the life of the project, such as entrainment of fish larvae, the question remains whether siting the Project at the ESGS is the least environmentally detrimental location.

To assess whether siting the Project at the ESGS location, or an alternative location within SMB, would result in more or less entrainment of planktonic organisms compared with other locations requires site-specific information. Within SMB, there are two other electrical generating stations besides ESGS that employ once-through cooling technology. These are the Scattergood Generation Station (SGS), located immediately north of ESGS, and the Redondo Beach

Generating Station (RBGS), located approximately 4.5 miles south of ESGS, in King Harbor (Fig. 1). Because all three generating stations employed once-through cooling technology, they were required to conduct 316(b) entrainment investigations under the Clean Water Act. As recently as 2007, data on the taxonomy and abundance of fish and invertebrate larvae, and in some cases eggs, were collected monthly over a period of one year for each of the three locations (i.e. SGS, ESGS, and RBGS). For this study, this detailed database was used to calculate potential entrainment and mortality of fish larvae in order to evaluate which of the three locations would be the least detrimental to site the Project from an ecological perspective. In this evaluation, data on fish larval abundances from 1) entrainment stations in the immediate vicinity of the intake structures and 2) the source waters of those intake structures were used. The data sources, calculations, and results of the comparison are described in detail below in the Approach and Results.

Approach

Data sources

Data from 316(b) investigations completed in the same year (MBC and Tenera 2007; MBC, Tenera and URS 2007; Tenera and MBC 2008) for each of the generating stations (SGS, ESGS, and RBGS) was used to evaluate potential entrainment of fish larvae as a result of drawing in 41 MGD (155,201.9 m^3 d^{-1}) or 123 MGD (465,605.6 m^3 d^{-1}) of seawater. Fish larval samples were collected monthly from 1-2 entrainment stations directly above the intake structures as well as 6-10 source water stations associated with each site (Fig. 2). All stations were sampled using a 2 ft diameter bongo plankton net constructed with 333 µm nitex mesh. The net was towed obliquely from the surface to approximately 0.15 m off the bottom of the water column and back up to the surface. Two replicate tows were taken at each station, and each station was sampled 4 times (twice during the day and twice during the night) over the course of 24 hours. These samples were averaged to give a mean daily abundance for each station for each sampling month.

Monthly fish larval abundances were averaged and presented as annual means for each fish species in the 316(b) reports (MBC and Tenera 2007; MBC, Tenera and URS 2007; Tenera and MBC 2008). These annual mean abundances for the entrainment stations and for the source water stations for each generating station are available in Appendix A. Mean annual larval concentrations, larval age and current speeds were used in combination with cooling water intake rates to calculate larval proportional mortalities (P_M) of a select number of fish species for each generating station (MBC and Tenera 2007; MBC, Tenera and URS 2007; Tenera and MBC 2008). Both annual mean abundances of all the fish larvae sampled and the P_M values of a select number of fish species published in these 316(b) reports were used in our analyses. The purpose of this analysis was to examine the potential effects of locating the Project's intake to an alternate location within SMB compared with the proposed ESGS location..

In addition to the annual mean fish larval abundances, monthly fish larval abundance data was available for the ESGS location only. These data were used to compute P_M values for 12 species/groups of fish used in the Area Production Foregone (APF) calculations from two of the offshore stations in each corner of the ESGS sampling grid (stations O1 and O3, Figure 2A). The P_M's were averaged to give one offshore value for each fish species which was used to calculate offshore APF values. Based on these, an overall offshore APF was calculated and compared with the overall nearshore APF generated using the entrainment station data (station E2/E3 in Figure 2A) for the same 12 fish species. The purpose of this latter analysis was to examine the impact of extending the existing power plant intake to a deeper water location, both on a per fish species basis and on an overall APF basis.

Total Number of Entrained Larvae

To give a snapshot of the total number of larvae that would be entrained (L_e) by the Project at each site in a given year, the concentration of each larvae (N_e, individuals m^{-3}) was multiplied by the total volume of water to be entrained (V_e, m^3) on an annual basis (y^{-1}) and summed across all fish species at each site for the total number of fish larvae according to (1):

$$L_e(y^{-1}) = \sum_{n=1}^{n} (N_e \times V_e)$$

Proportional Entrainment

The calculation of L_e does not take into account how many of these larvae are in the vicinity of the intake, and how the abundance of each fish larvae in the source water (N_{sw}) in the vicinity of the intakes for each location is impacted by the entrainment. Here, the entrainment as a proportion of the abundance of larvae in the source water was calculated for each species. This calculation of proportional entrainment (PE) is central to estimating larval mortality (Boreman et al. 1981) and takes into account the concentration of larvae being entrained (N_e), mean annual entrainment volume (V_e) on a daily basis (d^{-1}), density of larvae in the source water (N_{sw},) and source water volume (V_{sw}, m^3) according to (2):

$$PE\ (d^{-1}) = \frac{N_e \times V_e}{N_{sw} \times V_{sw}}$$

Where:

N_e = concentration of larvae entrained (m^{-3})
N_{sw} = concentration of larvae in the source water (m^{-3})
V_e = mean annual entrainment volume (m^3)
V_{sw} = source water volume (m^3)

Because the PE calculation does not require detailed information on life histories of the different fish species and the number of days of larval life, it can be calculated for all the larval species that were identified and for which concentration data was available from both the entrainment and source water stations. Here, PE was calculated using mean annual fish larval concentrations (calculated from monthly data) to give a broad view of the entrainment of all larvae at each site using the 41 MGD Project intake volume. Scaling these calculations by a factor of 3 would give the PEs for the 123 MGD Regional Project.

Larval Mortality (P_M)

While the PE calculation takes into account the concentration of larvae in the source water (N_{sw}), these larvae may have been transported from quite a distance given their age when they reach the source water. The distance traveled gives a dimension for the volume over which the entire larval source population is distributed (V_p), and therefore a way to calculate the total larval population abundance (N_p) of each fish species. The proportional mortality (P_M)

calculation takes into account larvae entrained as a fraction of source water as well as population abundances. As such, P_M calculations require knowledge of larval age and can only be calculated for those fish larvae where this information (i.e. age as a function of size) has been previously described. Here, P_M calculations were performed according to the 316(b) reports (presented in Appendix B) using 41 MGD and 123 MGD Project intake volumes, for anchovy from ESGS as follows (3):

$$P_M = 1 - \sum_{n=1}^{12} f_i \, (1 - PE_n \times P_s)^d$$

where
P_M = proportional mortality
PE_n = proportional entrainment for *n*th month; calculated as in equation 1 above
P_S = proportion of source water larvae ($N_{Sw} \times V_{sw}$) to the total larval population ($N_{Sw} \times V_p$)
f_i = proportion of N_p present during each month (sum of all months equal to 1)
d = estimated number of days of larval life

For our purposes, P_M values published in the 316(b) reports were scaled (SP_M) to the 41 MGD and 123 MGD Project intake rates according to (4):

$$SP_M = \frac{V_d}{V_c} \times P_M$$

where
V_d = daily desalination intake volume (m^3 d^{-1})
V_c = daily cooling water intake volume (m^3 d^{-1})

That the scaled mortalities (equation 4) produced the same mortality as the calculated mortality (equation 3) was verified by comparing both procedures for anchovies from ESGS (Appendix B).

Results

Total Number of Entrained Larvae

The total number of larvae that would be entrained on an annual basis for the Project with a seawater intake of 41 MGD was greater for RBGS and SGS than for ESGS (Fig. 3).

Proportional Entrainment

The diversity of fish larvae susceptible to entrainment was similar among the three sites, varying from 54 identifiable species at ESGS, to 65 species at RBGS and 68 species at SGS. In addition, there was a relatively high proportion of unidentifiable fish larvae entrained at all three sites (Table 1). Fish larvae with the greatest potential for entrainment differed from site to site. At SGS, Sargo and Basketweave cusk-eel larvae were most likely to be entrained compared with other species (Fig. 4, Table 1). At ESGS, Basketweave cusk-eel larvae also had the most potential for entrainment, but their proportional entrainment was 4-fold lower than at SGS (Fig. 4, Table 1). RBGS had the highest potential of entrainment for the largest number of larval species compared to the other two sites (Fig. 4). At RBGS, *Clinocottus* sp. sculpin larvae had the highest potential of entrainment, followed by Cabezon larvae and Wrasse larvae. Other fish larvae with high potential for entrainment at this site included Painted greenling, Roughneck sculpin, Garibaldi, and Queenfish (Fig. 4, Table 1). Clinid kelpfish larvae were common to all three sites and had relatively similar potentials of entrainment, varying from 0.0013 d^{-1} at ESGS, to 0.0015 d^{-1} at SGS and 0.0016 d^{-1} at RBGS (Table 1).

Scaled Proportional Mortalities

Fish larval proportional mortalities (P_M) associated with both design (i.e. maximum) cooling water intake rates (m^3 d^{-1}) and actual average cooling water intake rates (m^3 d^{-1}) were calculated by Tenera Environmental for both SGS and ESGS (MBC et al. 2007, MBC and Tenera 2008). Scaling of either P_M to the proposed desalination intake rates would be expected to produce the same proportional mortality (SP_M), provided all factors in the calculation of PE_i (equation 1) remain the same except for V_e. This was the case for SGS. For ESGS, greater concentrations of entrained larvae (N_e) were used for calculating PE_i associated with actual intake compared with that used for calculating the PE_i associated with design intake, for a number of fish species (MBC and Tenera 2008). As a result, the P_M associated with design intake was used for scaling to desalination intake. For RBGS, only the P_M associated with the actual average intake rate was available (MBC and Tenera 2007) and it was used to calculate the SP_M. The design and actual intake rates, desalination intake rates, and scaling factors used for calculating SP_M are presented in Table 2.

In general, larval SP_M was greatest at RBGS compared with SGS and ESGS, varying from 1.2-fold greater for Sea basses to 57-fold greater for Combtooth blennies (Fig. 5, Table 3). For example, SP_M of gobies at RBGS was 4.5-fold higher than at SGS which was twice the SP_M of gobies at ESGS. The SP_M of Silversides at RBGS was twice that of Silverside SP_M at ESGS (Table 3). Scaled mortalities of fish larvae were greater at SGS compared with ESGS for five species but they were greater at ESGS compared to SGS for Sea basses, Sanddabs and Diamond turbot (Table 3).

Comparison of the larval SP_M values for the 12 fish species/groups used in the calculation of overall APF for the nearshore (depth contour 10 m) entrainment stations (E2/E3) with the P_M values generated from the offshore (depth contour 30 m) stations (O1/O3), demonstrated differences depending on the fish species. For some estuarine fish such as Diamond turbot and Sea Bass, offshore P_M (OP_M) was less than nearshore SP_M (Figure 6). This was also the case for Silversides which were classified as soft-bottom pelagic fish. However, for most of the other soft-bottom fish species including English sole, Northern anchovy, White croaker, Sanddabs and California halibut, OP_M was greater than SP_M (Figure 6). Because the APFs associated with soft bottom species is scaled 1:10, increases for this group are not as important as the decreases for the estuarine species in the calculation of the overall APF. Therefore, the species-dependent differences in APF estimates cancelled each other out and the overall offshore APF estimate was almost identical to the nearshore APF estimate (Table 4).

Discussion

In this comparison, the three criteria used to evaluate entrainment potential within SMB were 1) total entrainment over the course of a year, 2) proportional entrainment, and 3) scaled proportional mortalities. Based on this analysis, Redondo Beach Generating Station (RBGS) had the highest number of larval fish entrained of the three power plant intake locations within SMB. In addition to having the highest concentration of larvae in the water close to the intake structure, resulting in the highest total potential annual larval entrainment (Fig. 1), this site had the greatest PE values for the largest number of different fish larvae of the three sites (Fig. 2), and the highest SP_M values, for those fish species where they could be calculated, of the three sites (Fig. 3). This result was not unexpected as previous studies have noted the high larval productivity associated with the King Harbor rocky reef and riprap habitats compared with other artificial or natural reefs in SMB (Stephens and Pondella 2002).

It was more difficult to distinguish differences in larval entrainment between SGS and ESGS since these two sites are geographically close to each other and therefore, would be expected to entrain fish larvae from the same source water. However, based on the larval fish enumeration completed by Tenera in 2007, the SGS intake location appears to potentially entrain annually almost twice the number of larvae compared with ESGS intake location, for the same volume of intake water (Fig. 3). In addition, in comparing PE values between the two sites, there was a 1.4-4-fold greater risk of entrainment at SGS compared with ESGS of species present at both sites, including Clinid kelpfishes, Pacific staghorn sculpin, and Basketweave cusk-eel (Table 1).

With respect to SP_M calculations, the differences between the two locations within SMB were less clear; five species of fish larvae had higher mortalities at SGS compared with ESGS and three species of fish larvae had higher mortalities at ESGS than SGS (Table 3). One reason for the possibly higher risk of larval entrainment that appears to be occurring at SGS could be that this location is closer to the Ballona wetlands complex which is known to be acting as a nursery ground for some fish species (Johnston et al. 2015).

None of the larvae identified at the three power plant intake locations in these 316(b) studies belonged to threatened or endangered species. However, a number of the larvae belonged to fish and shellfish species that have designated Essential Fish Habitat (EFH) within SMB under the Coastal Pelagics Fishery Management Plan (FMP) and the Pacific Groundfish FMP. In addition to these managed fish species, the California Department of Fish and Wildlife (CDFW) has designated Garibaldi and California grunion as special-status fish. Comparing the three locations in terms of fish and shellfish species with designated EFH or CDFW special status, the greatest rate of larval entrainment belonging to these groups was potentially at RBGS (Table 5). Also, all special-status species, with the exception of Pacific hake and rockfishes, appear to be potentially entrained at higher rates at SGS than at ESGS (Table 5).

With respect to siting the project in deeper water, data on 12 fish species from ESGS suggest that there was no difference in the overall APF between siting the Project along the 30 m contour (offshore) versus along the 10 m contour (nearshore) where the current ESGS intake is located. Despite the overall APF being essentially the same between the offshore and nearshore, there were notable differences in the APFs on a species-specific basis. As a result, a different set of species is disadvantaged if the intake is placed nearshore (Diamond turbot, Silversides, and Sea Basses) than if the intake is placed offshore (English sole, White croaker, Northern anchovy, Sanddabs, and California halibut).

Conclusions

In terms of total potential annual larval entrainment, rates of potential entrainment, entrainment of special-status taxa and scaled proportional mortalities, the RBGS ocean water intake location appears have the greatest potential effect on marine ecosystems of the three power plant intake locations evaluated. The data suggests that the highest larval abundances is present at the RBGS intake location, which may be the result of its close proximity to a highly productive hard substrate artificial reef. When comparing potential entrainment of all sampled fish larvae and potential entrainment of special-status species between the ESGS and SGS intake locations, the data suggests that ESGS intake location potentially entrains fewer fish larvae than the SGS intake location. For example, total annual entrainment based on the 2007 larval data was 1.5-fold greater at the SGS intake location compared with the ESGS intake location (i.e. 44.4 million larvae vs. 29.2 million larvae entrained). As discussed above, this may be a result of the SGS's intake location being closer than ESGS to Ballona Wetlands (Figure 1).

Within the ESGS location, it does not appear to make a difference in the overall APF estimate whether the intake is extended from the currently proposed 10 m contour location to a deeper 30 m contour location. This is because potential increases in entrainment of soft-bottom fish species at the deeper contour cancel out potential decreases in entrainment of estuarine and soft-bottom species at the shallower contour.

In summary, this analysis suggests that the largest impact on fish entrainment is the distance of the intake from hard substrate. The greater the distance an ocean water intake is located from natural or artificial rocky reef/hard substrate habitat, rocky headlands, coastal lagoons, and estuaries, the lower the expected potential entrainment of larval fish, including special-status and managed fish and invertebrate taxa

References

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Tables

Table 1. Proportional entrainment (PE) using a Project seawater intake of 41 MGD (155,202 m^3/day) of the top ten fish larvae at each location in Santa Monica Bay.

Location	Taxon	Common Name	PE 41 (d^{-1})
SGS Scattergood Generating Station	*Anisotremus davidsonii*	sargo	0.008655436
	Ophidion scrippsae	basketweave cusk-eel	0.007791811
	larval/post-larval fish unid.	larval fishes	0.002117337
	Leptocottus armatus	Pacific staghorn sculpin	0.001628549
	Gibbonsia spp.	clinid kelpfishes	0.001477757
	Xenistius californiensis	salema	0.001351833
	Gobiesocidae unid.	clingfishes	0.001139984
	Sphyraena argentea	Pacific barracuda	0.001052863
	Menticirrhus undulatus	California corbina	0.000907765
	Pomacentridae unid.	damselfishes	0.000886654
ESGS El Segundo Generating Station	*Ophidion scrippsae*	basketweave cusk-eel	0.001880782
	Gibbonsia spp.	clinid kelpfishes	0.001293038
	Syngnathus spp.	pipefishes	0.000828194
	Leptocottus armatus	Pacific staghorn sculpin	0.0007238
	larval/post-larval fish unid.	larval fishes	0.000542626
	Cheilotrema saturnum	black croaker	0.000538724
	Labridae unid.	wrasses	0.000452375
	Pleuronichthys guttulatus	diamond turbot	0.000407611
	Menticirrhus undulatus	California corbina	0.000402613
	Oxyjulis californica	senorita	0.000396949
RBGS Redondo Beach Generating Station	*Clinocottus spp.*	sculpins	0.01165021
	Scorpaenichthys marmoratus	cabezon	0.007466133
	Labridae unid.	wrasses	0.004196921
	Oxylebius pictus	painted greenling	0.004156908
	Ruscarius creaseri	roughcheek sculpin	0.00400267
	larval/post-larval fish unid.	larval fishes	0.003147084
	Hypsypops rubicundus	garibaldi	0.001807376
	Seriphus politus	queenfish	0.001632308
	Gibbonsia spp.	clinid kelpfishes	0.001609161
	Artedius spp.	sculpins	0.000938972

Table 2. Scaling Factors for three generating station locations in Santa Monica Bay.

Intake	SGS (unit1-3)	ESGS (unit 3/4)	RBGS (unit 5-8)
Design Cooling Intake Rate (m^3/day)	1,874,511	1,508,865	3,368,892
Actual Cooling Intake Rate (m^3/day)	1,199,687	717,808	659,355
Source Water Volume (m^3)	735,176,994	735,176,994	396,693,881
41 MGD Desalination Intake Rate (m^3/day)	155,201.9	155,201.9	155,201.9
123 MGD Desalination Intake Rate (m^3/day)	465,605.6	465,605.6	465,605.6
Scaling Factor 41	0.12937	0.10286	0.23538
Scaling Factor 123	0.38811	0.30858	0.70615

RBGS=Redondo Beach Generating Station
SGS=Scattergood Generating Station
ESGS=El Segundo Generating Station

Table 3. Comparison of proportional mortalities (P_M) as percent for fish larvae and larvae of California spiny lobster using a Project intake rate of 41 MGD (155,202 m^3/day) and 123 MGD (465,606 m^3/day) among three locations in Santa Monica Bay.

Common Name	SGS-41 (P_M %)	ESGS-41 (P_M %)	RBGS-41 (P_M %)	SGS-123 (P_M %)	ESGS-123 (P_M %)	RBGS-123 (P_M %)
Combtooth blennies	0.05	0.04	2.30	0.15	0.12	6.90
CIQ gobies	0.66	0.23	2.92	1.97	0.68	8.77
Northern anchovy	0.02	0.02	0.17	0.07	0.07	0.52
Garibaldi	NA	NA	1.98	NA	NA	5.95
White croaker	0.05	0.04	0.12	0.14	0.13	0.35
Labrisomid blennies	NA	NA	2.69	NA	NA	8.06
Queenfish	0.01	0.01	0.03	0.02	0.02	0.08
Blind goby	NA	NA	2.31	NA	NA	6.93
Clingfishes	NA	NA	4.10	NA	NA	12.31
Silversides	0.39	0.33	0.75	1.18	0.98	2.25
Clinid kelpfishes	NA	NA	0.97	NA	NA	2.92
Sea basses	0.02	0.05	0.06	0.07	0.15	0.18
California halibut	0.03	0.02	0.04	0.10	0.07	0.12
California sp lobster	NA	NA	2.69	NA	NA	8.07
Pacific barracuda	0.05	NA	NA	0.14	NA	NA
Sanddabs	0.01	0.02	NA	0.03	0.05	NA
Diamond turbot	0.17	0.32	NA	0.52	0.95	NA
Spotted turbot	0.03	NA	NA	0.09	NA	NA
Senorita	0.07	NA	NA	0.22	NA	NA
Unid Croakers	NA	0.07	NA	NA	0.21	NA
English Sole	NA	0.01	NA	NA	0.03	NA

RBGS=Redondo Beach Generating Station

SGS=Scattergood Generating Station

ESGS=El Segundo Generating Station

NA= P_M value not available for that fish species due to not being generated for the APF estimate for that location.

Table 4. Comparison of Area Production Foregone (APF) values based on 12 fish species/groups between the shallower nearshore (stations E2/E3) and the deeper offshore locations (stations O1/O3) for the Project intake rates of 41 MGD (155,202 m^3/day) and 123 MGD (465,606 m^3/day) at the ESGS location.

Scale Group	Fish	Nearshore 41 MGD	Offshore 41 MGD	Nearshore 123 MGD	Offshore 123 MGD
Estuarine 1:1	Sea Basses	15.6	0.4	46.8	1.1
	Combtooth Blennies	0.6	0.7	1.7	2.0
	CIQ Gobies	3.1	4.5	9.2	13.5
	Diamond Turbot	4.3	0.6	12.9	1.9
Soft bottom 1:10	Anchovy	66.3	221.4	198.8	664.3
	Silversides	74.1	3.7	222.2	11.2
	White Croaker	56.8	140.0	170.3	420.0
	Queenfish	4.4	10.4	13.3	31.2
	Unid. Croakers	36.5	41.5	109.4	124.5
	California Halibut	16.1	37.7	48.3	113.0
	Sanddabs	5.6	23.5	16.9	70.4
	English Sole	6.3	79.9	19	239.6
	Overall APF	**16.38**	**16.36**	**49.14**	**49.07**

Table 5. Proportional entrainment (PE) and mortality (P_M) as percent of special-status and EFH fish species commonly encountered at three locations in Santa Monica Bay. RBGS=Redondo Beach Generating Station; SGS=Scattergood Generating Station; ESGS=El Segundo Generating Station. P_M values were scaled from 316(b) reports for the three locations.

Management Group	Common Name	Location	PE - 41	P_M (%) - 41
Coastal Pelagics	Northern anchovy	SGS	1.44E-04	0.02
		ESGS	1.10E-04	0.02
		RBGS	3.08E-04	0.17
Coastal Pelagics	Market squid	SGS	5.47E-04	NA
		ESGS	8.56E-06	NA
		RBGS	NP	NA
Coastal Pelagics	Pacific sardine	SGS	7.86E-04	NA
		ESGS	1.41E-04	NA
		RBGS	5.44E-04	NA
CDFW	Garibaldi	SGS	9.56E-05	NA
		ESGS	1.43E-05	NA
		RBGS	1.81E-03	1.98
Pacific Groundfish	Pacific sanddab	SGS	1.13E-04	0.01
		ESGS	7.94E-05	0.02
		RBGS	2.06E-04	NA
Pacific Groundfish	Pacific hake	SGS	2.61E-05	NA
		ESGS	1.28E-04	NA
		RBGS	3.44E-04	NA

Management Group	Common Name	Location	PE - 41	P_M (%) - 41
Pacific Groundfish	Dover sole	SGS	NP	NA
		ESGS	NP	NA
		RBGS	5.48E-04	NA
Pacific Groundfish	English sole	SGS	3.85E-05	NA
		ESGS	2.75E-05	0.01
		RBGS	7.88E-05	NA
Pacific Groundfish	Cabezon	SGS	NP	NA
		ESGS	NP	NA
		RBGS	7.47E-03	NA
Pacific Groundfish	Rockfishes	SGS	2.05E-05	NA
		ESGS	3.89E-05	NA
		RBGS	9.73E-05	NA

NA = P_M value not available for that fish species due to not being generated for the APF estimate for that location.
NP = Fish species not present during sampling times at the location.

Figures

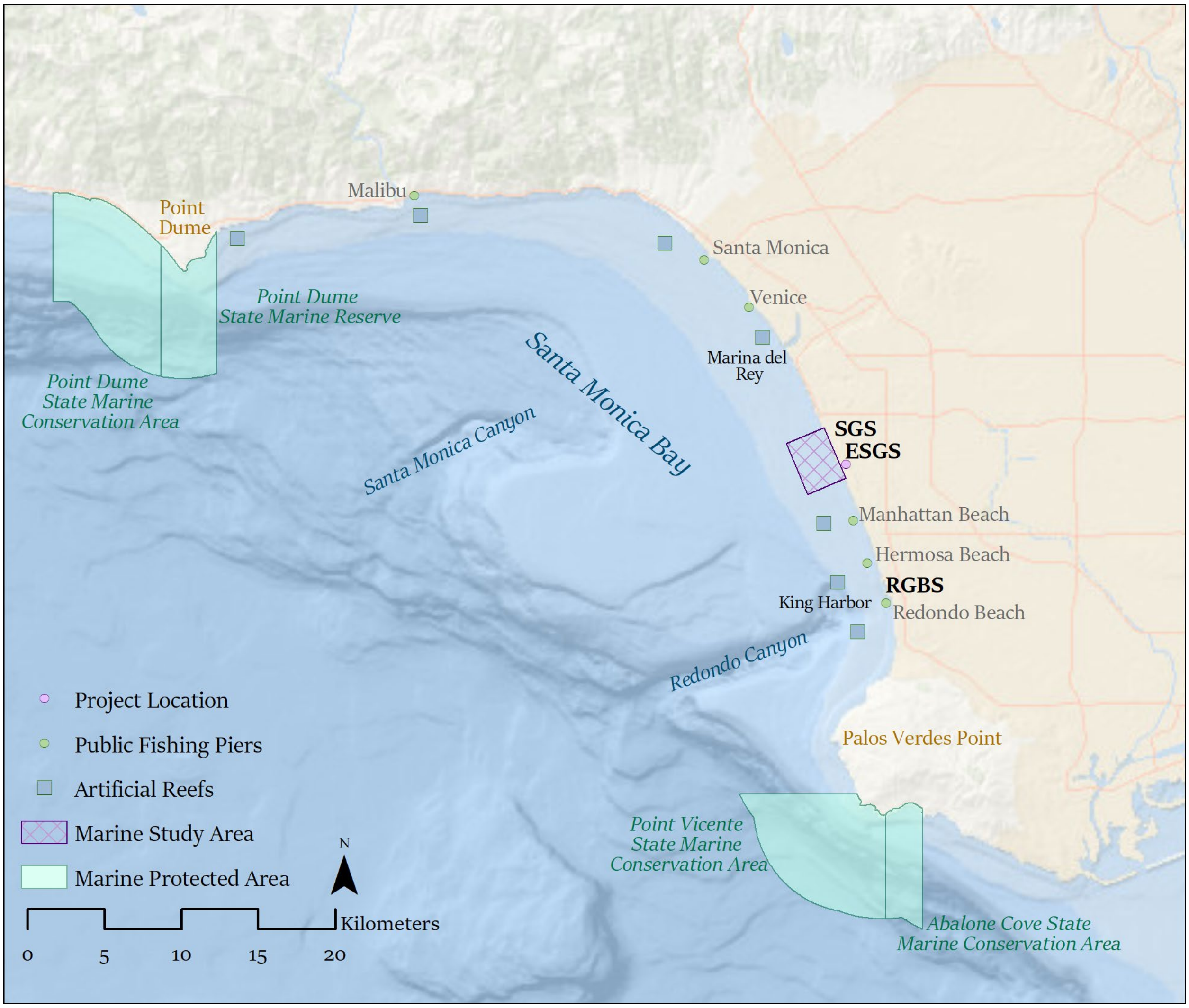

Figure 1. Locations of Scattergood Generating Station (SGS), El Segundo Generating Station (ESGS), and Redondo Beach Generating Station (RBGS) in Santa Monica Bay, as well as locations of marine protected areas (MPAs), artificial reef habitats, Ballona Wetlands adjacent to Marina del Rey, and public fishing piers.

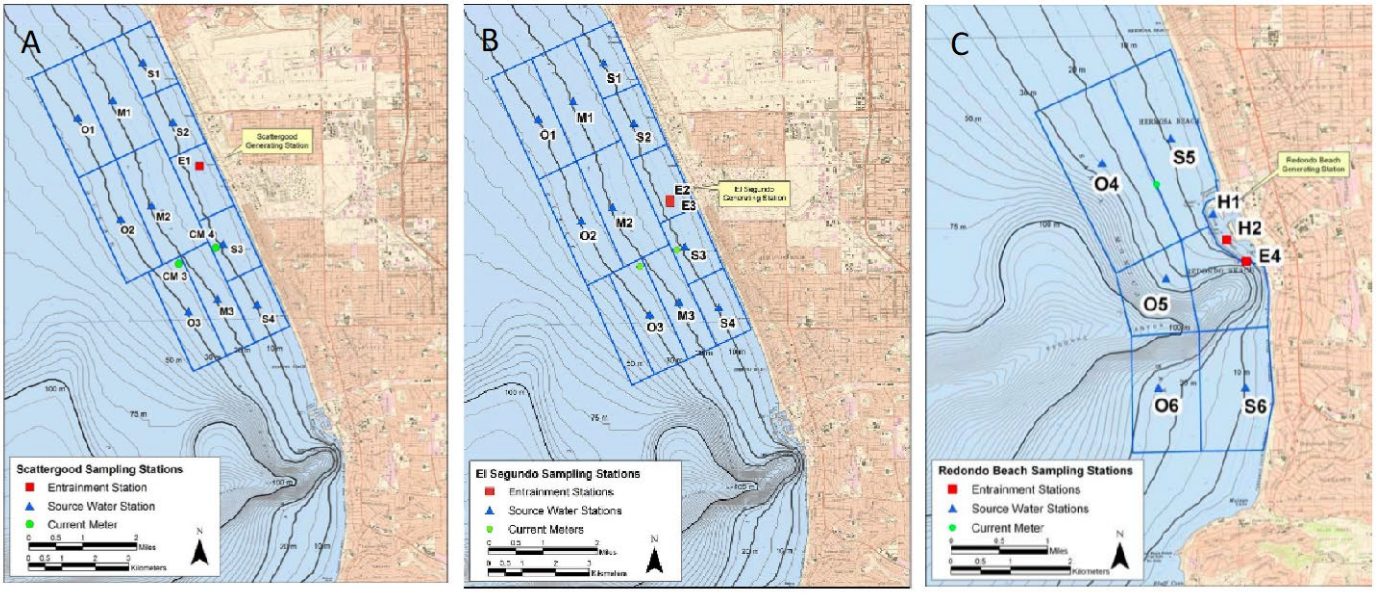

Figure 2. Locations of entrainment sampling stations (marked in red) and source water sampling stations (marked in blue) at A) SGS, B) ESGS, and C) RBGS. Maps from MBC and Tenera 2007, MBC et al. 2007, MBC and Tenera 2008.

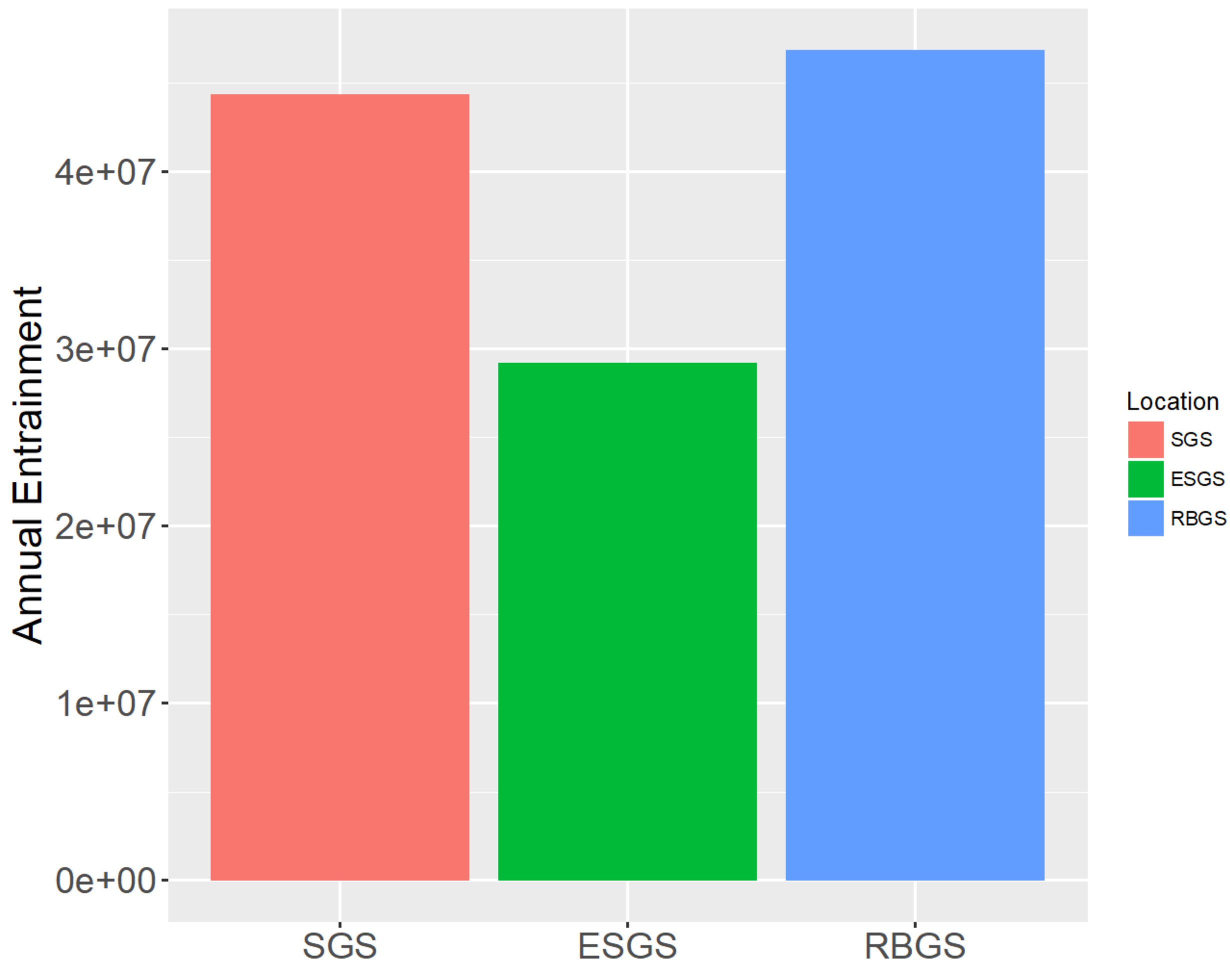

Figure 3. Total potential annual fish larval entrainment (# individual larvae) estimated for SGS (red bar), ESGS (green bar) and RBGS (blue bar) using a Project intake of 41 MGD and larval abundances measured in 2007.

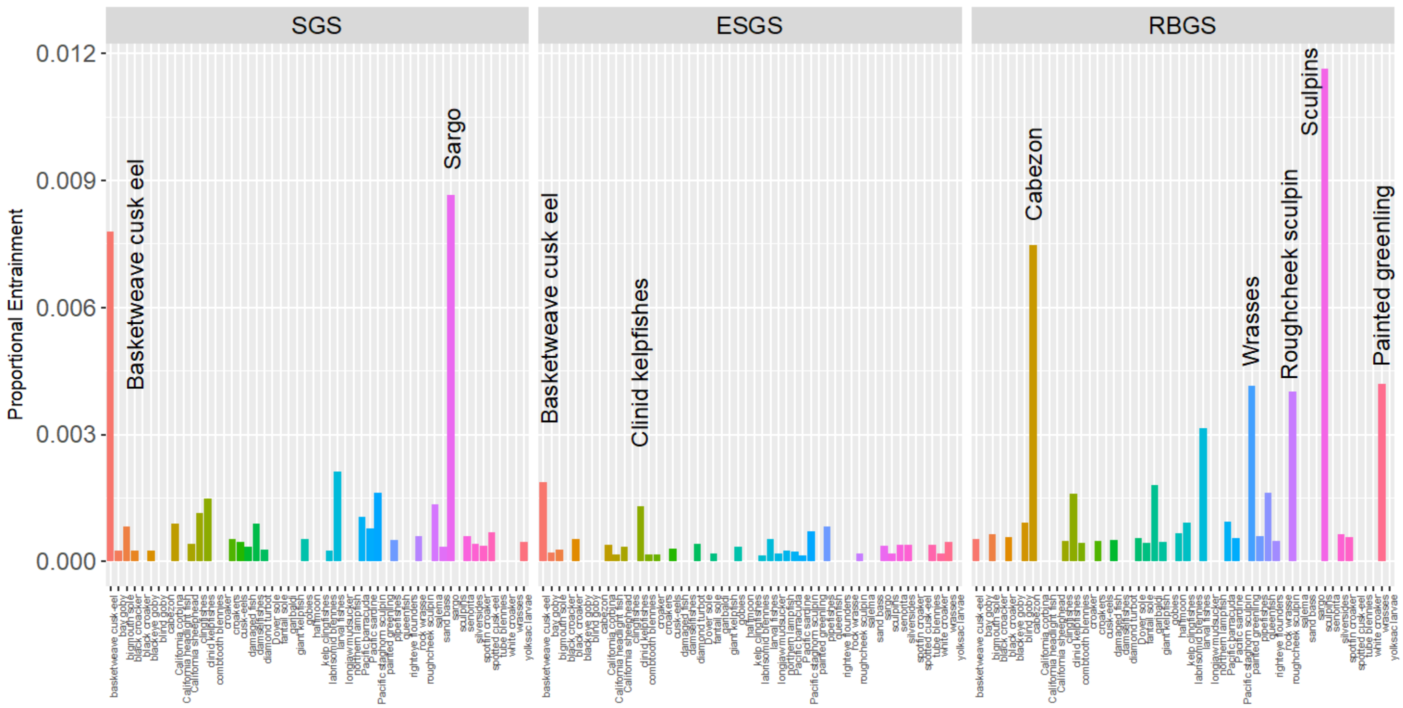

Figure 4. Proportional entrainment (PE) of the 30 most entrained larvae among three sites in Santa Monica Bay, calculated using a seawater intake of 41 MGD and larval abundances measured in 2007. RBGS=Redondo Beach Generating Station; SGS=Scattergood Generating Station; ESGS=El Segundo Generating Station.

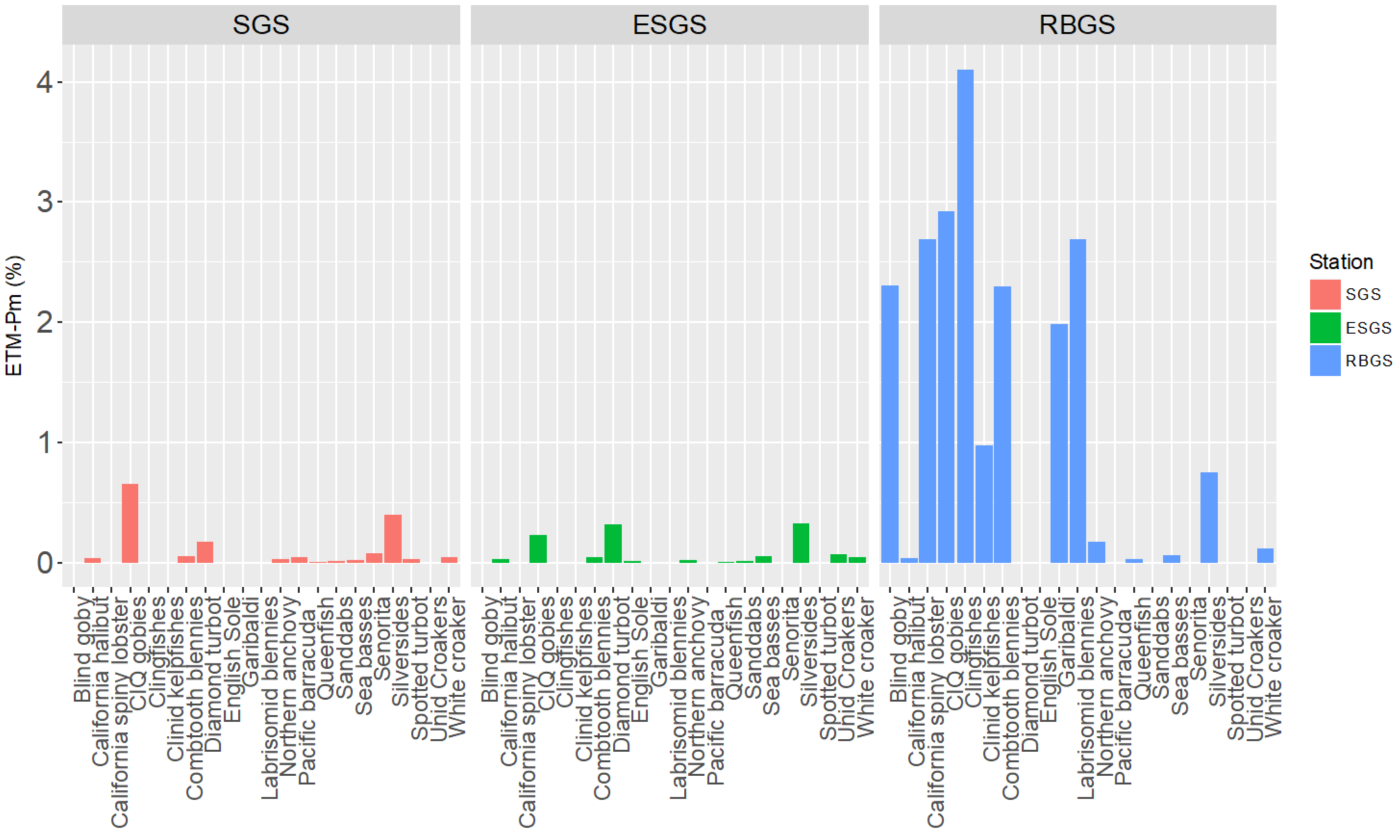

Figure 5. Scaled proportional mortalities (SP_M), calculated using a seawater intake of 41 MGD, among three sites in Santa Monica Bay. RBGS=Redondo Beach Generating Station; SGS=Scattergood Generating Station; ESGS=El Segundo Generating Station.

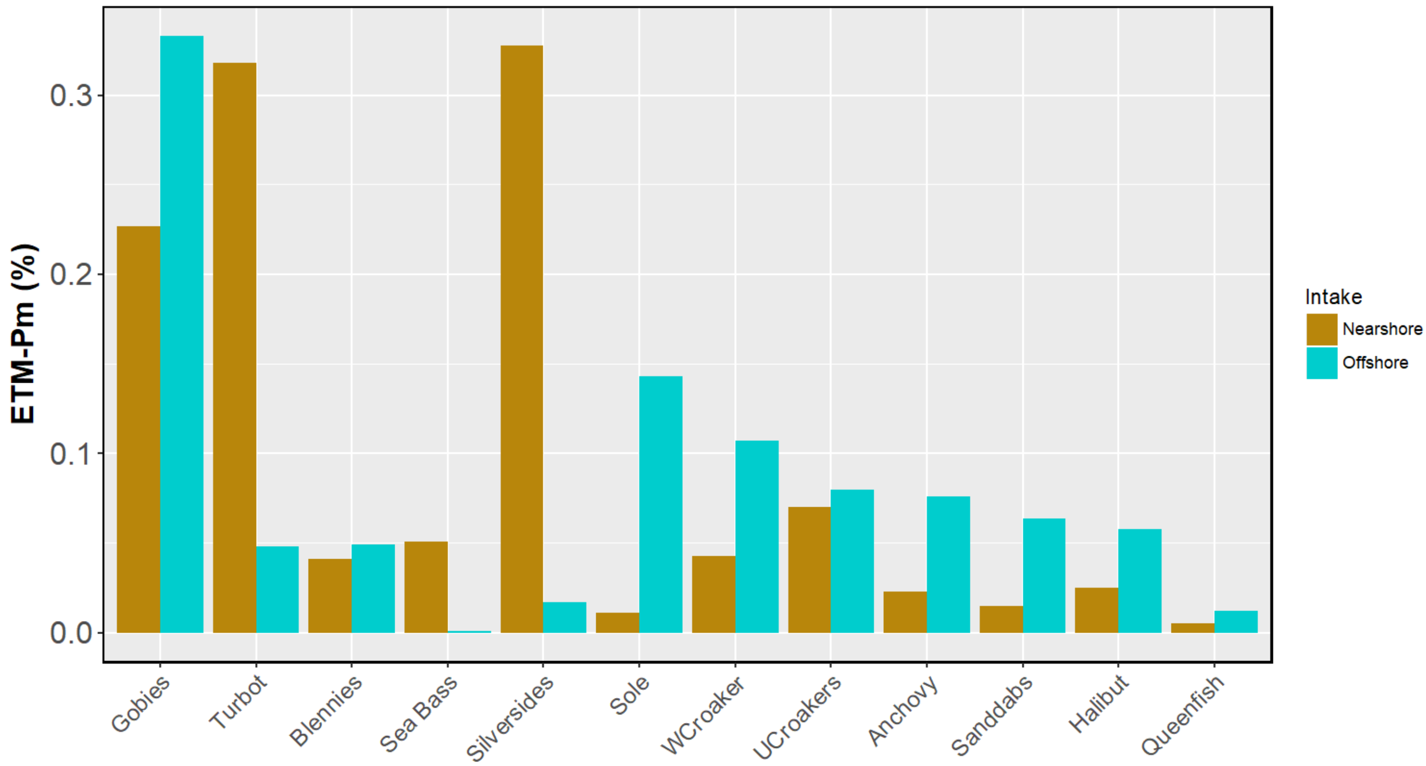

Figure 6. Comparison of proportional mortalities (P_M) for the nearshore and offshore calculated using a seawater intake of 41 MGD at El Segundo Generating Station.
Gobies=CIQ gobies;
Turbot=Diamond turbot;
Blennies=Combtooth blennies;
Sole=English sole;
WCroaker=White croaker;
UCroakers=Unidentified croakers;
Anchovy=Northern anchovy;
Halibut=California halibut.

Appendix A.

Abundances of Fish Larvae at Entrainment and Source Water Stations.

SGS Larvae Entrained			ESGS Larvae Entrained			RBGS Larvae Entrained		
Taxon	Common Name	Mean Entrained (	Taxon	Common Name	Mean Entrained (	Taxon	Common Name	Mean Entrained (individuals/m3)
yolksac larvae	yolksac larvae	147.84	Acanthogobius flavim	yellowfin goby	0.12	Hypsoblennius spp.	combtooth blennies	244.43
Engraulidae unid.	anchovies	114.17	Anisotremus davidson	sargo	0.12	Gobiidae unid.	gobies	94.16
Sciaenidae unid.	croakers	91.87	Atherinopsidae unid.	silversides	7.39	Engraulidae unid.	anchovies	93.12
Genyonemus lineatus	white croaker	64.4	Bathymasteridae unid	ronquils	0.26	Genyonemus lineatus	white croaker	90.02
Paralabrax spp.	sand bass	61.48	Chaenopsidae unid.	tube blennies	0.15	Hypsypops rubicundu	garibaldi	64.49
damaged fish	damaged fish	35.97	Cheilotrema saturnum	black croaker	5.41	damaged fish	damaged fish	28.37
Gobiidae unid.	gobies	35.38	Citharichthys spp.	sanddabs	10.47	Seriphus politus	queenfish	27.87
Seriphus politus	queenfish	24.33	Clupeformes unid.	herrings and anchovie	0.14	Labrisomidae unid.	labrisomid blennies	20.72
Sphyraena argentea	Pacific barracuda	23.59	Cottidae unid.	sculpins	0.23	Sciaenidae unid.	croakers	19.32
Hypsoblennius spp.	combtooth blennies	22.03	Cottus asper	prickly sculpin	0.16	larval fish unid.	larval fishes	16.49
Paralichthys californicus	California halibut	21.42	damaged larvae	damaged larvae	15.48	Typhlogobius californ	blind goby	15.4
Citharichthys spp.	sanddabs	14.9	Diaphus theta	California headlight fi	0.18	Gibbonsia spp.	clinid kelpfishes	14.56
larval fish unid.	larval fishes	13.54	Engraulidae unid.	anchovies	87.73	Gobiesocidae unid.	clingfishes	10.62
Stenobrachius leucopsarus	northern lampfish	10.28	Genyonemus lineatus	white croaker	114.79	Atherinopsidae unid.	silversides	10.3
Pleuronichthys guttulatus	diamond turbot	8.57	Gibbonsia spp.	clinid kelpfishes	0.49	Paralabrax spp.	sand bass	7.95
Atherinopsidae unid.	silversides	7.88	Gillichthys mirabilis	longjaw mudsucker	0.27	Ruscarius creaseri	roughcheek sculpin	6.65
Pleuronichthys ritteri	spotted turbot	7.76	Gobiidae unid.	gobies	23.3	yolksac larvae	yolksac larvae	6.11
Oxyjulis californica	senorita	7.35	Haemulidae unid.	grunts	5.14	Paralichthys californic	California halbut	6.07
Parophrys vetulus	English sole	6.86	Halichoeres semicinct	rock wrasse	0.64	Pleuronichthys guttul	diamond turbot	4.68
Menticirrhus undulatus	California corbina	6.02	Hippoglossina stomat	bigmouth sole	0.37	Sphyraena argentea	Pcific barracuda	3.92
Ophidiidae unid.	cusk-eels	5.71	Hypsoblennius spp.	combtooth blennies	18.07	Citharichthys spp.	sanddabs	3.26
Haemulidae unid.	grunts	5.4	Hypsypops rubicundu	garibaldi	0.1	Parophrys vetulus	English sole	2.79
Symphurus atricaudus	California tonguefish	4.46	Icelinus spp.	sculpins	0.36	Clinocottus spp.	sculpins	2.68
Ophidion scrippsae	basketweave cusk-eel	4.06	Labridae unid.	wrasses	1.35	Oxyjulis californica	senorita	2.67
Xenistius californiensis	salema	3.65	Labrisomidae unid.	labrisomid blennies	0.27	Scorpaenichthys marm	cabezon	2.29
Lepidogobius lepidus	bay goby	3.32	Larvae, unid. yolksac	unid. yolksac larvae	65.66	Pleuronichthys spp.	turbots	2.12
Pleuronectidae unid.	turbots	3.17	larval fish unid.	larval fishes	3.47	Pleuronichthys vertica	hornyhead turbot	2.09
Halichoeres semicinctus	rock wrasse	3.03	Lepidogobius lepidus	bay goby	2.88	Pleuronichthys ritteri	spotted turbot	1.93
Pleuronectidae unid.	righteye flounders	2.99	Leptocottus armatus	Pacific staghorn sculpi	0.24	Pleuronectidae unid.	righteye flounders	1.73
Anisotremus davidsonii	sargo	2.87	Menticirrhus undulatu	California corbina	2.67	Ophidiidae unid.	cusk-eels	1.71
Cheilotrema saturnum	black croacker	2.52	Merluccius productus	Pacific hake	2.01	Stenobrachius leucop:	northern lampfish	1.58
Semicossyphus pulcher	California sheephead	2.15	Microstomus pacificu	Dover sole	0.36	Merluccius productus	Pacific hake	1.44
Xystreurys liolepis	fantail sole	2.03	Myctophidae unid.	lanternfishes	0.14	Syngnathus spp.	pipefishes	1.28
Hippoglossina stomata	bigmouth sole	1.1	Ophidiidae unid.	cusk-eels	3.69	Rhinogobiops nicholsii	blackeye goby	1.23
Icelinus spp.	sculpins	1	Ophidion scrippsae	basketweave cusk-eel	0.98	Labridae unid.	wrasses	1.18
Pleuronichthys verticalis	hornyhead turbot	0.9	Oxyjulis californica	senorita	4.87	Cheilotrema saturnum	black croaker	1.14
Sardinops sagax	Pacific sardine	0.67	Paralabrax spp.	sand bass	23.04	Sebastes spp.	rockfishes	0.98
Hypsypops rubicundus	garibaldi	0.67	Paralichthidae unid.	sand flounders	0.98	Menticirrhus undulatu	California corbina	0.98
Gibbonsia spp.	clinid kelpfishes	0.56	Paralichthys californic	California halibut	14.46	Oxylebius pictus	painted greenling	0.85
Leptocottus armatus	Pacific staghorn sculpi	0.54	Parophrys vetulus	English sole	4.91	Scorpaenidae unid.	scorpionfishes	0.65
Chilara taylori	spotted cusk-eel	0.49	Peprilus simillimus	Pacific butterfish	0.24	Xystreurys liolepis	fantail sole	0.63
Labrisomidae unid.	labrisomid blennies	0.44	Pleuronectidae unid.	righteye flounders	4.23	Pleuronectiformes uni	flatfishes	0.57
Merluccius productus	Pacific hake	0.41	Pleuronectiformes uni	flatfishes	0.91	Rimicola spp.	kelp clingfishes	0.52
Ruscarius meanyi	Puget Sound sculpin	0.4	Pleuronichthys guttul	diamond turbot	12.28	Artedius spp.	sculpins	0.48
Paralichthyidae unid.	sand flounders	0.35	Pleuronichthys ritteri	spotted turbot	1.65	Halichoeres semicinct	rock wrasse	0.45
Triphoturus mexicanus	Mexican lampfish	0.32	Pleuronichthys vertica	hornyhead turbot	2.58	Cottidae unid.	sculpins	0.45
Kyphosidae unid.	sea chubs	0.32	Plueronichthys spp.	turbots	6.43	Zaniolepis spp.	combfishes	0.43
Pleuronectiformes unid.	flatfishes	0.32	Psettichthys melanost	sand sole	0.14	Ophidion scrippsae	basketweave cusk-eel	0.42
Syngnathus spp.	pipefishes	0.31	Ruscarius creaseri	roughcheek sculpin	0.12	Semicossyphus pulche	California sheephead	0.41
Gillichthys mirabilis	longjaw mudsucker	0.28	Sardinops sagax	Pacific sardine	0.12	Hippoglossina stomat	bigmouth sole	0.35
Gobiesocidae unid.	clingfishes	0.27	Sciaenidae unid.	croaker	29.09	Sardinops sagax	Pacific sardine	0.32
Oxylebius pictus	painted greenling	0.27	Sebastes spp.	rockfishes	0.19	Symphurus stearnsii	California tonguefish	0.31
Myctophidae unid.	laternfishes	0.25	Semicossyphus pulche	California sheephead	1.77	Bathymasteridae unid	ronquils	0.28
Pomacentridae unid.	damselfishes	0.21	Seriphus politus	queenfish	10.72	Leuroglossus stilbius	California smoothtong	0.28
Sebastolobus spp.	thornyheads	0.21	Sphyraena argentea	Pacific barracuda	5.41	Medialuna californien	halfmoon	0.27
Labridae unid.	wrasses	0.2	Stenobrachius leucop:	northern lampfish	11.6	Lepidogobius lepidus	bay goby	0.27
Atractoscion nobilis	white seabass	0.2	Symphurus atricaudus	California tonguefish	1.36	Heterostichus rostratu	giant kelpfish	0.2
Typhlogobius californiensis	blind goby	0.2	Syngnathus spp.	pipefishes	0.51	Paralichthyidae unid.	sand flounders	0.18
Roncador stearnsii	spotfin croaker	0.19	Triphoturus mexicanu	Mexican lampfish	0.13	Pomacentridae unid.	damselfishes	0.13
Lyopsetta exilis	slender sole	0.18	Typhlogobius californi	blind goby	0.21	Platichthys stellatus	starry flounder	0.1
Acanthogobius flavimanus	yellowfin goby	0.14	Umbrina roncador	yellowfin croaker	0.21	Icelinus spp.	sculpins	0.1
Rhinogobiops nicholsii	blackeye goby	0.14	Xystreurys liolepis	fantail sole	2.16	Gillichthys mirabilis	longjaw mudsucker	0.1
Bathylagidae unid.	blacksmelt	0.14	Zaniolepis spp.	combfishes	0.58	Chaenopsidae unid.	tube blennies	0.09
Artedeius spp.	sculpins	0.12				Chitonotus/Icelinus	sculpins	0.09
Clupea pallasii	Pacific herring	0.12				Roncador stearnsii	spotfin croaker	0.09
Ruscarius creaseri	roughcheek sculpin	0.11				Chilara taylori	spotted suck-eel	0.08
Chromis punctipinnis	blacksmith	0.1				Lythrupnus spp.	gobies	0.07
Sebastes spp.	rockfishes	0.1				Microstomus pacificu	Dover sole	0.07
Etrumeus teres	round herring	0.1						
Girella nigricans	opaleye	0.09						
Isopsetta isolepis	butter sole	0.09						
Zaniolepis spp.	combfishes	0.09						
Hexagrammidae unid.	greenlings	0.09						

SGS Larvae Source Water			ESGS Larvae Source Water			RBGS Larvae Source Water		
Taxon	CommonName	MeanSourceWate	Taxon	CommonName	MeanSourceWate	Taxon	CommonName	MeanSourceWater (individuals/m
Anisotremus davidsonii	sargo	0.07	Anisotremus davidson	sargo	0.07	Gobiidae unid.	gobies	296.3
Argentina sialis	Pacific argentine	0.08	Argentina sialis	Pacific argentine	0.08	Hypsoblennius spp.	combtooth blennies	218.04
Artedeius spp.	sculpins	0.11	Artedeius spp.	sculpins	0.11	Genyonemus lineatus	white croaker	122.45
Atherinopsidae unid.	silversides	3.99	Atherinopsidae unid.	silversides	3.99	Engraulidae unid.	anchovies	118.21
Atractoscion nobilis	white seabass	0.34	Atractoscion nobilis	white seabass	0.34	Labrisomidae unid.	labrisomid blennies	25.12
Bathylagidae unid.	blacksmelt	0.93	Bathylagidae unid.	blacksmelt	0.93	damaged fish	damaged fish	22.24
Bathymasteridae unid.	ronquils	0.89	Bathymasteridae unid	ronquils	0.89	unid. larvae, yolksac	unid. yolksac larvae	18.93
Brosmophycis marginata	red brotula	0.04	Brosmophycis margin:	red brotula	0.04	Sciaenidae unid.	croakers	15.27
Chaenopsidae unid.	tube blennies	0.08	Chaenopsidae unid.	tube blennies	0.08	Hypsypops rubicundu:	garibaldi	13.96

Cheilotrema saturnum	black croaker	2.12	Cheilotrema saturnun	black croaker	2.12	Parophrys vetulus	English sole	13.86
Chilara taylori	spotted cusk-eel	0.15	Chilara taylori	spotted cusk-eel	0.15	Paralichthys californic	California halibut	12.45
Chitonotus pugetensis	roughback sculpin	0.16	Chitonotus pugetensi	roughback sculpin	0.16	Gobiesocidae unid.	clingfishes	8.54
Chitonotus/Icelinus	sculpins	1.77	Chitonotus/Icelinus	sculpins	1.77	Paralabrax spp.	sand bass	8.31
Chromis punctipinnis	blacksmith	1.2	Chromis punctipinnis	blacksmith	1.2	Seriphus politus	queenfish	6.68
Citharichthys spp.	sanddabs	27.84	Citharichthys spp.	sanddabs	27.84	Typhlogobius californi	blind goby	6.54
Clinocottus spp.	sculpins	0.11	Clinocottus spp.	sculpins	0.11	Citharichthys spp.	sanddabs	6.19
Cottidae unid.	sculpins	0.26	Cottidae unid.	sculpins	0.26	Atherinopsidae unid.	silversides	6.17
Cyclothone signata	showy bristlemought	0.04	Cyclothone signata	showy bristlemought	0.04	Pleuronichthys guttul	diamond turbot	5.36
Diaphus theta	California headlight fis	0.23	Diaphus theta	California headlight fis	0.23	Oxyjulis californica	senorita	4.51
Engraulidae unid.	anchovies	167.95	Engraulidae unid.	anchovies	167.95	Pleuronichthys ritteri	spotted turbot	4.42
Genyonemus lineatus	white croaker	132.23	Genyonemus lineatus	white croaker	132.23	Stenobrachius leucop	northern lampfish	4.27
Gibbonsia spp.	clinid kelpfishes	0.08	Gibbonsia spp.	clinid kelpfishes	0.08	Sebastes spp.	rockfishes	3.94
Gillichthys mirabilis	longjaw mudsucker	0.31	Gillichthys mirabilis	longjaw mudsucker	0.31	Gibbonsia spp.	clinid kelpfishes	3.54
Girella nigricans	opaleye	0.22	Girella nigricans	opaleye	0.22	Pleuronichthys spp.	turbots	3.32
Gobiesocidae unid.	clingfishes	0.05	Gobiesocidae unid.	clingfishes	0.05	Pleuronichthys vertica	hornyhead turbot	3.22
Gobiidae unid.	gobies	13.88	Gobiidae unid.	gobies	13.88	Chromis punctipinnis	blacksmith	3.03
Haemulidae unid.	grunts	9.69	Haemulidae unid.	grunts	9.69	Ophidiidae unid.	cusk-eels	2.47
Halichoeres semicinctus	rock wrasse	1.07	Halichoeres semicinct	rock wrasse	1.07	Haemulidae unid.	grunts	2.44
Hexagrammidae unid.	greenlings	0.09	Hexagrammidae unid.	greenlings	0.09	Menticirrhus undulatı	California corbina	2.25
Hippoglossina stomata	bigmouth sole	0.28	Hippoglossina stomat	bigmouth sole	0.28	Bathymasteridae unid	ronquils	2.11
Hypsoblennius spp.	combtooth blennies	24.05	Hypsoblennius spp.	combtooth blennies	24.05	larval fish unid.	larval fishes	2.05
Hypsypops rubicundus	garibaldi	1.48	Hypsypops rubicundu	garibaldi	1.48	Rhinogobiops nicholsi	blackeye goby	1.71
Icelinus spp.	sculpins	8.23	Icelinus spp.	sculpins	8.23	Merluccius productus	Pacific hake	1.64
Isopsetta isolepis	butter sole	0.22	Isopsetta isolepis	butter sole	0.22	Sphyraena argentea	Pacific barracuda	1.64
Labridae unid.	wrasses	0.63	Labridae unid.	wrasses	0.63	Pleuronectidae unid.	righteye flounders	1.38
Labrisomidae unid.	labrisomid blennies	0.37	Labrisomidae unid.	labrisomid blennies	0.37	Lepidogobius lepidus	bay goby	1.02
larval fish unid.	larval fishes	1.35	larval fish unid.	larval fishes	1.35	Clinocottus spp.	sculpins	0.09
Lepidogobius lepidus	bay goby	2.84	Lepidogobius lepidus	bay goby	2.84	Paralichthyidae unid.	sand flounders	0.86
Lepidopsetta bilineata	rock sole	0.07	Lepidopsetta bilineata	rock sole	0.07	Bathylagidae unid.	blacksmelt	0.83
Leptocottus armatus	Pacific staghorn sculpi	0.07	Leptocottus armatus	Pacific staghorn sculpi	0.07	Syngnathus spp.	pipefishes	0.83
Leuroglossus stilbius	California smoothtong	0.58	Leuroglossus stilbius	California smoothtong	0.58	Cheilotrema saturnun	black croaker	0.76
Liparis spp.	snailfishes	0.08	Liparis spp.	snailfishes	0.08	Semicossyphus pulche	California sheephead	0.67
Lyopsetta exilis	slender sole	0.39	Lyopsetta exilis	slender sole	0.39	Ruscarius creaseri	roughcheek sculpin	0.65
Lythrypnus zebra	zebra goby	0.09	Lythrypnus zebra	zebra goby	0.09	Pleuronectiformes uni	flatfishes	0.65
Menticirrhus undulatus	California corbina	1.4	Menticirrhus undulatı	California corbina	1.4	Icelinus spp.	sculpins	0.63
Merluccius productus	Pacific hake	3.31	Merluccius productus	Pacific hake	3.31	Symphurus stearnsii	California tonguefish	0.59
Mircostomus pacificus	Dover sole	0.08	Mircostomus pacificus	Dover sole	0.08	Xystreurys liolepis	fantail sole	0.55
Myctophidae unid.	lanternfishes	0.37	Myctophidae unid.	lanternfishes	0.37	Leuroglossus stilbius	California smoothtong	0.59
Nannobrachium spp.	lanternfishes	0.04	Nannobrachium spp.	lanternfishes	0.04	Zaniolepis spp.	combfishes	0.44
Odontopyxis trispinosa	pygymy poacher	0.31	Odontopyxis trispinos	pygymy poacher	0.31	Halichoeres semicinct	rock wrasse	0.41
Oligocottus spp.	sculpins	0.05	Oligocottus spp.	sculpins	0.05	Lyopsetta exilis	slender sole	0.4
Ophidiidae unid.	cusk-eels	2.65	Ophidiidae unid.	cusk-eels	2.65	Umbrina roncador	yellowfin croaker	0.38
Ophidion scrippsae	basketweave cusk-eel	0.11	Ophidion scrippsae	basketweave cusk-eel	0.11	Xenistius californiensi	salema	0.33
Oxyjulis californica	senorita	2.59	Oxyjulis californica	senorita	2.59	Oligocottus/Clinocotti	sculpins	0.33
Paralabrax spp.	sand bass	38.17	Paralabrax spp.	sand bass	38.17	Ophidion scrippsae	basketweave cusk-eel	0.31
Paralichthyidae unid.	sand flounders	1.05	Paralichthyidae unid.	sand flounders	1.05	Blenniidae unid.	blennies	0.3
Paralichthys californicus	California halibut	30.93	Paralichthys californic	California halibut	30.93	Cottidae unid.	sculpins	0.26
Parophrys vetulus	English sole	37.64	Parophrys vetulus	English sole	37.64	Sardinops sagax	Pacific sardine	0.23
Peprilus simillimus	Pacific butterfish	0.6	Peprilus simillimus	Pacific butterfish	0.6	Rimicola spp.	kelp clingfishes	0.22
Platichthys stellatus	starry flounder	0.1	Platichthys stellatus	starry flounder	0.1	Peprilus simillimus	Pacific butterfish	0.22
Pleuronectes spp.	righteye flounders	0.04	Pleuronectes spp.	righteye flounders	0.04	Hippoglossina stomat	bigmouth sole	0.21
Pleuronectidae unid.	righteye flounders	7.45	Pleuronectidae unid.	righteye flounders	7.45	Artedius spp.	sculpins	0.2
Pleuronectiformes unid.	flatfishes	1.93	Pleuronectiformes uni	flatfishes	1.93	Triphoturus mexicanu	Mexican lampfish	0.19
Pleuronichthys guttulatus	diamond turbot	6.36	Pleuronichthys guttul	diamond turbot	6.36	Odontopyxis trispinos	pygmy poacher	0.18
Pleuronichthys ritteri	spotted turbot	7.02	Pleuronichthys ritteri	spotted turbot	7.02	Heterostichus rostrat	giant kelpfish	0.17
Pleuronectidae unid.	turbots	6.09	Pleuronectidae unid.	turbots	6.09	Chaenopsidae unid.	tube blennies	0.16
Pleuronichthys verticalis	hornyhead turbot	11.28	Pleuronichthys vertica	hornyhead turbot	11.28	Medialuna californien	halfmoon	0.16
Pomacentridae unid.	damselfishes	0.05	Pomacentridae unid.	damselfishes	0.05	Pomacentridae unid.	damselfishes	0.16
Rhinogobiops nicholsii	blackeye goby	0.12	Rhinogobiops nicholsi	blackeye goby	0.12	Atractoscion nobilis	white seabass	0.14
Roncador stearnsii	spotfin croaker	0.11	Roncador stearnsii	spotfin croaker	0.11	Trachurus symmetricu	jack mackerel	0.14
Ruscarius creaseri	roughcheek sculpin	0.14	Ruscarius creaseri	roughcheek sculpin	0.14	Blennioidei unid.	blennies	0.13
Sardinops sagax	Pacific sardine	0.18	Sardinops sagax	Pacific sardine	0.18	Gillichthys mirabilis	longjaw mudsucker	0.13
Sciaenidae unid.	croaker	36.15	Sciaenidae unid.	croaker	36.15	Scorpaenichthys marn	cabezon	0.12
Scorpaenichthys marmorat	cabezon	0.06	Scorpaenichthys marn	cabezon	0.06	Labridae unid.	wrasses	0.11
Scorpaenidae unid.	scorpionfishes	0.05	Scorpaenidae unid.	scorpionfishes	0.05	Clupeiformes unid.	herrings and anchovie	0.08
Sebastes spp.	rockfishes	1.03	Sebastes spp.	rockfishes	1.03	Lythrypnus zebra	zebra goby	0.08
Semicossyphus pulcher	California sheephead	1.11	Semicossyphus pulche	California sheephead	1.11	Oxylebius pictus	painted greenling	0.08
Seriphus politus	queenfish	23.69	Seriphus politus	queenfish	23.69	Oligocottus spp.	sculpins	0.07
Sphyraena argentea	Pacific barracuda	4.73	Sphyraena argentea	Pacific barracuda	4.73	Liparis spp.	snailfishes	0.07
Stenobrachius leucopsarus	northern lampfish	9.26	Stenobrachius leucop	northern lampfish	9.26	Roncador stearnsii	spotfin croaker	0.06
Symphurus atricaudus	California tonguefish	4.2	Symphurus atricaudus	California tonguefish	4.2	Nannobrachium spp.	lanternfishes	0.06
Syngnathus spp.	pipefishes	0.13	Syngnathus spp.	pipefishes	0.13	Anisotremus davidson	sargo	0.05
Triphoturus mexicanus	Mexican lampfish	0.42	Triphoturus mexicanu	Mexican lampfish	0.42	Microstomus pacificu	Dover sole	0.05
Typhlogobius californiensis	blind goby	0.69	Typhlogobius californi	blind goby	0.69	Cyclopteridae unid.	snailfishes	0.04
Umbrina roncador	yellowfin croaker	1.88	Umbrina roncador	yellowfin croaker	1.88	Leptocottus armatus	Pacific staghorn sculpi	0.04
damaged fish	damaged fish	21.55	damaged fish	damaged fish	21.55	Osmeriformes	salmons	0.04
Xenistius californiensis	salema	0.57	Xenistius californiensi	salema	0.57			
Xystreurys liolepis	fantail sole	2.54	Xystreurys liolepis	fantail sole	2.54			
yolksac larvae	yolksac larvae	67.7	yolksac larvae	yolksac larvae	67.7			
Zaniolepis spp.	combfishes	1.06	Zaniolepis spp.	combfishes	1.06			

Appendix B.

Comparison of Anchovy P_M and SP_M for El Segundo Generating Station.

Anchovy PM vs SPM comparison for El Segundo Generating Station

Cooling water Entrainment:	
Design Volume entrai	1,510,000
Acutal Volume entrair	717,808
Source water(m3)	735,176,994
Larval life (d)	36.3
Ps	0.06670

Desalination Entrainment:		
Volume entr:	41	155303.0303
Volume entr:	123	465909.0909

Month	Source water (larvae/m3)	Entrained (larvae/m3)	fi	PE for Design Intake	Design Intake - fi(1-PE*Ps)^d	PE for 41MGD	41MGD - fi(1-PE*Ps)^d	PE for 123MGD	123MGD - fi(1-PE*Ps)^d
Jan	0.001	0	0.00032	0	0.00032	0	0.00032	0	0.00032
Feb	0.001	0	0.00007	0	0.00007	0	0.00007	0	0.00007
Mar	0.06	0.02396622	0.03241	0.00082041	0.03234568	8.43794E-05	0.03240338	0.000253138	0.03239014
Apr	0.58	0.6000000	0.19081	0.00212475	0.18983083	0.00021853	0.19070907	0.00065559	0.19050736
May	1.16	0.39206271	0.6448	0.0006942	0.64371711	7.13979E-05	0.64468854	0.000214194	0.64446569
Jun	0.04	0.01065165	0.0354	0.00054694	0.03535315	5.62529E-05	0.03539518	0.000168759	0.03538554
Jul	0.015	0.00491615	0.009	0.00067316	0.00898534	6.92343E-05	0.00899849	0.000207703	0.00899548
Aug	0.035	0.00358469	0.01211	0.00021036	0.01210383	2.16357E-05	0.01210937	6.49072E-05	0.0121081
Sep	0.04	0.00819358	0.01437	0.00042073	0.01435537	4.32715E-05	0.01436849	0.000129814	0.01436548
Oct	0.06	0.00061452	0.01919	2.1036E-05	0.01918902	2.16357E-06	0.0191899	6.49072E-06	0.0191897
Nov	0.04	0.00040968	0.01444	2.1036E-05	0.01443926	2.16357E-06	0.01443992	6.49072E-06	0.01443977
Dec	0.05	0.0005121	0.02709	2.1036E-05	0.02708862	2.16357E-06	0.02708986	6.49072E-06	0.02708957
			PM	0.0022		0.00022		0.00067	
			SPM			0.00023		0.00068	