Appendix F. SET Retrofit Analysis Supporting Documentation

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Benefits of Retrofit Opportunities

In planning BMP retrofit projects, the effectiveness of the BMPs proposed is an important consideration. The following analysis demonstrates the potential benefits of the five projects located adjacent to the proposed stream restoration projects. The analysis also gives an indication of the benefits of potential BMP placement on the publically-owned parcels located in high priority subwatersheds identified earlier.

The annual water quality and annual hydrology benefits were estimated for each of the BMP retrofit sites located near the stream restoration reaches. Pre- and post-development loads and runoff were calculated using the Site Evaluation Tool (SET). The SET was developed for the assessment of development impacts to water quality at the site level, and has been customized for many locations throughout the United States (Job et al., 2008). The tool is founded upon sound scientific principles and models, and is capable of evaluating the impact of development on downstream water quality and the influence of Best Management Practices (BMPs) on hydrology and pollutant loads. The SET is particularly useful for assessing various LID techniques for stormwater management.

The SET calculates annual hydrology using the Simple Method (Schueler, 1987), and combines annual runoff with pollutant event mean concentrations (EMCs) to calculate pollutant loads. Runoff and loads are calculated separately for a variety of pervious and impervious land covers. For the Agua Hedionda SET, the annual runoff rates and pollutant EMCs were calculated from long term hydrology and pollutant loading time series generated by the Agua Hedionda LSPC watershed model (Tetra Tech, 2008b), allowing the Agua Hedionda SET to calculate site scale annual hydrology and loads specific to the watershed. Runoff and EMC values were calculated for pervious and impervious surfaces for both residential and commercial land uses.

BMP performance in the SET is estimated using pollutant percent removal rates (Table F-1). The removal rates for extended dry detention basins and swales were taken from the median removal rates published in the National Pollutant Removal Performance Database, Version 3 (Center for Watershed Protection, 2007). This study summarizes nationwide research for several BMP types. BMP performance in California's arid and semi-arid climates may differ somewhat from their results, but this study is the best available resource with a large enough sample size to estimate median mass-based pollutant removal. (Note that BMP performance was assessed differently in the LSPC model; the SET uses a simpler approach to estimate loads on an annual basis, while the LSPC model performs a long-term simulation on an hourly timestep, and uses BMP influent/effluent concentration relationships to estimate removal.) Annual hydrology impacts for extended dry detention basins and swales were estimated from LSPC model testing of the practices. Porous pavement performance was not reported in the Center for Watershed Protection database. Collins et al. (2007) report mixed results, as did Bean et al (2007). Bean et al. report nutrient removal for installations in sandy soils that support infiltration, though percent removal is not reported. The pollutant removal rates reflect best professional judgment of a review of these studies, but with the caveat that there is a great deal of uncertainty associated with them. Porous pavement that supports infiltration is likely to perform well if the underlying soils have high infiltration rates, less well if the soils have poor infiltration rates, and poorly if the installation has an impermeable liner. The porous pavement removal efficiencies are meant to reflect a retrofit installation with some storage capacity in the bottom layer, but with poor infiltration. For the rainwater cisterns, 85 percent of the total annual rainfall is assumed to be captured and later released onto landscaped areas for irrigation, and not contribute to annual runoff.

Table F-1. BMP Performance Assumptions at Retrofit Sites

	Percent Reduction				
BMP	**Annual Hydrology (Infilt. + ET)**	**TSS**	**TN**	**TP**	**Fecal Coliform**
Extended Dry Detention	5%	49%	24%	20%	88%
Vegetated Swale	13%	81%	56%	24%	0%
Porous Pavement	50%	35%	10%	20%	37%
Cistern*	85%	85%	85%	85%	85%

* Cistern sized to capture 85% of annual runoff from rooftop

Following retrofit site selection and SET setup, Tetra Tech delineated the drainage areas for each site using 2005 aerial imagery, a storm sewer layer, and 2-foot topography lines. The drainage area delineations should be considered approximate since they are based on limited data and were not determined in the field. Tetra Tech subsequently calculated the areas draining to each BMP for input into the SET. Percent imperviousness was determined from the 2001 National Land Cover Data (NLCD) percent impervious layer. NLCD, which is derived from satellite imagery, consists of a pixel grid with a resolution of 30 meters representing impervious percentage values. As discussed in the Agua Hedionda Modeling Report (Tetra Tech, 2008b), NLCD may overestimate impervious area in Southern California landscapes with bare soil (especially beaches and rural areas). However, the pervious areas of the retrofit drainage areas are mostly well vegetated, so NLCD should provide a general estimate of impervious area. The impervious estimates appear to correspond well with the building and paved infrastructure seen in the aerial imagery. Pervious and impervious area for the narrow swale drainage areas was calculated independently, using the length and width of road and pervious areas.

The predicted annual runoff and pollutant load reductions show a range of water quality and quantity improvements. Table F-2 shows treatment performance in terms of inches per year of volume reduction (which is normalized to site area), and site-scale load reduction with appropriate units. The pollutant load reductions are not normalized by site area; as a result, the reductions tend to be larger for the sites with greater area. Reporting loads (and not loads per acre) allows the results to be interpreted in terms of benefits to the larger watersheds to which the sites belong. Note that the underlying loading rates of the land surfaces affect the outcome (i.e., pervious versus impervious area, residential versus commercial). For instance, SW-3 and SW-4a have similar drainage area sizes and treatment, but the fecal coliform load removed by SW-4a is an order of magnitude larger than for SW-3. The increased removal reflects a higher underlying fecal coliform loading rate for SW-4a, which is a residential area; SW-3 is a commercial area and has a substantially lower fecal coliform loading rate. On the other hand, commercial areas show higher loading rates for nutrients, so SW-3 removes more nutrient mass than SW-4a.

Table F-2. Annual Pollutant Load Reductions from BMP Retrofits

Retrofit Site	Flow Volume (in/yr)	TSS (tons/yr)	TN (lb/yr)	TP (lb/yr)	Fecal Coliform (# x 10^9/yr)
SW-1	1.20	19.4	92	9.0	386
SW-2	0.54	1.7	16	1.6	14
SW-3	0.43	12.6	43	3.9	174
SW-4a	0.32	19.2	27	1.8	1,514
SW-4b	1.21	4.2	28	1.3	0
SW-5	1.24	1.4	10	0.5	0