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**Lake Tahoe EIP 2010-2020: An Economic Analysis of Private Source
Stormwater BMP Expenditures on Redevelopment Projects**



March 2010

This Economic Analysis is part of a multi-stakeholder effort to inform decision-making regarding the Environmental Improvement Program. This specific product is authorized pursuant to Section 234 (as amended) of the Water Resources Development Act of 1996 (PL 104-303), which provides for coordinated interagency efforts in the pursuit of watershed planning.



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This product would not be possible without the participation of several Lake Tahoe Basin public and private entities seeking to strengthen the linkage between a strong environmental restoration program and a vibrant economy in the Lake Tahoe Basin. This product is one of many that have been advocated by the Regional Planning Initiative (RPI) who seek to bring unbiased fact-based analysis to assist decision-makers in formulation of the Tahoe Regional Planning Agency Regional Plan Update. RPI leadership was provided by the North Lake Tahoe Chamber of Commerce and Lake Tahoe South Shore Chamber of Commerce.

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Executive Summary

This Economic Analysis is part of a multi-stakeholder effort to better inform decision-making regarding the linkage between the Regional Plan Update, Environmental Improvement Program goals, and the economy of the Lake Tahoe Basin.

In an effort to prevent continued degradation of the Lake Tahoe Basin (Basin), in 1969 the states of California and Nevada approved the Tahoe Regional Planning Agency (TRPA) bi-state agreement, which subsequently received the consent of the Federal Government (Public Law 91-148, 83 Stat. 360) to become known as the Tahoe Regional Planning Compact. The Compact was revised in 1980 (Public Law 96-551, 94 Stat. 3233) and TRPA continues to operate under that authority.

As required by the Compact, TRPA adopted environmental goals and standards for the Basin known as environmental threshold carrying capacities (Thresholds). TRPA must attain these nine environmental Thresholds that include Water Quality, Soil Conservation, Air Quality, Vegetation, Wildlife, Fisheries, Scenic Resources, Noise, and Recreation while maintaining a viable economy. The TRPA Regional Plan is the 20-year master plan under which TRPA will achieve attainment of these Thresholds. The Environmental Improvement Program (EIP) is the 'workplan' by which TRPA moves toward attainment of the Thresholds and is a part of the Regional Plan.

The Regional Plan is in the process of a 20-year update that includes an update of the EIP. The EIP update for the period 2010-2020 has received tacit approval, although arguably the update of the EIP is coincident with approval of the Regional Plan Update. Also coincident with the Regional Plan Update is the establishment of a Clean Water Act proscribed Total Maximum Daily Load (TMDL) program by both California and Nevada. . The TMDL program will inform, and be included to some extent, in attainment of the water quality Threshold in the Regional Plan Update.

This analysis investigated the relationship between private sector funded water quality improvements as indicated in the updated EIP, the relationship of urban core redevelopment to water quality improvement, the pace of current redevelopment, and the rate of redevelopment required to meet EIP targets under the Regional Plan Update. The analysis recognizes that since the TMDL identified that the greatest impact to deterioration of water quality was the urban upland area (the urban core), redevelopment is the major private sector funding vehicle that will address the problem at its source.

The updated EIP identifies an unfunded need, or target, of approximately \$300 million for water quality (urban stormwater) retrofit of public and private facilities over the 2010 – 2020 period to attain Thresholds. The updated EIP estimates that approximately \$200 million of this target is expected to be sourced from the private sector.

This analysis assumed that 85% of \$205 million, or \$170 million, would fall upon private redevelopment. The analysis then estimated the range of incremental percentage of redevelopment cost that accrued to water quality improvements, examined project scales and redevelopment trends, and performed a sensitivity analysis as a quality control check.

Results of the analysis suggest that status quo redevelopment conditions will not result in attainment of the updated EIP funding target. Furthermore, there is potential for both a financial and environmental cost with delays in decision-making. Some additional conclusions include:

- Redevelopment expected to occur under status quo trends will fall short of attaining the updated EIP private sector urban stormwater target. Even when a maximum percentage of project cost is accrued to urban stormwater benefits, redevelopment under status quo will only generate 66% of the EIP target over the 2010 – 2020 period of analysis.
- For any given project, the percent of project cost for urban stormwater improvements is a function of the types of Best Management Practices (BMPs) necessary to meet regulatory requirements. Therefore, it is unreasonable to assume that a higher rate of BMP investment (BMP%) can be maintained across all projects over the period of analysis under status quo conditions. It is for this reason that the analysis presented results for a range of possible BMP%s.
- The current project execution rate is, on average, about 0.5 projects per year. This amounts to between \$3.39 million and \$11.3 million in BMP spending per year during the period of analysis, depending on which BMP% was used in the calculation. To attain updated EIP targets, also depending on which BMP% is used, the project execution rate would have to increase to between 0.7 and 2.5 projects per year on average, or between \$170 million and \$567 million per year of redevelopment investment.
- If redevelopment delays occur during the period of analysis (2010 – 2010), the annual project execution rate during this time would similarly decline unless project execution increased even further in the latter part of EIP implementation.
- In order to meet updated EIP targets for private sector redevelopment with a medium BMP% expenditure level, 1.4 projects would need to be completed every year. For comparison, this is nearly one Heavenly Village or Boulder Bay sized project every year.
- The updated EIP target is attained most quickly if large projects are prioritized. However, the goal is also attained through construction of a high number of smaller projects. The total land requiring redevelopment is relatively constant across project size scenarios, but decreases as BMP% increases.
- The cost of BMP construction is likely to increase over time due to inflation. Assuming all other variables were held constant, and BMP funding of \$170 million was fixed, spending on BMPs earlier in the period of analysis would likely yield 19% more benefit for each dollar spent than spending the same \$170 million later in the period of analysis.

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Lake Tahoe EIP 2010-2020: An Economic Analysis of Private Contributions from Stormwater BMP Spending on Redevelopment Projects

1 Introduction

The Tahoe Regional Planning Agency (TRPA) is in the process of updating its Regional Plan¹. This Regional Plan Update (RPU)² targets the future achievement of nine Environmental Threshold Carrying Capacities (Thresholds) for the Lake Tahoe Basin (Basin). A major component of the RPU will provide for the regulation of land use, including development and redevelopment that will occur in the Basin over the next 20 years. The TRPA and RPU use a watershed restoration program document titled the Environmental Improvement Program (EIP) as a strategy to achieve Thresholds. In addition to the RPU, the Lake Tahoe EIP is also being updated (EIP II), and funding targets are being revised. A primary target of the EIP II is to improve the clarity of Lake Tahoe through improved stormwater management³, largely through implementation of Best Management Practices (BMPs), or *techniques, processes, activities, or structures used to reduce the pollutant content of a storm water discharge*.

The EIP II identifies an unfunded need of approximately \$300 million for retrofit of public and private facilities with BMPs over the 2010 – 2020 period to attain Thresholds. The EIP II estimates approximately \$95 million of this need would be met by federal, state, and local government investment. The remaining \$205 million need is expected to be sourced from the private sector. In order to meet the private sector funding target, it is estimated that the majority of spending on stormwater BMPs must come from redevelopment projects. Private redevelopers are required to install stormwater BMPs at each project as part of the permit approval process. The expenditures on stormwater BMPs then contribute to satisfying a portion of the EIP II target. The EIP does not, however, set the allowable level of redevelopment in the basin. That task is the responsibility of the Regional Plan.

The RPU will determine the level and type of development and redevelopment that can occur in the Basin. Because the EIP II funding for stormwater BMPs is anticipated to be sourced largely from private redevelopment, and the RPU will determine the potential level of redevelopment, stakeholders are interested in insuring decision-makers have adequate information regarding whether the RPU will allow for sufficient redevelopment to meet the EIP II funding target.

¹ TRPA (Tahoe Regional Planning Agency). 1987 Lake Tahoe Regional Plan. <http://www.trpa.org/default.aspx?tabindex=4&tabid=167>

² TRPA. Regional Plan Update. <http://www.trpa.org/default.aspx?tabindex=11&tabid=130>

³ TRPA. August 2009. Lake Tahoe EIP: Taking the Environmental Improvement Program to the Next Level.

1.1 Study Purpose

The purpose of this report is to document the economic analysis performed to evaluate the viability of the goals outlining stormwater BMP funding to be sourced from private sector redevelopment presented in the EIP II. This report documents the analysis, summarizes findings, and presents conclusions and recommendations and is intended to inform policymakers during the RPU process.

1.2 Study Area

The study area for this analysis is the Lake Tahoe Basin, which spans four counties and the Carson City Consolidated Municipality. In California, El Dorado and Placer counties divide the western portion of the lake and its basin. In Nevada, Washoe and Douglas counties as well as Carson City share the eastern portion of the lake and Basin. TRPA has published a draft Zoning Map outlining the areas of potential redevelopment⁴.

2 Evaluation Methodology and Assumptions

This assessment relies on available local and national data to estimate current and future redevelopment trends and associated BMP implementation. The analysis is detailed in the following steps:

1. Define range of percentages for BMP cost as a percent of redevelopment total project cost (BMP%)
2. Define three typical redevelopment project scales
3. Estimate range of redevelopment spending required to achieve the EIP II target

Assumptions used in this work are as follows:

- Period of analysis: defined as the 10-year period from 2010-2020. This period is selected in recognition that the EIP runs in 10-year cycles and the Regional Plan in 20-year cycles. Additionally, the current phase of EIP will likely be half completed before the RPU is approved, making a 10-year period sufficient for purposes of this analysis.
- BMP funding need: given the relative accuracy of the data, it was assumed that the funding need from the private sector was approximately \$205 million over the ten-year period.
- Private Sector Contribution from Redevelopment: this value is derived by starting with the \$205 million and reducing by the sum of the amount allocated to residential parcel BMPs (also known as “backyard BMPs”) plus any work allocated to community-based area-wide treatment such as that proposed by Nevada Tahoe Conservation District. It is anticipated that between 80% and 90% (\$160 - \$190 million) of the BMP

⁴ Draft Transect Zoning Map. 2008. 20-Year Regional Plan Update. TRPA.
<http://www.trpa.org/default.aspx?tabindex=11&tabid=130>

implementation will be carried out through private sector redevelopment⁵. For purposes of this analysis, the midpoint of 85% was assumed, yielding a private sector redevelopment BMP funding need of \$170 million.

- Price levels: all analysis and results are computed in 2010 dollars.

2.1 Step 1: BMP Cost as a Percent of Redevelopment Project Cost

During the literature review of BMP costs for redevelopment projects, it was determined that no data specifically quoting BMP cost as a percent of development/redevelopment project cost was available. It was apparent that characterization of BMP cost in this manner is not typically considered at the local or national level. Discussion with other national Tetra Tech entities confirmed that no studies or data was available to directly estimate BMP cost as a % of redevelopment project cost. It is likely that data has not previously been collected in this manner because while BMP cost and redevelopment project cost may be positively correlated, redevelopment cost does not determine BMP cost. Rather, local ordinances and site-specific environmental conditions determine the type and breadth of BMPs that are necessary to effectively manage stormwater discharges.

Due to the sparse availability of data, an alternate means of estimating BMP spending that relied on data from Tahoe-specific redevelopment projects was applied. Using data from the Basin, an estimate of BMP spending as a percent of total project cost (BMP%) was completed, resulting in a range of possible percentages for subsequent analysis. The analysis focuses on two key metrics of BMP cost: BMP construction cost and BMP land acquisition cost. Available Tahoe-specific data was assembled primarily from resource documents (Boulder Bay Draft Environmental Impact Statement) and anecdotal data (discussion with local specialists, newspaper/web articles) for recent and ongoing redevelopment projects, including Heavenly Village and Boulder Bay. Other general redevelopment information such as TRPA's draft zoning maps were also used to support the analysis.

2.1.1 BMP Design/Construction Cost

Typical BMP implementation on redevelopment projects focuses primarily on stormwater management features such as infiltration galleries, stormwater vaults, catch basins, porous pavers, on/off-site detention ponds, restored open space, collection systems, roadway improvements, and underground bioretention and conveyance systems. BMP design/construction costs for on- and off-site BMPs have been estimated at the local, state, and federal level and integrated into the Environmental Protection Agency's National Menu of BMPs database⁶ as well as the International BMP Database⁷. Based on available cost data, the assembled range of construction cost accounts for a wide variety of possible BMP types and effectiveness in removing pollutants. Table 1 presents the range of costs for BMPs of varying

⁵ TRPA. July 2009. Lake Tahoe EIP: Retrofitting Public and Private Facilities with Best Management Practices. Environmental Improvement Program Update, Planning Horizon 2008-2018.

⁶ EPA. 2008. National menu of stormwater best management practices. <http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm>

⁷ IBMPDB. 2010. *International Stormwater BMP Database*. <http://www.bmpdatabase.org/index.htm>

effectiveness, construction cost per redevelopment acre, and associated examples of bioswale implementations. The intent of Table 1 is to demonstrate the wide range of values possible from one type of BMP and does not intend to represent all BMP types or actual costs in the Basin.

Table 1. BMP Construction Costs per Redevelopment Acre

BMP Effectiveness	Construction Cost Per Redevelopment Acre	Example Range of Bioswale Implementations
Very Low	\$5,000	(\$5/ft ²) Compost-topsoil mix, gravel drain only, lower quality material, minimum construction of slope and meander
Low	\$25,000	(\$7-8/ft ²) Improved soil and drain materials, improved meander/slope construction
Medium	\$50,000	(\$10/ft ²) Addition of some landscaping and vegetation, high quality construction
High	\$75,000	(\$15/ft ²) Addition of high quality landscaping for urban park or recreation area
Very High	\$100,000	(\$20/ft ²) Addition of underdrain conveyance system to secondary site

The \$5,000 to \$100,000 range of BMP construction cost per redevelopment acre does not include land acquisition cost. The large range accounts for possible variation in the effectiveness of BMPs (in terms of ability to reduce pollutant loads) as well as the type of BMP (such as a pond versus on-site water treatment facility). Also, this range is broad enough to account for a variety of project densities. For example, necessary BMP costs for a one acre project with only a single story structure and ample open space is likely less costly (dollars per acre) than a high density residential/retail complex that is mostly impervious. The range of BMP cost per redevelopment acre presented in Table 1 was supported by national Tetra Tech BMP specialists. Based on the “medium BMP effectiveness” from that range, it was assumed that TRPA regulations would typically result in about \$50,000 of BMP construction cost per redevelopment site acre in the Basin. This assumption was reinforced by the two pro-forma models completed recently for the Regional Plan Initiative⁸, where the assumed BMP construction cost was about \$50,000 per redevelopment acre in both models. Using the estimate of typical BMP construction and the characteristics of existing redevelopment projects in the Basin, an estimate of on- and off-site BMP construction cost was generated.

2.1.2 BMP Land Acquisition Cost

In addition to the design and construction cost of BMPs, land acquisition cost is a key component of BMP spending on redevelopment projects. Available data was used to characterize the percent of each redevelopment site allotted for BMP use only. In order to estimate this value, the number of acres converted to open space was used as an estimate of

⁸ RPI Project Case Study Analysis Memo. July 2009. Kings Beach and South Lake Tahoe Pro Forma Analyses. Prepared for Regional Plan Initiative.

BMP acres on-site. Off-site BMP acres, such as detention ponds, were also used. This method provides a reasonable estimate of the percent of the site acres that are being used exclusively to facilitate BMPs. Next, available data was used to generate an estimate of land acquisition cost for each project. The land cost was converted to a cost per acre value and combined with the BMP acres data to determine the proportion of the land acquisition cost that constituted BMP spending. Total land cost attributable to BMP spending was tallied. Land acquisition cost attributable to BMP spending had an average of \$469,000 per redevelopment site acre.

2.1.3 Ranges of Values

Using the sum of BMP design/construction and land acquisitions costs as a proportion of total project cost it was estimated that BMP spending constituted about 3.6% of total project cost for Heavenly Village and about 7% for Boulder Bay. Based on this estimate and in lieu of additional data points, it was assumed that about 3% to 10% of total redevelopment project cost was typically spent on BMPs (Table 2).

Table 2. Reference Range of BMP Cost as Percent of Redevelopment Project Cost (BMP%)

Percent of Project Cost Spent on BMPs	BMP %
Minimum BMP Expenditure	3.00%
Low BMP Expenditure	3.50%
Medium BMP Expenditure	5.25%
High BMP Expenditure	7%
Maximum BMP Expenditure	10%

The values presented in Table 2 were used in conjunction with three prototypical redevelopment projects (defined in Section 2.2) to evaluate the viability of the EIP II BMP funding target from private redevelopment projects and implications for the RPU.

2.2 Step 2: Typical Redevelopment Project Scales

In order to evaluate the range of BMP cost as a percent of total project cost, three typical or average redevelopment project scenarios were evaluated based on actual redevelopment projects in the Basin. Use of the typical project scales are intended to simplify the process of estimating current and possible future redevelopment trends and the implications of those trends on the current RPU.

Typical large, medium and small scale projects are defined in Table 3. Based on the size of Heavenly Village (17 acres) and Boulder Bay (16.3 acres), a typical large project was assumed to be greater than or equal to 16 acres. A typical medium project was then assumed to be about 8 acres, and a typical small project was assumed to be about 2 acres. Other estimated characteristics of these typical projects include average project cost, average open space acres, average off-site BMP acres, and average land acquisition cost. These averages were computed using available data points from the Heavenly Village and Boulder Bay projects.

Table 3. Typical Redevelopment Project Scales*

Key Features	Project Scale Type		
	Small	Medium	Large
Size (acres)	<2	8	>16
On-site BMP (acres of converted open space)	0.6	2.3	4.7
Off-site BMP (acres)	0.2	0.8	1.6
Total Land Cost (\$)	\$3,500,000	\$14,100,000	\$29,400,000
Total Project Cost (\$)	\$33,300,000	\$133,200,000	\$280,000,000

* Subsequent analysis will consider BMP spending at each of the five BMP% defined in Table 2

These typical projects make up the estimate basket of redevelopment projects that may occur in the future. Using these typical projects and the BMP% developed in Section 2.1.3, estimates of BMP spending can be generated (Section 2.3).

2.3 Step 3: Redevelopment Required to Meet EIP II Target

Based on the range of potential BMP spending to redevelopment spending ratios and the range of typical redevelopment projects, it is possible to estimate the total private redevelopment spending that would be required to meet the EIP II BMP funding need over the period of analysis. Table 4 provides the total investment in private redevelopment that would be required to generate \$170 million in BMP spending at each of the five possible BMP spending to redevelopment spending ratios (BMP%) over the 2010-2020 period of analysis.

Table 4. Required Redevelopment Spending to Attain EIP II Target at each BMP%

BMP%	Annual Redevelopment (\$)	Total Redevelopment (\$) From 2010 - 2020
Minimum BMP Expenditure (3%)	\$566,700,000	\$5,667,000,000
Low BMP Expenditure (3.5%)	\$485,700,000	\$4,857,000,000
Medium BMP Expenditure (5.25%)	\$323,800,000	\$3,238,000,000
High BMP Expenditure (7%)	\$242,900,000	\$2,429,000,000
Maximum BMP Expenditure (10%)	\$170,000,000	\$1,700,000,000

Table 5 shows 15 possible scenarios of BMP% and typical project types and the total number of projects that would be required over the 2010-2020 period to meet the EIP II targets. In each scenario, it is assumed that the BMP% and the typical project are fixed for the period of analysis. Table 5 illustrates the number of projects that would need to be completed for each combination of BMP% and typical project, but it does not account for the multiple types of projects that would occur in reality (discussed in Section 3). For example, if it is assumed that the BMP% is medium (5.25%) and that only medium projects will typically occur, then \$323.8 million (Table 4) must be spent annually to build approximately 24 (Table 5) medium redevelopment projects during the period of analysis in order to generate \$170 million in BMP spending and reach the EIP II target.

Table 5. Matrix of Total Number of Projects Required to Meet EIP II Target

BMP %	Total Number of Projects by Typical Project		
	Small	Medium	Large
Minimum (3%)	170	43	20
Low (3.5%)	146	36	17
Medium (5.25%)	97	24	12
High (7%)	73	18	9
Maximum (10%)	51	13	6

Table 6 provides the same data as Table 5, but presents the average number of projects that would need to be completed annually during the period of analysis to meet the EIP II target for each of the 15 possible scenarios of BMP% and typical projects. For example, if it is assumed that the BMP% is 3% and that only small projects will typically occur, then \$566.7 million (Table 4) must be spent annually to build approximately 17 (Table 6) small redevelopment projects during each year of the period of analysis in order to generate \$170 million in BMP spending and reach the EIP II target.

Table 6. Matrix of Annual Number of Projects Required to Meet EIP II Target

BMP %	Annual Number of Projects by Typical Project		
	Small	Medium	Large
Minimum (3%)	17.0	4.3	2.0
Low (3.5%)	14.6	3.6	1.7
Medium (5.25%)	9.7	2.4	1.2
High (7%)	7.3	1.8	0.9
Maximum (10%)	5.1	1.3	0.6

3 Redevelopment Trends

The BMP% and project sizes that occur over the period of analysis are not likely to be static in reality. Current redevelopment trends in the Basin were estimated based on data from Tahoe-specific redevelopment data and knowledge provided to the study team by redevelopment professionals in the Basin. Characteristics of current redevelopment such as project size and quantity of projects were examined. In addition, zoning maps were used to generalize the availability of land for redevelopment.

3.1 Current Redevelopment Trends (Status Quo)

Information for current redevelopment trends are largely based on discussions with redevelopment professionals in the Basin. Redevelopment completed to date has primarily been large projects in high density urban areas such as the Tourist Center and Town Center zoning areas. Again, based on conversations with local professionals, it was conservatively estimated that 70% of the projects have been large, 20% medium, and 10% small projects. Reducing the percent of large projects would mean a greater number of projects would need to

be built to meet EIP II targets. That is, large projects raise EIP II funds most quickly. By extension, administrative, approval, and permitting costs often prevent smaller redevelopment projects from appearing profitable to the developer. And, medium and small size projects are less predictable in their zoning location. The 70-20-10 breakdown was applied to the analysis of current and future redevelopment.

Table 7 provides an overview of the current redevelopment trend in the Basin based on discussions with redevelopment professionals. It was assumed that the current redevelopment trend is the status quo, and would not change in the future without changes in the RPU. An estimate of the likely number of redevelopment projects that will occur during the period of analysis under status quo conditions is presented with the breakdown by typical project type and an estimate of the total redevelopment spending associated with those projects.

Table 7. Status Quo Redevelopment Trends

Description	Value
Total number of projects estimated for period 2010 - 2020	5
# Small Projects	0.5
# Medium Projects	1
# Large Projects	3.5
% Small Projects	10%
% Medium Projects	20%
% Large Projects	70%
Total Redevelopment Spending over 10 years (\$)	\$1,130,000,000

The five BMP%_s were evaluated to determine whether it was realistic to assume that the EIP II target of \$170 million from private sector BMP spending would be attainable over the period of analysis. Table 8 presents the BMP funding that would likely be generated over the 2010-2020 period under status quo redevelopment conditions.

Table 8. Summary of Status Quo Redevelopment Trend Implications, 2010 - 2020

Period 2010 - 2020	BMP %				
	Min (3%)	Low (3.5%)	Med (5.25%)	High (7%)	Max (10%)
# Small Projects	0.5	0.5	0.5	0.5	0.5
# Medium Projects	1	1	1	1	1
# Large Projects	3.5	3.5	3.5	3.5	3.5
Total # Projects	5	5	5	5	5
Total Redevelopment (\$1000)	\$1,130,000	\$1,130,000	\$1,130,000	\$1,130,000	\$1,130,000
BMP Spending (\$1000)	\$33,900	\$39,600	\$59,300	\$79,100	\$113,000
% of BMP Spending Target	20%	23%	35%	47%	66%

Because the number of projects is fixed over the period of analysis, the Table 8 shows that as the BMP% increases, the total redevelopment dollars remain constant. However, an increase in the BMP% results in an increase in the amount of BMP funding received. As an alternative example, consider that under current status quo redevelopment conditions, projects will continue to command about \$1 of BMP spending for every \$20 of project cost (5% BMP%). In order to reach a 10% BMP%, developers would be required to spend \$1 on BMPs for every \$10 of project cost. Total BMP spending has a range of between \$33.9 million and \$113 million for the five BMP%. When compared to the EIP II target of \$170 million over the ten year period of analysis, redevelopment under status quo will fall short. Even using maximum BMP% estimate, only 66% of the EIP II target is attained over the period of analysis.

In addition to the redevelopment construction spending that occurs, the availability of land for redevelopment was also considered. Using the TRPA published zoning map, the gross acreage within each zoning area was estimated. These estimates, presented in Table 9, were used to determine whether there was sufficient available land to support the projected redevelopment under current conditions. Note that the estimates are not parcel-specific, and do not take into account areas already redeveloped. The estimates are intended only to lend perspective to estimates of required redevelopment. It was assumed that redevelopment projects could potentially occupy any of the five zones shown in Table 9.

Table 9. Summary of Land Available for Redevelopment

Zone	Acres	Percent
Neighborhood Center	360	8%
Tourist Center	580	12%
Special Districts	1,210	25%
High Density Residential	1,290	27%
Town Center	1,360	28%
Total	4,800	100%

Table 10 describes the estimated acres of land that would be redeveloped under status quo redevelopment conditions over the period of analysis and its related percent of total available land conversion. The estimated redevelopment acreage for each project size includes total main site acres as well as off-site BMP acres. As can be seen in Table 10, a very small percentage of the available land is used for redevelopment when only five redevelopment projects are completed under status quo conditions over the period of analysis.

Table 10. Summary of Land Used for Redevelopment (Status Quo Trend)

Project Type	# Projects	Total Acres Redeveloped	Total Available Acres	% of Available Acres
Small	0.5	1.1	4,800	0.02%
Medium	1	8.8	4,800	0.18%
Large	3.5	61.6	4,800	1.28%
Total	5	71.5	4,800	1.49%

3.2 Future Redevelopment Trends Necessary to Meet EIP II Target

To estimate the future level of redevelopment to meet the EIP II target, the range of BMP% was compared with the characteristics of the three typical redevelopment projects. It was assumed that the 70% large, 20% medium, 10% small breakdown of typical projects would remain the same.

The key difference in this analysis from the status quo analysis is that the number of projects occurring between 2010 and 2020 is allowed to vary in order to meet the constant EIP II target, whereas in the previous section the number of projects occurring over the period of analysis was held constant to show the discrepancy between the EIP II targets and the outcome predicted by status quo redevelopment trends.

For this analysis, the number of projects required to meet the EIP II target change due the variation in the BMP%. Tables 11 and 12 summarize the redevelopment, in total and annual terms, required to meet the EIP II funding target during the period of analysis. Tables 11 and 12 also show that in order to meet the EIP II target with a BMP% of 10%, a minimum of \$1.7 billion in redevelopment must occur over the period of analysis. Assuming the minimum BMP% of 3%, at least \$5.66 billion in redevelopment would need to occur in order to generate \$170 million of stormwater BMPs.

Table 11. Summary of Necessary Future Redevelopment Trend Implications, 2010 - 2020

Total 2010 - 2020	BMP %				
	Min (3%)	Low (3.5%)	Med (5%)	High (7.5%)	Max (10%)
# Small Projects	2.5	2.1	1.4	1	0.7
# Medium Projects	5	4.2	2.8	2	1.4
# Large Projects	17.5	14.7	9.8	7	4.9
Total # Projects	25	21	14	10	7
Total Redev (\$1000)	\$5,670,000	\$4,860,000	\$3,240,000	\$2,430,000	\$1,700,000
BMP Spending (\$1000)	\$170,100	\$170,100	\$170,100	\$170,100	\$170,000
% BMP Spending Target	100%	100%	100%	100%	100%

Table 12. Summary of Necessary Future Redevelopment Trend Implications, Average Annual

Average Annual	BMP %				
	Min (3%)	Low (3.5%)	Med (5%)	High (7.5%)	Max (10%)
# Small Projects	0.25	0.21	0.14	0.1	0.07
# Medium Projects	0.5	0.42	0.28	0.2	0.14
# Large Projects	1.75	1.47	0.98	0.7	0.49
Total # Projects	2.5	2.1	1.4	1	0.7
Avg Ann Redev (\$1000)	\$567,000	\$486,000	\$324,000	\$243,000	\$170,000
BMP Spending (\$1000)	\$17,000	\$17,000	\$17,000	\$17,000	\$17,000
% BMP Spending Target	100%	100%	100%	100%	100%

In addition to redevelopment spending, land use was considered in the analysis of necessary future conditions as well. In contrast to the land analysis for status quo redevelopment trends, this analysis varied depending on the BMP%. A higher BMP% required fewer total projects to be completed. Table 13 summarizes the land that would require redevelopment in order to meet the EIP II target under each of the five BMP%. As seen in Table 13, the amount of land that must be redeveloped during the period of analysis is inversely proportional to the BMP% used in the calculation. At the maximum BMP%, about 2% of the available land, or about 100 acres, must be redeveloped during the period of analysis. At the minimum BMP% of about 7.5%, 358 acres of land must be redeveloped between 2010 and 2020.

Table 13. Land Requiring Redeveloped to Attain EIP II Target

Summary by Project Type	BMP %				
	Min (3%)	Low (3.5%)	Med (5.25%)	High (7%)	Max (10%)
Small					
Acres Redeveloped	5.5	4.6	3.1	2.2	1.5
% of Available Acres	0.11%	0.10%	0.06%	0.05%	0.03%
Medium					
Acres Redeveloped	44.0	37.0	24.6	17.6	12.3
% of Available Acres	0.92%	0.77%	0.51%	0.37%	0.26%
Large					
Acres Redeveloped	308.0	258.7	172.5	123.2	86.2
% of Available Acres	6.42%	5.39%	3.59%	2.57%	1.80%
Total					
Acres Redeveloped	357.5	300.3	200.2	143.0	100.1
% of Available Acres	7.45%	6.26%	4.17%	2.98%	2.09%

3.3 Redevelopment Comparisons

Table 14 compares the estimated redevelopment that will occur under status quo conditions and the redevelopment that must occur to meet the EIP II target. Table 14 illustrates that redevelopment expected to occur under status quo trends will fall short of attaining the EIP II target. Even the maximum BMP% of 10% will only generate 66% of the EIP II target over the period of analysis, or 34% less BMP implementation than is recommended in the EIP II.

Table 14. Current and Necessary Future Redevelopment Trends Compared, 2010 - 2020

Current vs. Necessary Future Redevelopment Trends	BMP %				
	Min (3%)	Low (3.5%)	Med (5.25%)	High (7%)	Max (10%)
Status Quo					
# Projects	5	5	5	5	5
Acres Redeveloped	71.5	71.5	71.5	71.5	71.5
Redevelopment Spending (\$1000)	\$1,130,000	\$1,130,000	\$1,130,000	\$1,130,000	\$1,130,000
BMP Spending (\$1000)	\$33,900	\$39,600	\$59,300	\$79,100	\$113,000
% Target Attainment	20%	23%	35%	47%	66%
Necessary Future					
# Projects	25	21	14	10	7
Acres Redeveloped	357.5	300.3	200.2	143.0	100.1
Redevelopment Spending (\$1000)	\$5,670,000	\$4,860,000	\$3,240,000	\$2,430,000	\$1,700,000
BMP Spending (\$1000)	\$170,100	\$170,100	\$170,100	\$170,100	\$170,000
% Target Attainment	100%	100%	100%	100%	100%

In addition, the current project execution rate is about 0.5 projects per year on average. This amounts to between \$3.39 million and \$11.3 million in BMP spending per year during the period of analysis, depending on which BMP% was used in the calculation. If some delay occurred during the period of analysis, and projects did not occur in one or more years, the annual project execution rate during the period of analysis would decline. For example, if no projects occurred in 2010 and 2011, and the execution rate remained that same, then only eight years during the period of analysis would have an average of 0.5 projects, reducing the total number of projects completed during the period of analysis to four rather than five. A reduction of one project over the period of analysis could result in a range of reduction in BMP spending. For example, on average the loss of 1 out of 5 projects would amount to a 20% reduction in private EIP II contribution over the period of analysis. At the minimum BMP% of 3%, the necessary future redevelopment rate requires that 2.5 projects be completed per year in order to meet the EIP II target during the period of analysis. This would be equivalent to completing about 1.75 large Heavenly Village type projects per year (70% of 2.5). At the maximum BMP% of 10%, 0.7 projects must be completed each year during the period of analysis, or about 0.5 Heavenly Village type projects per year.

If the cost of pollutant removal increases, then it is possible that BMP spending in the future will yield less environmental benefit than spending an equivalent amount today. For example, if redevelopment is delayed and BMP spending does not occur, the total future pollutant load in the lake may increase relative to the future conditions with new BMPs in place. Similarly, the cost of BMP construction is likely to increase over time due to inflation. Assuming all other variables were held constant, and BMP funding of \$170 million was fixed, spending on BMP earlier in the period of analysis would likely yield more benefit for each dollar spent than spending the same \$170 million later in the period of analysis. For example, the USACE Civil

Works Construction Cost Index System⁹ was used to estimate the increase in construction cost for the “Building, Grounds, and Utilities” category between FY 2010 and FY 2020. Using the index values for these two years, it is estimated that construction cost will increase 18.94% over the period. That is, a dollar of BMP spending in 2010 is only worth 84 cents in 2020. Thus, if available BMP funding is fixed, equivalent spending later in the period of analysis will not yield an equivalent level of benefit as the same level of spending early in the period.

4 Additional Project Scenarios

The analysis presented in previous sections assumes that under the status quo and future redevelopment scenarios the distribution of redevelopment project size will remain constant at 70% large, 30% medium, and 10% small projects. Due to the lack of extensive data, additional sensitivity analysis was performed to determine the extent to which a change in the mix of project sizes would affect the predicted levels of BMP spending over the period of analysis.

The project size distribution scenarios included in the following analysis range predominantly large to predominantly small projects (Table 15).

Table 15. List of Project Size Scenarios and Descriptions

Project Size Scenario (%Large - %Medium - %Small)	Description
70 – 20 – 10	Current status quo assumption – predominantly large projects
50 – 25 – 25	Large projects are favored
33 – 33 – 33	Equal distribution of project types
25 – 25 – 50	Small projects are favored
10 – 20 – 70	Predominantly small projects

In order to assess the sensitivity of results to these scenarios, the total BMP funding generated over the period of analysis under each scenario was estimated under the following conditions:

- To present a range of results, the analysis was performed for the 5.25% and the 7% BMP expense ratios
- For each BMP%, the total BMP funding generated over the period of analysis was estimated for each of the five project size scenarios
- For each BMP%, the total number of acres that would need to be redeveloped to meet the EIP II target over the period of analysis was calculated

Figure 1 illustrates the total BMP funding generated by scenario as a function of total projects completed over the period of analysis for the 5.25% and 7% BMP expense ratios. Also shown are the total acres of redevelopment that would be required to reach the \$170 million BMP target for each scenario.

⁹ Civil Works Construction Cost Index System. EM 1110-2-1304. U.S. Army Corps of Engineers. Revision 30 September 2009.

Figure 2 illustrates the *range* of possible funding outcomes. That is, Figure 2 uses the same data as Figure 1 but emphasizes the variability of project size and number of projects completed.

The analysis presented in Figures 1 and 2 shows that total BMP spending generated is sensitive to variation in project size scenario. For example, Figure 1 shows that at the 5.25% BMP% and about 14 projects, the EIP II target can be attained if 70% of the projects are large ones. If only 10% of the projects are large, however, only about \$70 million in BMP spending will be generated after the 14th project. Furthermore, when increasing the BMP% from 5.25% to 7%, the EIP II target may be obtained in as few as 11 or as many as 31 projects, depending on the scenario. If speed of attainment is the priority, then larger projects with higher BMP%s are favorable in reaching the EIP funding target.

While the funding target may be achieved more quickly by favoring large projects, the analysis shows that the total acres of required redevelopment does not fluctuate substantially across the project size scenarios. The 70-20-10 and the 10-20-70 scenarios differ by only two or three acres in the 5.25% BMP expense analysis. This is a result of the project size assumptions presented in Table 3, where it is assumed that on average, eight small projects occupy the same number of acres as one large project. Thus, while many more projects are completed, they occupy less land and are less expensive, generating BMP spending and using land more slowly. However, a higher BMP% will reduce the land requirement. At a BMP% of 5.25%, an average of 210 acres is required across scenarios, whereas in the 7% analysis, an average of 161 acres is required, a reduction of about 23%. If the goal is to minimize land use, the choice between large and small projects is less important than maximizing the BMP% for each project.

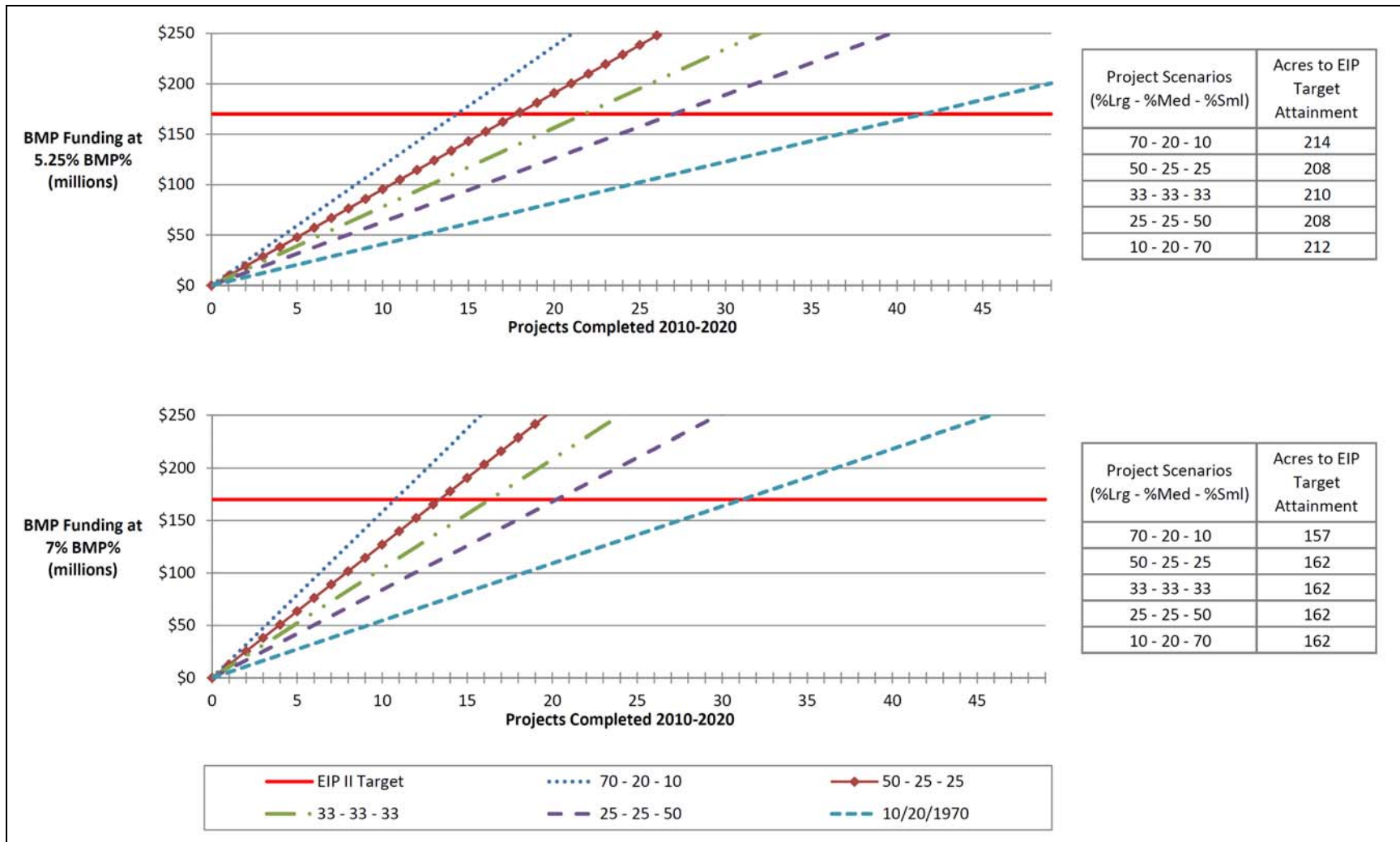


Figure 1. Number of Projects and Acres of Redevelopment Required to Meet EIP II Funding Target for Five Project Size Distribution Scenarios at 5.25% and 7% BMP Expense Ratios

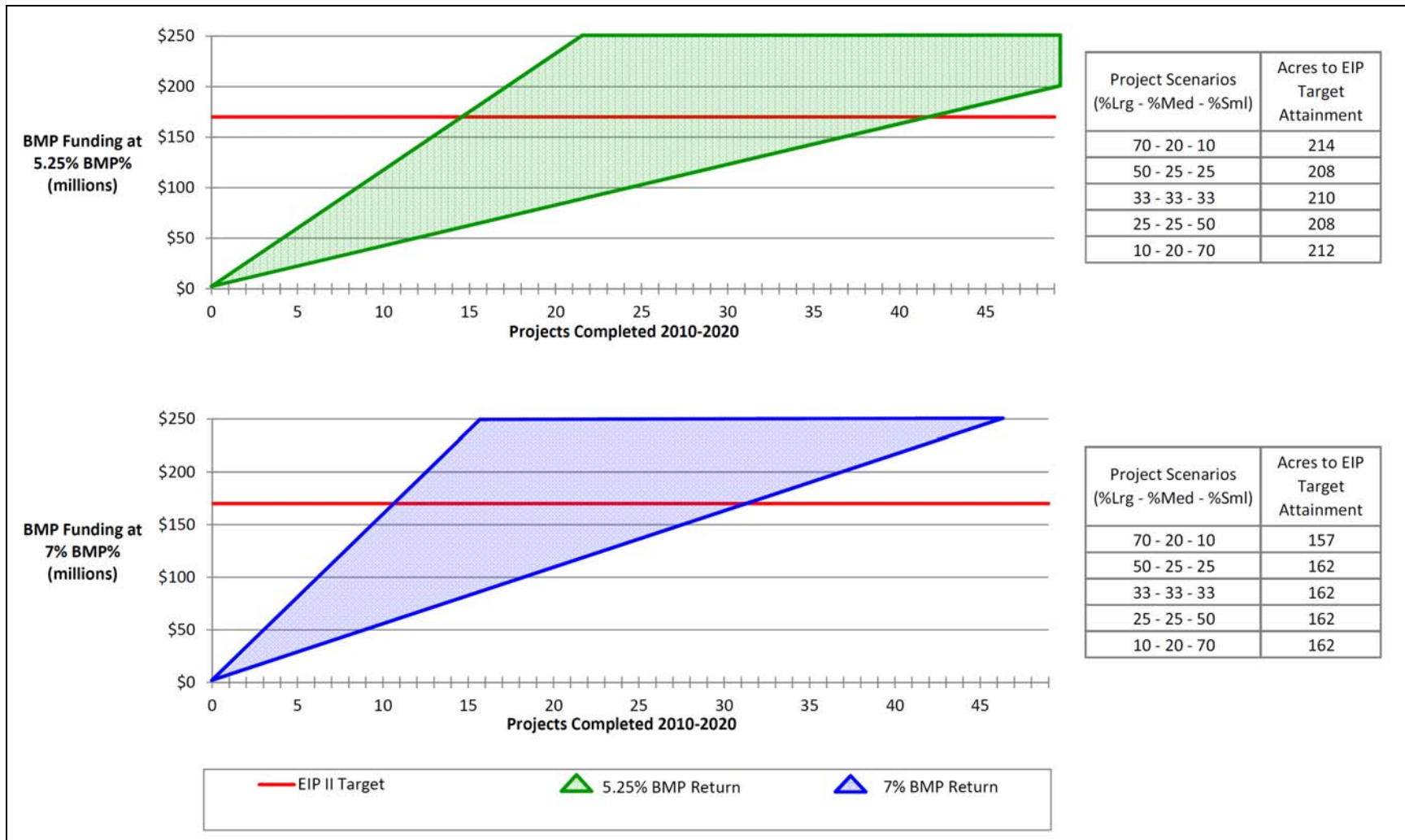


Figure 2. Combined Range of Possible Funding Outcomes Across Five Project Size Distribution Scenarios and for a Range of Total Projects Completed, at 5.25% and 7% BMP Expense Ratios

5 Conclusions

- Redevelopment expected to occur under status quo trends will fall short of attaining the EIP II private sector stormwater BMP target. Even the maximum BMP% of 10% will only generate 66% of the EIP II target over the 2010 – 2020 period of analysis.
- Because the BMP% realized for any given project is a function of the types of BMPs necessary to meet regulatory requirements at each project site, it is unreasonable to assume that a BMP% of 10% can be maintained across all projects over the period of analysis under status quo conditions. It is for this reason that the analysis presents results for a range of possible BMP%s.
- Revisiting the example in Section 3.1, that under current status quo redevelopment conditions, projects expend about \$1 of BMP spending for every \$20 of project cost at the 5% BMP% level. In order to attain the EIP II target at the status quo redevelopment rate, a BMP% of 15%, or \$1 of BMP spending for each \$6.67 of project cost would be required. This value is well above the maximum BMP% that was estimated in the analysis
- The current project execution rate is about 0.5 projects per year on average. This amounts to between \$3.39 million and \$11.3 million in BMP spending per year during the period of analysis, depending on which BMP% was used in the calculation. To attain EIP II targets, depending once again on which BMP% is used, the project execution rate would have to increase to between 0.7 and 2.5 projects per year on average, or between \$170 million and \$567 million per year of redevelopment investment.
- If some delay occurred during the period of analysis, such as being two years into the EIP II cycle or a delay in RPU, the annual project execution rate during the period of analysis would decline unless project execution increased even further in the latter part of EIP implementation.
- In order to meet EIP II targets for private sector redevelopment with a medium BMP expenditure level (BMP%) of 5.25%, 1.4 projects would need to be completed every year. For comparison, this is nearly one Heavenly Village or Boulder Bay sized project every year.
- The cost of BMP construction is likely to increase over time due to inflation. Assuming all other variables were held constant, and BMP funding of \$170 million was fixed, spending on BMP earlier in the period of analysis would likely yield more benefit for each dollar spent than spending the same \$170 million later in the period of analysis by an amount estimated to be nearly 19%.
- Favoring large rather than small projects will result in attainment of the EIP II target more quickly and with a fewer number of projects. However, because smaller projects use less land, the total land requiring redevelopment to attain the target is relatively constant across project size scenarios. The land requirement is minimized by maximizing the BMP% on each project.
- In conclusion, status quo redevelopment conditions will not result in attainment of the EIP II funding target. Furthermore, there is potential for both a financial and environmental cost of delaying BMP implementation from private redevelopment.