Title
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Publication Date
2015-05-01

Research Report – UCD-ITS-RR-15-03

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This research by the University of California-Davis was funded by the California Department of Transportation, under Agreement No. 74A0719 A01. The contents of this document reflect the views of the authors, who are solely responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California or the Federal Highway Administration. This document does not constitute a standard, specification, or regulation.

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Statewide Advance Mitigation Funding and Financial Strategies
Study for the California Department of Transportation

Task 3 Report:
The Business Case for Advance Mitigation in California

Final Research Report UCD-ITS-RR-15-03

May 15, 2015

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Executive Summary

When developing or improving infrastructure in ways that could impact sensitive natural habitats and species, transportation agencies are required to avoid, minimize and mitigate for impacts to natural resources through compensatory mitigation. Traditionally, transportation agencies plan and implement environmental mitigation relatively late in the project development cycle, and on a project-by-project basis. In contrast, the practice of advance mitigation estimates the impacts from one or many transportation projects before or during the planning phase, assesses the mitigation that will likely be required, and also undertakes mitigation activities to satisfy those requirements. Advance mitigation has attracted attention for its potential benefits, which include reducing project delays along with mitigation and associated transaction costs, and to improving mitigation quality, by aligning mitigation activities with statewide and regional landscape-level conservation goals and priorities.

As the California Department of Transportation (Caltrans) considers implementation of advance mitigation as a new business practice, it has commissioned the Statewide Advance Mitigation Funding and Finance Study (SAMFFS) to provide analysis to help inform its decision-making. Shifting from conventional, project-by-project mitigation will require new ways of planning and funding Caltrans' mitigation activities. Task 3 of the SAMFFS study examines the "business case" for advance mitigation, outlining the potential benefits and costs associated with this approach, and carefully articulating the assumptions embedded therein.

Drawing on a variety of existing and new analyses, we conclude from Task 3 that available evidence provides optimism that advance mitigation could lead to financial and staff time savings to Caltrans in the form of mitigation costs avoided altogether, economies of scale achieved in necessary mitigation expenditures, and avoided procedural costs and project delays. In particular, savings that accrue from advance acquisition of mitigation credits and land may be significant. For advance acquisition, we observe the biggest potential savings may result when a purchase is made during a market trough when it otherwise would have been made at market peak.

Given the scale of infrastructure investment anticipated in California over the coming years, mitigation practices that offer even small per project savings can provide orders of magnitude larger savings when carried across whole programs of investment. Under California's Five-Year Infrastructure Plan the state proposes to invest $53.4 billion in transportation and high speed rail over the next five years (California Department of Finance 2014). Applying the national average for mitigation expenditures to that portfolio, roughly $4 billion (7.5 percent of total project costs) will be required in mitigation from 2014 to 2019. Expressed as a range, mitigation costs may run between $1.07 billion (2 percent) and $6.4 billion (12 percent of total project cost). Under current budget limitations, the potential to realize savings on these costs is an important rationale for pursuing advance mitigation. Advance mitigation might also reduce incidence and length of environmental process-related delay, by as much as 10 percent per project we estimate (equaling an average potential time savings of 1.3 months per project in avoided delay.

At the same time, there are some reasons for caution. The task of definitively measuring the cost savings possible through advance mitigation is hampered by inherent methodological challenges. For instance, almost any attempt to estimate either conventional mitigation costs or advance mitigation savings is limited by incomplete or missing data on environmental mitigation costs and timelines. Also, evaluating the impact of an advance mitigation effort is difficult, as no counterfactual exists to assess what would have happened with underlying projects and expenditures in the absence of such a program. Given data and methodological limitations, existing evidence on advance mitigation's costs and benefits results largely from analytical simplifications, back of the envelope calculations, and expert opinion or narrowing the scope of analysis to fit available data.

And while the results of most available studies must be considered in light of such limitations, existing studies consistently report positive impacts from advance mitigation, lending confidence to assumptions about basic directionality. Even if the size of such reductions cannot be stated with statistical precision, available reports almost uniformly find that the approach can reduce project costs and delivery times or specific elements thereof.

Additionally, planning for advance mitigation inevitably involves future planning uncertainties. The long time horizon of advance mitigation plans means that the trajectory of a planned transportation project and estimation of its mitigation needs and costs are subject to change. Advance acquisition of mitigation land could result in financial loss, for instance, if not well timed with land market fluctuations. For these reasons, we recommend that Caltrans pursue a pilot initiative for advance mitigation, and carefully use such a pilot to measure the initiative's impact on the agency's operations.

Overview of the report. In this report, we present evidence from a wide variety of available and new sources to explore the potential for savings from advance mitigation, as well as the costs borne by Caltrans under conventional mitigation. These include:

1. Discussion of available evidence on advance mitigation's financial benefits.

2. Estimates of Caltrans environmental delay that could be attenuated via advance mitigation, and examination of data on the agency's own current mitigation costs.

3. Empirical and hypothetical scenarios examining the potential cost savings and risk associated with advance acquisition of mitigation land.

4. Case studies of advance mitigation in action, using the SR-76 Middle project completed under SANDAG's Environmental Mitigation Program, and OCTA's mitigation acquisitions made under its Measure M2 Environmental Mitigation Program.

Summary Table 1. Available Evidence of the Benefits of Advance Mitigation				
	Example	**Effect of Advance Mitigation**	**Text Reference**	**Comments**
Topic of Analysis	**Avoided Mitigation Costs**		1.1.1	
	Beach Lake Mitigation Bank	$12.33 million in savings from escalating land prices by acquiring land in advance.		
	SANDAG EMP	> $24 million in savings from escalating land prices by acquiring land early.		
Topic of Analysis	**Economies of Scale**		1.1.2	
	Elkhorn Slough	30% - 80% cost savings over per-project wetland mitigation.		
	SANDAG EMP	$200 million in savings; 25% savings on highway projects, 20% savings for local streets and roads.		
	Michigan DOT	$70,000 per acre savings.		
	Washington DOT	30% - 80% cost savings over traditional wetland mitigation.		
Topic of Analysis	**Avoided Procedural Costs and Delays**		1.1.3	
	AASHTO Study	Identified individual environmental delays to project delivery of 2-10.5 months. Advance mitigation may reduce these delays.		
	FL Efficient Transportation Decision Making Process	Saved 805 man-months (62 - 67 man-years).		
	NC DOT Ecosystem Enhancement Program	Mitigation associated project delays dropped from 55% of projects to zero, with a 95% compliance rate.		
	Michigan's Wetland and Advance Mitigation Program	Previously, regulatory approval typically required 4-5 site visits; mitigation sites approved after first visit in 95% of cases.		
	Oregon DOT	Saved over $73 million over the life of the program.		
	USACE Special Area Management Plans Program	Evidence of time savings; data unavailable to this study.	Table 1	Proprietary data.

Summary Table 2. Internal Caltrans Costs of Conventional vs. Advanced Mitigation				
Example		**Effect of Advance Mitigation**	**Text Reference**	**Comments**
	CTIS	Found an average savings of 1.3 man-months per project, on average, based on conservative assumption of 10% savings.	2.1	These analyses are not considered robust or definitive due to restrictions on the available data that limit the ability to isolate mitigation-specific costs from other environmental-related project delivery costs.
Review of Databases	PRSM, STEVE, ROWMIS	Mitigation Bank Credit purchases appear to have more time savings than person-hours savings over developing permittee responsible mitigation through land acquisition, although Caltrans staff report significant person-hours savings through bank purchases.	2.2	These analyses are not considered robust or definitive due to restrictions on the available data that limit the ability to isolate mitigation-specific costs from other environmental-related project delivery costs. Caltrans staff have indicated that the finding about marginal savings of mitigation bank credit purchases over land acquisition does not adequately reflect the actual savings, which is considered to be greater.

Summary Table 3. Advance Acquisition of Mitigation Land				
Example		**Effect of Advance Mitigation**	**Text Reference**	**Comments**
	Beach Lake Mitigation Bank	Early acquisition estimated to have saved $25.1 million	3.1	
Hypothetical Scenarios	Studied cost savings/losses incurred for purchasing land 15, 10, 5 & 1 year in advance of need, in single purchases or multiple installments, based on real estate market values between 1989 and 2013.	Purchases made during market low period resulted in $21 - $39 million in savings. Purchased during peak prices resulted in $26 - $47 million in losses.	3.2	Real estate values based on the Davis-Palumbo Index and adjusted for inflation using both CPI and CCI for comparison. Results of savings sensitive to timings of peaks and troughs in the real estate values.

Summary Table 4. Case Studies of Advance Mitigation in Action			
Example		**Effect of Advance Mitigation**	**Text Reference**
SR 76 Middle	SANDAG/ Caltrans	Saved between $10-$29 million in avoidance of escalated land costs. Unquantified savings due to avoided delays in project delivery and lack of legal challenges.	4.1
OCTA Advance Mitigation	Orange County	25% savings from avoiding land cost escalation by being able to buy land opportunistically.	4.2

1. Available Evidence of the Benefits of Advance Mitigation

Reviewing the available literature on advance mitigation, we find a number of umbrella categories of potential cost savings which may be realized through the approach: avoided mitigation costs, economies of scale, avoided procedural costs and delays. Evidence exists in all of these categories for cost savings.

- **Avoided mitigation costs**: The establishment of Caltrans' own Beach Lake Mitigation Bank has been estimated to have saved $12.33 million by acquiring land early and avoiding escalating land prices. (Typically, mitigation banks are private enterprises, whereby speculative investors conserve or restore mitigation lands and sell credits to agencies or developers in a bid process. With Beach Lake, Caltrans created its own bank.)

- **Economies of scale**: An evaluation of Michigan DOT's wetland advance mitigation program found an average cost savings of $70,000 per acre due to economies of scale. A study in California examined the cost of land parcels that could meet both projected mitigation needs as well as regional conservation objectives. On average, the study found that in the Elkhorn Slough Watershed region on California's Central Coast a 10 percent increase in parcel size was significantly associated with an 8 percent decrease in cost per acre (Thorne, et al. 2009), meaning that real cost savings are likely if advance mitigation programs allow the mitigating agency to purchase larger tracts of land at once.

- **Avoided procedural costs and delays**: An evaluation of Florida's Efficient Transportation Decision Making Process found that the program saved 805 man-months (about 62 to 67 man-years)[1] due to increased efficiency. Similarly, Michigan's wetland advance mitigation program improved its regulatory approval rate after the initial site visit to 95 percent.

Our review of the literature also suggests that comprehensive evaluations of advance mitigation face inherent methodological challenges and hence do not appear in the literature. Rather, we find documentation of advance mitigation's benefits in the form of existing program evaluations, academic literature and case studies.

Determining the level of potential cost savings from advance mitigation presents several serious challenges:

a. Almost any attempt to estimate either conventional mitigation costs or advance mitigation savings is limited by incomplete or missing data on both mitigation costs and timelines.

b. The task of evaluating the impact of an advance mitigation program is inherently difficult, as no counterfactual exists to assess what would have happened with the underlying projects and expenditures in the absence of such a program.

Given data and methodological limitations, existing evidence on advance mitigation's costs and benefits result largely from analytical simplifications, relying either on back of the envelope calculations and expert opinion or narrowing the scope of analysis to fit available data. While the results of most available studies must be considered in light of such limitations, existing studies

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[1] One man-month is the unit measuring one person's productive effort in a 4-week period. Authors' conversion to man-years, assuming 1 man-month equals between 4 weeks and 4.3 weeks.

consistently report positive impacts from advance mitigation, lending confidence to assumptions about basic directionality. Even if the size of such reductions cannot be stated with statistical precision, available reports almost uniformly find that the approach can reduce project costs and delivery times or specific elements thereof.

2. Internal Caltrans Costs of Conventional vs. Advance Mitigation

First, we draw on the literature and on Caltrans own investment database (CTIS) to develop rough estimates of potential savings in various domains that could accrue under advance mitigation.

Applying nationwide figures about the average frequency and median time of delay to state DOT projects due to environmental processes, we make rough estimates of potential time savings that might accrue from advance mitigation. Our most conservative scenario assumes that advance mitigation might reduce incidence and length of such delay by 10 percent per project. Across the 885 programmed major transportation projects we consider, we estimate an average potential time savings of 1.3 months per project in avoided delay.

Second, we examine Caltrans' internal costs of mitigation using three of the main agency databases used to conduct Caltrans business: the environmental tracking (STEVE - Standard Tracking and Exchange Vehicle for Environmental Systems), Right-of-Way (ROWMIS - Right-of-Way Management Information System), and project management and schedule database (PRSM - Project Resourcing and Schedule Management).

Although the limitations of its data on environmental operations are known to Caltrans and are also common among other state DOTs, we use them to report the best available figures on time between environmental milestones, and staff time and cost associated with mitigation-related activities. We conclude in many instances that the data available do not support the development of robust estimates of costs and hence of potential savings, a finding that was not unexpected. One result, for instance, suggests that in-house mitigation land acquisition may be more staff-time intensive (hours) but only marginally more staff-cost-intensive (dollars) than bank credit purchases, a finding that contradicts Caltrans staff reports that land acquisition is in fact far more staff intensive than bank purchases. In many instances, the number of records is too small or the reporting detail not sufficiently granular. Albeit subject to such limitations, the analysis provides a more sophisticated picture of Caltrans own operational costs for mitigation than the agency has had heretofore.

We recommend that any pilot advance mitigation incorporate elements that would enhance Caltrans ability to quantify expenditures, staff time, and staff costs related to environmental mitigation. One way to do so is to encourage or perhaps selectively require staff to use higher level, more specific "work breakdown structure" (WBS) codes when inputting project data into PRSM. Level 5 is the current reporting standard, but task activities are not sufficiently detailed to capture mitigation specific work.

3. Advance Acquisition of Mitigation Land: Potential Savings and Risk

Here, we seek examine the potential savings from advance mitigation that stem from avoiding escalating real estate prices over time. We develop a series of real and hypothetical scenarios that estimate the magnitude of savings possible from advance mitigation and that also illustrate what factors can influence whether advance purchase results in savings or loss. In these scenarios, we apply an index of average historical land values in California (which excludes values of any associated structures) and consumer inflation rates.

First, we examine one of Caltrans' own experiences with advance mitigation – the Beach Lake Mitigation Bank. In this case land was purchased in 1979 and used as mitigation from 1995 to 2013, with approval of the California Department of Transportation, the Federal Highway Administration, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, and the California Department of Fish and Game via an MOA. Although this example is unique in how early it was purchased and unlikely to be repeated, considering the increase in land value over that time period we calculate that the Beach Lake bank saved Caltrans $25.1 million.

Second, we develop hypothetical scenarios examining how cost savings and losses result when 150 mitigation acres are purchased in advance. In the scenarios, we vary how far in advance of the need that a single purchase is made (15-, 10-, 5- and 1-year), how far in advance multiple periodic purchases are made, and the pattern of mitigation need over a 15 year usage period. In all these scenarios, results are strongly influenced by underlying trends in land values over the period. We observe the biggest potential savings when an advance acquisition is made during a market trough when it otherwise would have been made at market peak.

We observe the maximum potential for savings from the scenario where 150 acres were purchased in 1989 and used as mitigation from 1999 to 2013, covering the peak of the real estate bubble; here, savings would amount to $21 to $39 million respectively using CPI and CCI for inflation. Conversely we see the greatest potential for loss when land is purchased in advance at a market high, when it otherwise could have been purchased as-needed at a lower price. We see a loss of $26 to $47 million respectively, using CCI and CPI for inflation, when roughly the same number of acres are purchased in 2005 for use in 2006 through 2013.

In practice, it is difficult or sometimes impossible to project real estate values forward, however advance mitigation purchases should be made with close, expert consideration of real estate cycles and general trends in order to maximize realized savings and avoid losses.

In this summary, we further highlight the scenarios where the advance purchase horizon occurs 1- and 5-years before the onset of mitigation need, as these are potentially most realistic and actionable by Caltrans in near term. The results show a range of outcomes from savings of $17.9 million with a single 1-year advance purchase to loss of $5.4 million with periodic advance purchases that overlap the period of need. These results again demonstrate the influence of the underlying real estate market, where advance mitigation tends to be favorable if purchases are made prior to the real estate bubble. However, we do not conclude that periodic advance purchases will always produce loss; in fact, in a scenario using the exact same parameters but over the 1990 to 2004 period, we found a savings of $1.3 million for the same approach.

4. Advance Mitigation in Action

The SR-76 Middle Project (San Diego)

To explore further empirical evidence, we examine through case study how advance mitigation can shape the delivery, costs, and benefits of a regionally significant transportation project: the SR-76 Middle project in San Diego County. The SR-76 Middle Segment expansion is one of the first projects completed under the *TransNet* Transportation Investment Plan and undertaken within *TransNet*'s innovative advance mitigation program. It is one of the few cases in California to date which can be used empirically to study how an advance mitigation program may shape project delivery, costs, and benefits.

The SR-76 Middle project is a noteworthy case, given the opposition it initially faced. Viewed by opponents as a "poison project" in the proposed sales tax investment plan, the project initially threatened to derail the prospect of winning voter approval for the entire *TransNet* measure. Ultimately, however, and largely due to *TransNet*'s advance mitigation program, the environmental community accepted the project within the sales tax expenditure package. Construction of the SR-76 Middle proceeded without litigation and was completed quickly, from 2010 to 2012.

Benefits from advance mitigation in the SR-76 Case include:

1. **Avoided Land Cost Escalation due to Early Acquisition of Mitigation Parcels.** *TransNet* EMP enabled early access to funding for the acquisition of strategic mitigation parcels. Passage of the *TransNet* measure relied on voter support in a region with a strong tax base. The measure's EMP enabled SANDAG able to acquire 424 acres of mitigation land to satisfy SR-76 Middle's mitigation obligations from 2008-2009, when the U.S. economic recession had driven land costs down significantly. SANDAG originally estimated that it would save roughly 25 percent of conventional mitigation costs by acquiring parcels early and avoiding land price escalation. We estimate actual savings compared to SANDAG's projected costs, and find that SANDAG may have saved from 34 to 60 percent through these early acquisitions (between $10 and $29 million), though we caution that the selection of a baseline for comparison strongly influences the scale of savings observed.

2. **Avoided Project Development and Delivery Delay.** SR-76 Middle benefitted from early coordination of and communication among federal, state, and local transportation agencies; federal and state natural resource agencies; and local environmental and conservation planners, and stakeholders that occurred through several contemporaneous initiatives. These included planning for the *TransNet* ballot measure and its implementation, planning for the SR-76 Middle itself, and planning for various regional parks, conservation, and habitat preservation initiatives. These efforts likely made it easier to identify suitable mitigation parcels and facilitated the development of consensus among a broad array of interests that the properties were appropriate.

3. **Avoided Legal Costs and Delays.** It is impossible to attribute the absence of SR-76 legal challenges to its mitigation; however, observers suggest that the EMP advance mitigation framework along with the "net benefit" mitigation standard applied to improvements in the SR-76 corridor and two other freeway corridors helped to defray concerns among civic and environmental groups that may otherwise have spurred legal action. The net benefit

provisions also added to the EMP's cost, however; for the SR-76 corridor, net benefit has entailed $20.8 million in expenditures not related to required mitigation.[2]

Taken as a whole, the SR-76 case provides an informative look at how advance mitigation can impact even a highly contentious transportation project. Even so, it is still not possible to say definitively how the project would have unfolded had advance mitigation not been used, or had the timing of real estate cycles in this instance been less fortuitous for SANDAG. It is further important to underscore the role played in the SR-76 case by underlying political, social, and economic conditions that enabled passage of the *TransNet* tax measure and support for its early mitigation component.

OCTA Advance Mitigation Acquisitions under Measure M2 (Orange County)

Orange County Transportation Authority's (OCTA) Renewed Measure M (M2) sales tax funds transportation projects and includes a regional advanced mitigation program called the Environmental Mitigation Program (EMP). To jump start transportation projects before M2 revenues would begin to accrue in 2011, OCTA issued bonds against future sales tax receipts, funding an "Early Action Plan." Included in this Early Action Plan was $55 million for the EMP, allowing for acquisition, restoration, and management costs, as well as the establishment of a Natural Communities Conservation Plan and Habitat Conservation Plan.

This case explores how funding early acquisition of mitigation lands even before the M2 tax measure started allowed OCTA to make mitigation purchases opportunistically, benefitting from cheaper prices and access to parcels that were unentitled, in ideal locations, linked with permit assurances, and aligned with impacted habitats. By studying the six land acquisitions made to date, and comparing them to similar purchases made by conservation organizations earlier, we consider how OCTA's advance mitigation purchases might have cost far more had the agency waited five years or more to make them. These real estate comparables suggest that through these early purchases, OCTA may have saved up to 25 percent in purchase price by avoiding land cost escalation.

It is not an objective of this study to explore in depth the factors enabling the M2 tax measure to succeed or enabling the early mitigation component to be included. Nonetheless, it is important to note that such local measures ultimately must win voter support and be sustained by a robust tax base.

[2] Greer, Keith. April 23, 2014. Personal communication.

Introduction

Legally required compensatory mitigation is a common and often costly feature of transportation projects. When transportation infrastructure improvements would intrude upon or degrade the natural environment, and federal and state environmental laws ensure that impacts to natural lands, species, and habitats are avoided and minimized where possible, and that restoration and conservation activities are undertaken where impacts are unavoidable. While comprehensive data documenting the full cost of environmental compliance are not available, either within California or nationwide, a survey of selected state transportation departments suggests that the per project cost of environmental mitigation, excluding right-of-way (i.e. land acquisition), typically ranges between 2 and 12 percent and averages 7.5 percent of total project cost (Macek, 2006).

California's Five-Year Infrastructure Plan proposes to invest $53.4 billion in transportation and high speed rail over the next five years (California Department of Finance 2014). Applying this cross-state mitigation average, the state can expect to spend roughly $4 billion (7.5 percent) on mitigation of transportation projects from 2014 to 2019. Expressed as a range, mitigation costs may run between $1.07 billion (2 percent) and $6.4 billion (12 percent). Given the scale of mitigation expenditures expected in California over the coming years, mitigation practices that offer even small per project savings can provide orders of magnitude larger savings when carried across whole programs of investment.

Advance, comprehensive planning and implementation of environmental mitigation for transportation projects is anticipated to deliver a variety of benefits, both to sponsoring transportation agencies and to the general public. As documented in Task 2 of the SAMMFS study, advance mitigation can be associated with improved ecological outcomes from mitigation and better working relationships among transportation and natural resource agencies and public stakeholders.

As the California Department of Transportation (Caltrans) considers adopting advance mitigation as a new business practice, it also needs information on the financial benefits that may accrue from this approach. Shifting from conventional, project-by-project mitigation will require new ways of planning and funding Caltrans' mitigation activities. In this Task 3 report, we examine the "business case" for advance mitigation, outlining the potential benefits and costs associated with this approach, and carefully articulating the assumptions embedded therein.

Drawing on a variety of existing and new analyses, we conclude from Task 3 that available evidence provides room for optimism that advance mitigation could provide financial savings to Caltrans in the form of mitigation costs avoided altogether, economies of scale achieved in necessary mitigation expenditures, and avoided procedural costs and project delays. In particular, savings that accrue from advance acquisition of mitigation land may be significant.

At the same time, there are some reasons for caution. The task of definitively measuring the cost savings possible through advance mitigation is hampered by inherent methodological challenges. Additionally, planning for advance mitigation inevitably involves future planning uncertainties. The long time horizon of advance mitigation plans means that the trajectory of a planned transportation project and estimation of its mitigation needs and costs are subject to change. Advance acquisition of mitigation land could result in loss, for instance, if not well timed with land market fluctuations. For these reasons, we recommend that Caltrans pursue a pilot initiative for advance mitigation, and carefully use such a pilot to measure the initiative's impact on the agency's operations.

In Part 1 of this report, we discuss the available evidence on advance mitigation's financial benefits. While the methodological and data limitations of available studies are apparent, the direction of reported financial impacts attributed to advance mitigation is consistently positive.

In Part 2, we develop estimates of Caltrans environmental delay that could be attenuated via advance mitigation, assuming conservatively that advance mitigation might save 1.3 months of environmental process delay per project. We also use Caltrans data to document the agency's own current mitigation costs to the best extent possible, showing time between environmental milestones, and staff time and cost associated with mitigation-related activities.

In Part 3, we focus on the potential for savings and loss from advance purchase of mitigation land. We estimate that Caltrans' own Beach Lake Mitigation Bank saved the agency upwards of $20 million in land purchase costs over mitigation acquisitions that would have been made project-by-project. Through a wide range of hypothetical scenarios, we explore how the timing of advance purchase and mitigation need can change the potential for cost savings and loss, pointing to the underlying influence of land market cycles.

Finally, in Part 4, we examine empirical experiences with advance mitigation in San Diego and Orange County. Case study of the SR-76 Middle project in San Diego suggests that SANDAG may have saved from 34 to 60 percent through early acquisition (between $10 and $29 million), compared with the agency's projected acquisition costs. A case study of advance mitigation purchases made under the OCTA's "Early Action Plan" suggests that OCTA may have saved up to 25 percent in mitigation purchase price by avoiding land cost escalation.

1. Available Evidence of Advance Mitigation Benefits

As a first step in considering the business case for advance mitigation, this section draws on published studies, public agency reports, and some original data collection to summarize the benefits expected from the approach, as well as to discuss the challenges inherent in measuring those benefits. It also identifies the project resource and expenditure domains in which advance mitigation is anticipated to produce savings, and in so doing it provides a conceptual framework for the original analyses undertaken here to estimate the potential value of those savings under different circumstances.

What emerges from this review of the literature is that advance mitigation is expected to yield various types of cost savings. We discuss these first, organized under the following categories: avoided mitigation costs, economies of scale, and avoided procedural costs and delays. Our review also shows that literature on the subject is relatively thin and suggests that caveats attend many existing reports of state and local savings attributed to advance mitigation. Consequently, the second part of our discussion outlines the challenges in estimating cost savings from improved environmental processing and the need for caution when interpreting such estimates.

1.1. Overview of Available Evidence of Cost Savings

According to published assessments, advance mitigation programs promise to reduce the costs of environmental mitigation in a variety of direct and indirect ways. Savings are anticipated through avoiding certain costs (such as price escalation), achieving economies of scale on necessary costs (such as a single mitigation purchase made for multiple projects), and avoiding procedural costs and delays (such as reduced staff hours required to fulfill mitigation requirements or reduced project delivery times). Table 1 summarizes the known attempts to quantify cost and time savings associated with advance mitigation.

Our review of available assessments shows that standard methods and data sources for quantifying these benefits are scarce (see Appendix A). A handful of state DOTs with advance mitigation or similar programs have undertaken cost/benefit analyses of their implementation, and these provide the most rigorous existing estimates of benefits. Beyond these, however, many estimates of the cost and times savings represent rough and sparsely documented calculations made within agencies or developed from expert opinion.

1.1.1. Avoided Mitigation Costs

By definition, advance mitigation is planned and implemented earlier in the timeline of a transportation project than is conventional project-by-project mitigation. Acting earlier in the project development process to acquire mitigation land or undertake other conservation activities allows implementing agencies to avoid certain costs altogether, such as costs associated with general land price escalation, short-term price escalation due to market cycles, and land price costs associated with purchases made under duress, when the implementing agency has little leverage as the buyer. Costs due to “temporal loss” violations are also more easily avoided under advance mitigation. While land acquisition is likely to be the prime example of avoided cost escalation in the long-term, it is possible that earlier mitigation may allow agencies to avoid the related cost escalation for construction and maintenance inputs as well. Further, acting in advance may increase opportunities for purchasing higher-quality habitat land parcels, and hence for potentially avoiding or reducing the need for enhancement and/or restoration and their associated costs. Also, the conditions associated with regulatory agency approval of a mitigation package and with required ratios for impacts may be more favorable when mitigation land is of higher quality.

Avoided land acquisition cost escalation

With the fixed supply of land in California, many expect real estate prices to continue rising in the long-term at a rate greater than inflation; this price escalation may be especially stark where open spaces suitable to conservation are in limited supply. Acquiring and conserving natural resources earlier in the project timeline may allow mitigating agencies to avoid the increments of cost escalation for needed land or habitat types limited in supply.

Caltrans’ experience with the Beach Lake Mitigation Bank provides an example of such savings. The land used for Beach Lake was originally acquired by Caltrans for construction purposes, but was serendipitously made available as a mitigation bank in 1991 through efforts costing approximately $2.1 million. In 2009, Caltrans staff estimated the value of the same property at

Table 1. Existing Estimates of Advance Mitigation Cost Savings by Category

Program	Year Established	Total Budget/Expenditures	Benefit Category		
			Avoided mitigation costs	**Economies of scale**	**Avoided procedural costs and delays**
Caltrans Beach Lake Mitigation Bank /1	1991	$2.07 M total cost to establish the bank, including land acquisition, construction, monitoring and transfer costs	$12.33 M in 2009 dollars. Difference between purchase price and value estimated in 2009.		
San Diego Asscociation of Governments' Environmental Mitigation Program (EMP)/2	2004	$850 M total EMP funding over the 40 year life of the program	>$24 M estimated savings in land acquisition compared to costs estimated in 2003.	$200 M ●25% savings, regional hwy projects ●20% savings, local street & road projects estimated cost savings from advance mitigation over mitigation later in the planning process	
Michigan DOT programmatic wetlands advance mitigation program /3				$70,000 average cost savings per acre, before and after program implementation	regulators now approve 95% of the wetland mitigation sites MDOT shows them at the outset
Florida DOT's Efficient Transportation Decision Making Process /4.	2004				805 man-months: cumulative time savings from ETDM Process $26.1 M: total cost savings, calculated in 2011
Oregon DOT's Oregon Bridge Standards Approach /5		$23 M			zero violations over life of the program; ROI of $3.19 for every $1 expended, versus $.75 per $1 in traditional permitting approach >$73 M, estimated over the life of the program
Washington DOT sponsored mitigation banks /2 *	1997			30-80% cost savings compared to costs of traditional wetland mitigation in Washington state	
Army Corp Special Area Management Plans Program					Existing evidence of time savings. Proprietary data can be obtained from Venner Consulting

/1. Jeffrey Swindle (associate environmental planner, Caltrans, Environmental Stewardship Branch), in discussion with Jackie Bjorkman and Gian-Claudia Sciara, October 18, 2013.

/2. Greer, K., M. Som. 2010; Richard Chavez, SANDAG, personal communication, April 8, 2014.

/3. NCHRP Project 25-25, Task 67: Optimizing Conservation and Improving Mitigation Cost/Benefit, October 2010.

/4.. Florida Department of Transportation. 2012. Florida's ETDM Process: Progress Report #5. https://etdmpub.fla-etat.org/est/

/5. OTIA III State Bridge Delivery Program. Environmental Programmatic Permitting Benefit/Cost Analysis. October 2008.

$14.4 million, representing a 7:1 increase in value[3]. Our own analysis of the Beach Lake case, discussed in Section 3.1, suggests that Beach Lake allowed Caltrans to avoid between $22.8 (2013$) and $27.2 million (2013$) in price escalation due to its advance purchase.

Avoided short-term price increases

Making mitigation acquisitions in early stages of project development also allows agencies to time purchases to capitalize on favorable buying conditions. Evidence of such cost saving are found in San Diego's *TransNet* Environmental Mitigation Program. When compared to original estimates made in 2003 of costs for needed *TransNet* acquisitions, SANDAG purchase 1,040 acres of land from 2003 to 2007 at a savings of $24 million, or 32.3 percent (Greer & Som 2010).

According to Greer, Senior Regional Planner at SANDAG, this savings was largely due to two factors. Acquiring land early in the project timeline gave staff the time and flexibility both (a) to take advantage of more favorable purchase prices during the downturn in the real estate market, and (b) to identify land acquisitions with the greatest value per dollar. In general, we expect that enabling early mitigation acquisitions will allow agencies greater flexibility to time purchases to favorable market conditions, to compare parcel costs more expansively before making a purchase, and to avoid short-term price volatility.

Avoided costs of purchases made under duress

Transportation agencies making mitigation purchases well in advance act with far more leverage than do agencies that, in order to meet a project's construction schedule, must acquire or conserve mitigation land under a compressed timeline. Acting under time pressure can lead an agency to purchase needed mitigation at significantly higher prices than it would otherwise pay. Conversely, the identification and purchase of various anticipated mitigation lands well in advance of time sensitive mitigation needs can protect transportation project sponsors from the need to make mitigation purchases under duress.

The purchase by the San Bernardino Association of Governments (SANBAG) of kangaroo rat habitat to mitigate unexpected impacts associated with the I-15 & I-210 interchange project provides an illustrative example. The late discovery of kangaroo rat habitat in the area impacted by the interchange prompted SANBAG to quickly purchase kangaroo rat habitat elsewhere rather than delay the project. Because SANBAG needed to acquire land on a tight timeline, to avoid construction delays, the agency was forced to pay nearly $280,000 per acre, a six-fold premium over common land acquisition prices of $38,000 per acre in neighboring regions.[4]

This case highlights several lessons for advance mitigation planning. First, the case underscores the need for accurate and standardized early impact assessment methodologies. Second, it suggests that, as with conventional mitigation, some uncertainty is unavoidable with advance mitigation. It is possible that project planners become aware of a species and the corresponding need for mitigation late in the process. Were an advance mitigation program in place in this instance, it is conceivable that kangaroo rat habitat would have been among the targeted acquisitions, even if it was not an anticipated need of this specific interchange project. Third, this case also suggests that advance mitigation planning and acquisition might fruitfully be structured to make some acquisition decisions in advance of need, informed by regional conservation goals and critical habitat needs. A program that provides some buffer in its acquisition plan, for needs

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[3] Swindle, Jeff. October 18, 2013. Personal communication.

[4] Phu, Dan. February 11, 2014. Personal communication.

identified via early assessment as likely to arise but not yet confirmed, could minimize potential for needing to make critical habitat purchases under duress. Had an advance mitigation planning framework been present in this case, it is possible that SANBAG would have already secured suitable habitat at a lower price and avoided the pressure inherent in a purchase-at-any-cost scenario.

Avoided costs of temporal loss

Anticipating and fulfilling future compensatory mitigation requirements well in advance of need increases the likelihood that agencies can avoid the higher mitigation requirements and accompanying costs of temporal loss. Temporal loss is the time that elapses between initiation and maturation of a compensatory mitigation site. During this period, the habitat or natural resource in question is considered not fully available, leading resource agencies to increase mitigation requirements. For example, whereas required compensatory mitigation of wetlands might be 1:1 under ordinary circumstances, the required mitigation where there is temporal loss might be 3:1.

The possibility of avoiding temporal loss was a strong motivation behind SANDAG's Environment Mitigation Program.[5] Prior to the EMP, compensating for wetlands under higher mitigation requirements (3:1 for wetlands) was common. To estimate the economic benefit of advance mitigation when creating the *TransNet* Ordinance, SANDAG projected the savings to the agency as roughly ¼ to $^{1}/_{5}$ of the cost of historical mitigation costs, anticipating that advance mitigation would help projects to avoid incurring temporal loss and associated costs.

1.1.2. Economies of Scale

Whereas the conventional approach ties mitigation funds to individual project budgets, the advance approach allows mitigation to be funded and scaled across the needs of multiple projects, making economies of scale a second category of financial benefits.

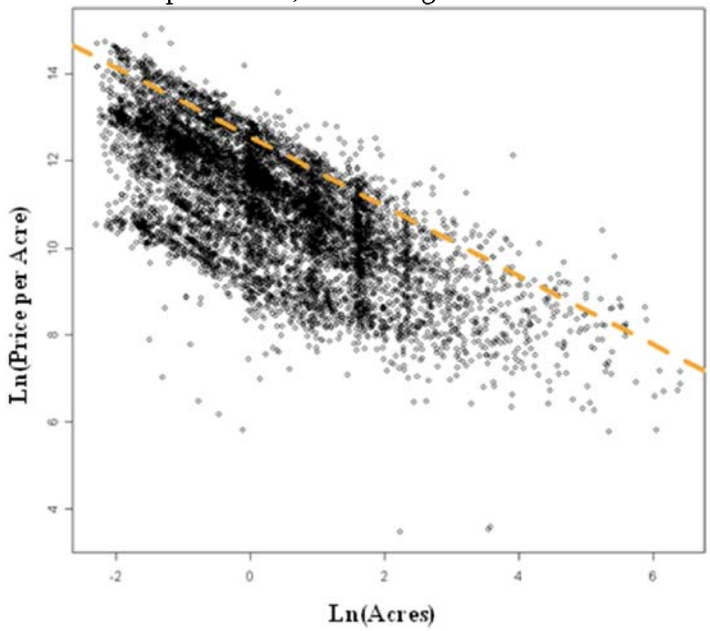
Cost savings from acquiring larger parcels

Undertaking mitigation in advance and for several projects at once allows the implementing agency to acquire mitigation parcels that serve the restoration or conservation requirements for several future projects. In turn, bundling mitigation acquisition needs may enable the purchase of fewer, larger parcels to satisfy those needs. At least some evidence suggests that larger land purchases produce significant cost savings over smaller purchases. One California study examined the cost of land parcels that could meet both regional conservation, or greenprint, objectives as well as projected mitigation needs from road projects. On average, larger parcels cost less on a per acre basis than smaller parcels, even after accounting for inflation in real estate prices (Thorne, et al. 2009). In the Elkhorn Slough Watershed region on California's Central Coast, parcels exhibited a significant inverse relationship between parcel size and parcel price ($p<.0001$), with a 10 percent increase in parcel size associated with an 8 percent decrease in cost per acre (Figure 1).

[5] Chavez, Richard. April 8, 2014. Personal communication.

Figure 1. Parcel Price Decreases as Parcel Size Increases

This graph shows the relationship between the natural log area of a given parcel (x-axis) and the natural log price per acre (y-axis) for parcels in the Elkhorn Slough Watershed. The dashed orange line is the 90% quantile regression line, modeling the relationship between parcel area and parcel cost, accounting for inflation in land values over time.



(Source: Thorne, et al. 2009)

Cost savings from consolidating parcel transactions

Similarly, making fewer land purchases allows agencies to economize on the transaction costs associated with land acquisitions, reducing the staff resources needed to research real estate options and carrying out purchases as well as the number of individual transaction fees and legal costs. Similar cost savings may be realized when a Conservation Easement is sought for only one larger parcel versus multiple smaller parcels. In Washington State, the WSDOT has established three state operated mitigation banks, allowing it to restore fewer large sites instead of many smaller sites. This yielded cost savings ranging from 30 to 80 percent over traditional project-by-project wetland mitigation (Greer and Som 2010).

1.1.3. Avoided Procedural Costs and Delays

A final category of benefits from advance mitigation consists of avoided procedural costs and delays that may be associated with conventional mitigation. These benefits include cost savings associated with the reduced likelihood of legal challenge, smoother environmental approval processes, and the resulting reduction in project delays. Such savings are typically measured in terms of project delivery times and schedules, and in staff costs.

Because most of the available evidence concerning environmental process delays does not isolate those delays associated with mitigation related activities, we know little about either the time costs associated with conventional mitigation or the magnitude of time savings that might be realized specifically from advance mitigation. Anecdotal reports within Caltrans suggest that advance mitigation promises discrete project-level time savings that are above and beyond time savings from consolidated parcel transactions, however. For any project requiring mitigation, many steps are involved both pre- and post-construction land acquisition in developing the mitigation strategy, including baseline mitigation studies, conceptual and final plans, and arrangements for what entity will hold the fee title to or conservation easement over a property or will be land manager. Such steps may take many months to years, and do not get underway until a mitigation parcel has been indentified for purchase. Project-level time savings are to be won from advance mitigation when such a strategy can be developed once, for multiple projects, rather repeatedly for individual projects.[6]

Reduced procedural delays, faster approval timelines

Project delays associated with environmental review and permitting can be extremely costly. While such delays are frequently cited as a cause for cost escalation, the exact length of and causes of such delays are not always well understood. In some cases, these processes can add as much as 10 to 15 years to the delivery timeframe for some infrastructure projects. Caltrans' estimated its own project cost overruns due to environmental review delays in fiscal years 2002/03 and 2003/04 were approximately $59 million per year (Byrne 2004). In a recent hearing before the U.S. House of Representatives Transportation and Infrastructure Committee, Thomas Margro, CEO of Transportation Corridor Agencies in Orange County, testified that the federal environmental review process added 15 years to development of SR-241 in California (Bergstein & Mo 2012).

A survey of state DOTs for the American Association of State and Highway Transportation Officials (TransTech Management 2003) examined underlying causes of environmental delay and reported that 12 months as the median environmental-related delay estimated by responding agencies. The same survey associates the most common causes of environmental delay with the selection of alternatives (39%), technical study (35%), and agreement on purpose and need (29%). (See Table 2) While it is unknown what role mitigation-specific issues play in these delays, it is conceivable that some delay could be constructively attenuated via advance mitigation. (We examine the potential for such savings for Caltrans in Section 2.1.)

There are several reasons to think that advance mitigation could help to reduce environmental delay. For instance, a recent evaluation of Florida's Efficient Transportation Decision Making program (ETDM) cites several examples of projects where early coordination with stakeholders and conservation agencies served to reduce the number of project alternatives and to better focus technical studies (Florida Department of Transportation 2012). Early awareness and interagency coordination under the ETDM resulted in more timely acceptance of project purpose, need, and concepts; elimination of project alternatives; reduction in project scopes of service; and reductions in the frequency of late issue identification and project challenges, all adding to time and cost savings. Further, by reducing the uncertainties of late-stage environmental mitigation, advance mitigation may yield significant time savings for permit approvals, reduce environmental violations and challenges, and save on associated costs. Florida DOT reports that its ETDM effort saved 805 man-months (62- to 67-man years)[7] over the seven year life of the project (Florida DOT 2012), a savings we calculate as equaling roughly 10 full-time positions per year. According the report's survey of DOT district offices, the program has resulted in projected savings of $26 million.

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[6] Carolyn Brown. Branch Chief of Environmental Stewardship, North Region, Caltrans. Personal communication. December 12, 2014.

[7] Authors' conversion to man-years, assuming 1 man-month equals between 4 weeks and 4.3 weeks.

North Carolina provides another example, where 55 percent of the NC DOT's transportation developments in 2001 were delayed due to issues associated with wetland mitigation requirements (Crist, et al. 2014). Today, under its Ecosystem Enhancement Program (EEP) wetland and stream mitigation needs are assessed annually for all NCDOT transportation projects planned in the seven year planning horizon. Then, needed mitigation for upcoming transportation projects is completed in advance. After the program was implemented, no delays in Transportation Improvement Projects were reported.[8] Similarly, Michigan DOT's programmatic wetlands advance mitigation program now results in a 95 percent approval rate by the Army Corps of Engineers of mitigation sites on their first site visit, reflecting the higher quality of potential mitigation sites considered; in contrast, MDOT staff report that it commonly took four to five site visits to secure site approval under project-by-project mitigation (Environmental Law Institute et al. 2010, p. 19). Further, "holistic consideration of wetland mitigation has permitted MDOT to achieve economies of scale via off-site, consolidated wetland mitigation sites, reducing per-acre compensation costs from typically exceeding $100,000…to a present-day average cost of $25,000-$30,000 per acre," making for average savings of roughly $70,000 per acre (Environmental Law Institute et al. 2010, p. 15).

8 For further discussion of North Carolina's EEP, see the Statewide Advance Mitigation Funding and Financial Strategies Task 2 Report: *Setting the Stage for Statewide Advance Mitigation in California.*

Table 2. Potential for Alleviating Causes of Environmental Delay

Cause of Delay[1]	Incidence of DOT projects affected by this delay[1]	Median reported delay[1]	How advance mitigation may alleviate delay
Selection of Alternatives	39%	4 months	No impact.
Technical Study Complexity	35%	10.5 months	Early coordination among permitting agencies, planners, and environmental groups to identify suitable mitigation parcels and practices in advance of need can ensure that lead agencies are meeting the requirements of the ESA, NHPA and CWA, smoothing the integration of NEPA with these other statutes.
Purpose and Need	26%	2 months	Early and regular communication among agencies can help resolve disagreements over on the purpose and need statement early in the process and increase the likelihood of reaching agreement and avoiding on agency vetoing the statement.
Addition of Late Alternatives	19%	8 months	Planning advance mitigation activities around regional conservation goals can help agencies anticipate concerns about potential mitigation-related litigation and permitting and avoid devoting time and attention to late alternatives.
Concurrence Points	16%	3 months	Early coordination with conservation agencies can help to develop consensus around proposed mitigation plans as generally appropriate, alleviating delay at key milestones.
Late Legal Challenge	10%	5 months	When advance mitigation planning involves stakeholders in a collaborative process, potential opponents' concerns can be addressed, reducing the potential for litigation.
Conflicting Study Results	3%	4 months	No Impact

/1. According to results of a survey requested by AASHTO (TransTech Management 2003)

Reduced legal costs

Advance mitigation also holds potential to reduce the incidence of legal challenges mounted against a project for environmental reasons and hence to reduce the often significant costs associated with preparing the administrative record, legal fees, and resultant project delay. In the San Diego region, environmental challenges like those mounted against the SR-56 from 1987 to 1999 are viewed by some transportation officials as less likely under advance mitigation programs. Though still relatively young, Orange County Transportation Authority's Environmental Mitigation Program, part of its Measure 2 transportation sales tax, has encountered no CEQA challenges on its transportation projects.[9] Officials attribute the absence of legal challenges to early coordination with stakeholders on identifying mitigation habitat, a benefit of advance mitigation. Although it is not possible to attach a dollar amount to the savings from avoidance of legal challenge, such savings in staff time and delay are likely to be considerable.

Similarly, under Oregon DOT's Oregon bridge standards program, which integrates an environmentally proactive approach to environmental mitigation and upfront mitigation planning, there were no environmental permit violations over 4 years of construction (Oregon Department of Transportation 2008). In contrast, consider the example of California's SR-56, a transportation project mitigated conventionally and facing significant lawsuits from the Del Mar Terrace Conservancy, the Sierra Club and subsequently the City of Del Mar over concerns with environmental mitigation. These legal challenges continued for 5 years, and the costs borne by Caltrans, San Diego, and the Coastal Commission to address them were undoubtedly significant, though not well documented.[10]

1.2. Challenges to Evaluating Benefits of Advance Mitigation

There is broad agreement that advance mitigation can yield significant cost and time savings for transportation projects and programs, and various public agency reports estimate the magnitude of such savings for agency-specific applications. Yet, it is important to note that rigorous quantification of advance mitigation's benefits in comparison to conventional, project-by-project mitigation faces fundamental analytical challenges and has not yet been possible. A variety of methodological approaches may be used, each with its own strengths and weaknesses. We conclude that there is no single best methodology for evaluating the benefits of advance mitigation, and we discuss these analytical challenges here. In Appendix A, we discuss in greater detail the specific methods used in studies cited in this report to develop estimates of advance mitigation's cost and benefit.

First, our understanding of mitigation costs in general, even without advance mitigation, is incomplete at best. A basic challenge facing any attempt to estimate either conventional mitigation costs or savings from advance mitigation is the fact that data on environmental mitigation costs and timelines are often incomplete, missing or not tracked in such a way to allow for analysis, making comprehensive estimates cost savings difficult or impossible. Available studies of advance mitigation's benefits reflect this absence of comprehensive data in their frequent reliance on surveys to collect targeted data from transportation agency staff.

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[9] Dan Phu. February 11, 2014. Personal communication.

[10] Dan Phu. February 11, 2014. Personal communication.

Across most state DOTs, the costs of addressing environmental concerns in general "have not been adequately reflected in project costing systems…This has limited efforts to assess policy impacts and the efficient allocation of resources, given that all benefits and costs of investments cannot be clearly identified" (Macek 2006, p. 4). Information on the costs of ongoing mitigation maintenance and monitoring is particularly hard to come by, making it hard to estimate cost savings from such activities implemented through advance mitigation. In contrast, land acquisition costs are generally well documented, making estimates of cost savings from land acquisition a relatively approachable undertaking.

Second, the task of evaluating an advance mitigation program is inherently difficult as no counterfactual is available to assess what would have happened without such a program. One might work around this issue by comparing average mitigation costs across pre- and post-advance mitigation implementation, yet even this approach has its limitations. An advance mitigation program would need to be in place for a significant amount of time before such a comparison could yield statistically robust and simply coincidental results. For example, while SANDAG's advance mitigation program under *TransNet* is a candidate program for such before-and-after study, only seven projects have been completed with advance mitigation as of the date of this report, too few to draw definitive conclusions about program savings. Even where such comparisons could be drawn, confounding factors may influence the results, as program implementation may coincide with such other events that impact project costs and timelines as real estate market fluctuations or permitting agency changes. The potential for confounding factors to influence the results make it difficult to attribute any observed impacts or changes to advance mitigation alone. Another possible approach is to identify matching pairs of similar projects, one mitigated conventionally, the other under an advance mitigation program. Ideally, if projects are well-matched, the impact of advance mitigation on costs and delay can be isolated. Yet, given the multitude of factors (e.g. location, scale, facility type, preexisting conditions) shaping project cost and delay, finding well-matched projects can be challenging.

Given these limitations, few overall evaluations of the costs and benefits of advance mitigation have been carried out. Rather, existing reports of advance mitigation's costs and benefits rely largely on attempts to make analytical tasks more manageable, either by using back of the envelope calculations and expert opinion or by narrowing the scope of analysis to use available data. Estimates of the time and cost savings from Florida's ETDM program, for example, rely on reports from state DOT district office staff who were asked to estimate ETDM's costs and benefits on a project by project basis. Further, each district office used its own methods to assess costs and benefits and the methodologies employed for doing so were not clearly documented in the final report. While estimates from experts with inside knowledge of project delivery do not supply statistically reliable values, they do provide an informed, but potentially rough picture of benefits. Another approach limits the dimensions across which comparisons are drawn between projects mitigated conventionally and those mitigated via advance programs. For example, comparing per acre mitigation costs of using a bank to those of purchasing comparable natural resources later does not supply a comprehensive picture of advance mitigation's benefits; however, it does illuminate the potential for savings from early land acquisition that avoids cost escalation and achieves economies of scale.

While we caution that the results of most available studies must be considered in light of such limitations, we also underscore the value of existing studies in suggesting the basic directionality of influence of advance mitigation. Even if the size of such reductions cannot be stated with statistical precision, available reports almost uniformly suggest that the approach can reduce project costs and delivery times or specific elements thereof.

2. Internal Caltrans Costs: Conventional vs. Advance Mitigation

Available literature on advance mitigation applications suggests the approach can achieve project delivery, staff time, and dollar savings, attributable both to economies of scale achieved in project development and to avoidance of certain procedural costs and delays altogether. Although various reports indicate substantial time and administrative cost savings can accrue to public agencies, details on the measurement of such claims are scant.

In this portion of our analysis, we draw on the literature and on Caltrans own investment database and its operational data to develop rough estimates of potential savings in various domains that could accrue to if advance mitigation is pursued. We undertake these efforts in two different ways. First, we apply percentages of per project time savings reported in the literature to Caltrans own portfolio of projects as documented in the California Transportation Investment System (CTIS). Second, in order to document Caltrans staff time, staff costs, and project timelines for the environmental process under conventional, project-by-project mitigation, we analyze data from three Caltrans information systems covering project management, environmental, and right-of-way activities. We also explore non-staff mitigation expenditures, such as for mitigation bank credits.

Whereas most reports we reviewed provide little documentation of methods used to calculate reported savings or of pertinent assumptions embedded therein, we explicitly describe how we arrive at savings estimates and the assumptions used in our analysis.

Our results suggest that:

- This analysis provides a more sophisticated picture of Caltrans own operating costs for mitigation than the agency has had heretofore. Still, they are clearly imperfect. One result, for instance, suggests that in-house mitigation land acquisition may be more staff-time intensive (hours) but only marginally more staff-cost intensive (dollars) than bank credit purchases, a finding that contradicts Caltrans staff reports that land acquisition is in fact far more staff intensive than bank purchases. (Mitigation banks are typically private enterprises, whereby speculative investors conserve or restore mitigation lands and sell resulting mitigation credits to agencies or developers in a bid process.)

- Any advance mitigation pilot to be tested by Caltrans should incorporate elements that enhance Caltrans' ability to quantify expenditures, staff time, and staff costs related to environmental mitigation. One way is to encourage or perhaps require staff to use higher level, more specific "work breakdown structure" (WBS) codes to input project data.

For the CTIS based analysis, our most conservative scenario assumes that advance mitigation might reduce incidence of delay and average delay times by 10 percent, achieving a total time savings of 1.3 months per project compared with business-as-usual scenario.

2.1. Estimating Avoided Caltrans Project Delay under Advance Mitigation

For projects impacting endangered or threatened species or important natural lands, key steps in the environmental clearance process include planning, securing approval for, and implementing the required mitigation. While the precise extent to which mitigation issues figure into documented environmental delays is unknown, it is clear that difficulties in identifying, receiving permits for, and/or purchasing appropriate mitigation can lengthen project delivery.

Here, we develop three sets of estimates of the potential time savings that advance mitigation might produce specifically by attenuating specific causes of environmental-related delay. To do so, we also use the most recent data available (2004) via CTIS to estimate the number of active Caltrans projects in the state's STIP and SHOPP pipelines. We also draw on general estimates of per-project environmental-related delay attributable to specific factors, as reported by state DOTs and described above (TransTech Management 2003). By identifying delay factors which advance mitigation has the greatest potential to lessen, and by calculating different degrees (high, medium, and low) to which advance mitigation might be effective in reducing such delays, we illustrate the range of potential time savings across the STIP and SHOPP that might be achieved due to advance mitigation.

Data and Methods

The most recent available CTIS (California Transportation Investment System) data were used as a proxy for estimating the number of projects in the Caltrans pipeline for the current TIP and SHOPP. We used the database of highway programmed projects, available for download from Caltrans at: *http://www.dot.ca.gov/hq/tpp/offices/osp/ctis_sources_download.html* (file name: ctis_h_pr). The database includes projects programmed as of 2004 as STIP and SHOPP projects on the State Highway System, from the Caltrans Transportation Improvement Program System database.

To estimate a count of current Caltrans construction projects, we included only those CTIS projects for which Caltrans is the lead agency and which would be expected to have a significant environmental impact. These selection criteria yielded 885 unique Caltrans highway construction projects over the period covered, for which CTIS also returns project funding totals.

To estimate environmental delays under conventional mitigation, we used survey results from "Causes and Extent of Environmental Delays in Transportation Projects" (TransTech Management 2003). We assume that the sources and frequency of environmental-related project delays in California are comparable to those reported in this nationwide survey. Further, we isolate those causes of delay that advance mitigation has the greatest potential to diminish; we document the mechanisms through which we believe advance mitigation can lessen such delays in Table 2 above. As determined in consultation with Stuart Kirkham at Caltrans, delays associated with the 'selection of alternatives' and 'conflicting study results' are not expected to be lessened by advance mitigation. Therefore, delays in these categories were included in the advance mitigation scenarios in amounts identical to the Business-as-Usual (BAU) approach. We did not assume that advance mitigation could reduce these sources of delay.

We use the count of 885 projects to estimate illustrative scenarios of potential reductions in delay under advance mitigation across the state's STIP and SHOPP investments. First we develop, a BAU scenario to suggest how environmental delays impact those 885 projects, assuming conventional, project-by-project mitigation, and assuming the reported averages of prevalence of delay and of delay times for each delay factor. Under these BAU assumptions, Caltrans projects incur 8.4 months of environmental related delay per project on average.

Results

We develop three different scenarios to illustrate potential time savings from advance mitigation (See Table 3). These scenarios differ by the extent (low, medium, and high) to which we assume that advance mitigation might attenuate for Caltrans projects the average prevalence and length of delays from specific causes reported in the national study. Although some studies have found evidence of overall time savings from advance mitigation programs (Florida DOT for example reports that its ETDM effort saved 805 man-months (about 62 to 67 man-years)[11] over the seven year life of the program), there are no examples in the literature of the rate at which a program might create time savings. We therefore attempt to present a range of plausible scenarios, without being overly optimistic about the time-saving impact.

Our most conservative scenario assumes that advance mitigation might reduce incidence and length of per project delay *due to the cited causes* by 10 percent; our medium scenario, by 25 percent; and our most optimistic, by 50 percent. We apply the low, medium, and high proportional reductions to the BAU scenario, estimating total environmental-related delay per project when advance mitigation is assumed to have a low, medium, and high impact in reducing such delays.

After total delay per project was calculated for the low, medium, and high advance mitigation scenarios, we then subtracted these from the BAU totals to calculated the per project time savings attributable to advance mitigation under the three scenarios. While our results represent a best possible approximation of potential reductions in environmental delay attributable to advance mitigation, we emphasize that they are approximations.

When estimated most conservatively, advance mitigation has the potential to reduce environmental delay from these causes by 1.3 months per project; estimated most optimistically, delay may be reduced by 5.0 months per project. Medium-range estimates suggest 2.9 months of delay could be saved per project. Again, these estimates consider the potential for advance mitigation to reduce measured delay from cited causes; they do not account for any additional time savings that advance mitigation might realize through such mechanisms as consolidated parcel transactions or avoided per-project mitigation strategizing (see section 1.1.3. discussion).

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[11] One man-month is the unit measuring one person's productive effort in a 4-week period. Authors' conversion to man-years, assuming 1 man-month equals between 4 weeks and 4.3 weeks.

Table 3: Reducing Environmental Delay via Advance Mitigation: Low, Medium, and High Savings Estimates

Cumulative months of delay across all projects				
Scenario Assumptions	**Business-As-Usual**	**Low Savings Scenario**	**Medium Savings Scenario**	**High Savings Scenario**
median delay reduced by:	0%	10%	25%	50%
prevalence of delay reduced by:	0%	10%	25%	50%
Causes of delay*				
Technical Study Complexity	1138	830	480	142
Purpose and Need	120	87	50	15
Addition of Late Alternatives	256	186	108	32
Concurrence Points	68	50	29	8
Late Legal Challenge	44	32	19	6
Total delay (months)	1626	1185	686	203
Total delay (years)	135	99	57	17
Time savings over BAU (years)		37	78	119

Table 4. Complete Results of Low, Medium, and High Time Savings Scenarios

			no savings (BAU)		**low savings scenario**--median delays reduced by 10%, prevalence reduced by 10%		**medium savings scenario**--median delays reduced by 25%, prevalence reduced by 25%		**high savings scenario**--median delays reduced by 50%, prevalence reduced by 50%	
Cause of Delay *	Prevalence among State DOT projects *	Median amount of delay reported (in months)*	# projects affected	delay per project (months)	# projects affected	delay per project (months)	# projects affected	delay per project (months)	# projects affected	delay per project (months)
Selection of Alternatives***	39%	4	345	1.6	345	1.6	345	1.6	345	1.6
Technical Study Complexity	35%	10.5	310	3.7	279	3.0	232	2.1	155	0.9
Purpose and Need	26%	2	230	0.5	207	0.4	173	0.3	115	0.1
Addition of Late Alternatives	19%	8	168	1.5	151	1.2	126	0.9	84	0.4
Concurrence Points	16%	3	142	0.5	127	0.4	106	0.3	71	0.1
Late Legal Challenge	10%	5	89	0.5	80	0.4	66	0.3	44	0.1
Conflicting Study Results***	3%	4	27	0.1	27	0.1	27	0.1	27	0.1
Total delay (months per project):				8.4		7.1		5.4		3.4
Time savings relative to BAU (months per project):						1.3		2.9		5.0

*According to results of a survey requested by AASHTO (AASHTO 2003)

**survey results applied to 885 Caltrans highway construction projects currently programmed as of 2004, according to CTIS database (filename: ctis_h_pr)

***rates of delay from selection of alternatives and conflicting study results are not expected to improve with advance mitigation

2.2. Documentation of Caltrans Costs for Conventional Mitigation

An important objective of this report is to assess the costs associated with conventional mitigation in California in tandem with the potential for savings from pursuing advance mitigation instead. If Caltrans is to understand how advance mitigation might impact its bottom line for mitigation, it must first understand what that bottom line currently is. This section describes analysis undertaken to document primary contours of the internal and external costs Caltrans currently bears to deliver mitigation under the conventional project-by-project model.

For this work, we used data from three of the prominent databases used by Caltrans to conduct the agency's business: the project management and schedule database (PRSM - Project Resourcing and Schedule Management), the environmental tracking (STEVE - Standard Tracking and Exchange Vehicle for Environmental Systems), and Right-of-Way (ROWMIS - Right-of-Way Management Information System). The data in each of these systems reveal different dimensions of project cost and to different degrees of detail, and we cross-reference the data systems where possible to reveal additional cost dimensions.

Our original analytical intention in undertaking this analysis was ultimately, using data gleaned on conventional project-by-project mitigation costs, to develop estimates of potential cost savings that could accrue from the adoption an advance mitigation model. We conclude, however, that the data available do not support the development of such estimates. In many instances, the number of records is too small or the reporting detail not sufficiently granular to do so. Further, in many instances, the data results do not harmonize with expectations of or anecdotal reports by Caltrans staff regarding time and money costs for specific activities. Albeit subject to these limitations, this analysis nonetheless provides a more detailed picture of Caltrans' own operational costs for mitigation, as captured by its accounting systems, than the agency has had heretofore. It is precisely those instances where data results do not align with staff expectations that are important for guiding any future efforts to improve Caltrans' cost accounting for mitigation and related activities, whether performed conventionally or in advance.

Key highlights of this analysis include:

- It is difficult to say definitively which environmental phase is most expensive for mitigation activities and, hence, may present greater opportunity for advance mitigation saving costs. Analyses undertaken with different pools of data yield contradictory results.

- Reported averages of staff cost are likely far lower than the true cost for most projects, as evidenced by data skew. For these reasons, reported averages may provide a very rough but conservative picture of required per project resources.

Observations for Improved Application of Caltrans Data

While the main goal of this task is to examine the potential for savings to Caltrans of advance mitigation, it is important to reflect on the role that the department's internal data systems play in informing the business case for advance mitigation. Our analysis of data from these systems affords a view of how they might be used more effectively to aid Caltrans in future efforts to implement advance mitigation as a new business practice.

It is clear from our work with these databases that Caltrans has, in PRSM and STEVE, fairly sophisticated data systems in place to track respectively, project cost and time/schedule resources, as well as environmental process activities. In a separate memo to Caltrans completed for Task 2A of this project, we identified several ways in which these systems could be modified to better accommodate an advance mitigation program, if and when such a program is available. Based on further engagement with these systems in Task 3, we identify a few additional potential improvements for Caltrans' consideration:

- Implement a simple STEVE feature to isolate those projects that use mitigation bank credits or that involve in-house mitigation land acquisition.
- Improve the ability to discern the cost of mitigation bank credits, and whether credits were purchased for species issues (if so, which ones); for wetland or other resources (if so, which ones); or for multiple species or resource types (if so, which ones).
- Various STEVE fields appear to serve for inputting data on mitigation credit costs (Cost of Bio Bank MCCE, Actual Dollars, and Bank Cost). Greater clarity is needed to discern which should be used, or under what circumstances.
- Improve input of data describing the measurement units (e.g. acreage, linear feet) for mitigation bank credits; this field is often not filled out currently.

2.2.1. Mitigation-related Staff Time for Key Project Milestones (Using PRSM)

First, we use PRSM data to consider Caltrans staff time and cost associated with major segments of the project delivery process and with key components of the environmental process. For both PRSM projects that are complete and those still active, we use PRSM data in the dollar cost category "Estimate At Complete" (EAC cost) to document staff costs associated with key project delivery milestones and tasks involved therein. The EAC cost variable provides a single measure to study project costs for both complete and active projects. For projects that are complete, EAC cost generally aligns with the actual expenditures to date (Actual Cost). For projects still underway, the EAC cost forecasts the total cost of each task at task completion, and is generally the sum of Actual Cost and expenditures still anticipated (Estimate To Complete).

We use the Caltrans' environmental process as organized in its environmental tracking system, STEVE, to structure our analysis (Table 1). To associate staff time with discrete milestones tracked in STEVE, we identified the substantive work tasks and activities performed within each milestone. Consultation with Caltrans environmental staff, as well as our own review of task descriptions in the WBS manual allowed us to identify the work (and associated WBS codes) typically associated with each milestone. While we document our analysis with detailed discussions of the PRSM data and records selected for this work, we report the results first, acknowledging these are of greatest interest to most readers.

Table 5. Milestones in Caltrans' Environmental Review Process

Project Delivery Phase		Environmental Milestone		Milestone Description
Phase*	No.			
PA&ED	0	BES	Begin Environmental Studies	The environmental functional units are notified that the PA&ED phase of the project has been opened, and requests that the studies for completing the environmental document commence.
		DED	Draft Environmental Document	The environmental document is circulated for public review and comment.
		PA&ED	Project Approval and Environmental Document	The final environmental document is signed, and the project is approved to move into the design phase.
PS&E	1	RTL	Ready-to-list	Mitigation plans and designs may still be underway if arrangements to secure and implement mitigation are not yet complete. The project goes out for bid to construction contractors.
Constr.	3	CCA	Construction Contract Acceptance	Construction can begin. Mitigation monitoring commitments may extend through and beyond construction.

* Shown phases are: Project Approval/Environmental Documentation (PA&ED); Plans, Specifications, & Estimate (PS&E); Construction (Constr.)

Results

Overall, our analysis of PRSM data provides a rough picture of staff cost and effort involved in different segments of the environmental process. (See Table 6) It also suggests inherent limitations in the ability to accurately enumerate mitigation related staff time and dollar costs using existing data. Given the study's emphasis on quantifying mitigation costs, we emphasize Level 6 results, although this choice involves analytical tradeoffs as discussed in greater detail below.

Table 6. Overview of Results:* Avg. Per Project Staff Time & Personnel Costs for the Environmental Process						
Milestone Period	**Staff Hours Estimated at Completion (Avg)**		**Personnel Cost Estimated at Completion (EAC) (Avg)**		**Records in Analysis (Range of *n* across task activities considered in phase)**	
	Level 5	**Level 6**	**Level 5**	**Level 6**	**Level 5**	**Level 6**
1. BES - DED	1,545	1,555	$83,931	$97,593	1,461	42 – 287
2. DED - PA&ED	1,204	1,533	$88,401	$95,396	25 - 1,207	50 - 219
3. PA&ED - RTL	7,477	2,420	$493,891	$153,925	990 – 2,010	27 - 135
4. RTL - CCA	10,794	698	$745,538	$49,798	736 – 1,125	9 - 109
Total	**21,020**	**6,206**	**$1,411,761**	**$396,712**		

*Standard deviations are not reported in this summary table, as the components of these sums are milestone-based averages drawn from different records for each milestone.

We can draw somewhat preliminary conclusions about the level of staff resources demanded by each environmental phase relative to others and hence about in which phases any efficiencies from advance mitigation may be more or less noticeable.

The results suggest that mitigation-oriented activities in Milestone Periods 1 (BES – DED) and 2 (DED – PA&ED) of Caltrans environmental process typically demand fewer staff resources than do such activities in later periods. Per project staff hours and cost for Period 1 (ranging around 1,500 staff hours, and $90,000) and Period 2 (ranging around 1,400 staff hours, and $92,000) figures are fairly consistent across Level 5 and 6 analyses, providing some confidence in their reliability. Additionally, Period 3 is consistently more expensive in staff time and dollar cost than the two earlier periods, in both Level 5 and 6 analyses. In both the Level 5 and Level 6 analysis, Period 3 is visibly more expensive than the earlier milestone periods, though by a far larger margin for Level 5 data (about 7,500 staff hours and almost $500,000) than for Level 6 (about staff 2,400 hours and $150,000).

As visible in Table 6, the choice of data (Level 5 or Level 6) included in the analysis affects the results. On one hand, Level 5 data return far more records (upwards of several hundred to over 1,000 records per task). Yet, project tasks are defined more generally at Level 5 increasing the likelihood that staff hours and costs captured in these data represent some work unrelated to environmental mitigation, such as completing cultural resource studies, managing hazardous waste, or drafting traffic plans. On the other hand, Level 6 data better isolate mitigation related tasks, but provide fewer records and a smaller *n* for analysis, and hence less robust results.

In this study, we emphasize the Level 6 results, given our emphasis on quantifying mitigation costs. While containing fewer records, Level 6 data provide a more reliable filter for discerning mitigation costs, including less “noise” about activities that are not directly related to mitigation. For instance, Level 6 results suggests that the final milestone period (RTL – CCA) may require the least resources for mitigation of all periods, and hence that any savings achievable here from advance mitigation might be modest. This result aligns with expectations, as mitigation planning and activities would be largely resolved by this point.

It is difficult to say definitively which period is most expensive for mitigation activities and, hence, which may present greater opportunity for saving costs via advance mitigation. In principle, advance mitigation should produce savings in all periods, but savings ought to be greater in the third “PA&ED – RTL” period; it is during this phase that all arrangements to secure and implement mitigation are made. Advance mitigation may also realize savings post-construction (e.g. WBS code 295.40) if mitigation monitoring, reporting, and remediating actions can be reduced or avoided.

Two important observations attend this analysis. The first bears on inherent data limitations. Caltrans projects vary tremendously in staff hours and costs required to fulfill mitigation related tasks. The extent of variation is reflected in the large standard deviations for reported averages of staff costs in Tables 7 and 8. Further, for almost all mitigation activities examined, the standard deviation greatly exceeds (frequently by two or more times) the reported average cost. This indicates the data are skewed toward higher costs and that the average figures we report are likely far lower than the true cost for most projects. For these reasons, reported averages should be considered tentatively, providing a very rough but conservative picture of required resources rather than reliable estimates across all projects.

Table 7.
Caltrans Staff Hours and Costs for Key Tasks in Environmental Mitigation
(Level 6 reporting – Greater task detail; fewer records.)

Mile-stone Name	WBS Code	Description of Activities (from Caltrans' Work Breakdown Structure, or WBS)	Hours Estimated at Completion (Avg)	Cost Estimated at Completion (EAC) (Avg)	St. Dev. of EAC Cost	*N*
BES - DED	0.165.05	Environmental scoping of alternatives identified for studies in PID phase	369	$21,449	$92,120	287
	0.165.10	General environmental studies	681	$46,297	$187,659	337
	0.165.15	Biological studies	238	$11,825	$25,549	260
	0.175.20	Project preferred alternative	267	$18,023	$68,009	42
	Total		**1,555**	**$97,593**		
DED - PA&ED	0.165.25	Draft environmental document	386	$19,562	$45,544	219
	0.170.10	Permits	66	$5,033	$6,047	31
	0.175.05	DED circulation	168	$9,840	$14,849	69
	0.175.10	Public hearing	255	$15,675	$22,454	63
	0.175.15	Public comment responses and correspondence	658	$45,286	$214,929	50
	Total		**1,533**	**$95,396**		
PA&ED - RTL	1.205.05	Required permits	83	$5,958	$9,404	47
	1.205.10	Permits	172	$9,972	$12,966	78
	1.230.10	Draft highway planting plans	706	$49,295	$81,439	135
	1.235.05	Environmental mitigation	896	$54,76	$181,902	92
	1.235.35	Long term mitigation monitoring	129	$8,232	$24,319	27
	1.235.40	Updated environmental commitments record	32	$2,244	$2,763	39
	1.255.15	Environmental re-evaluation	401	$23,459	$51,957	88
	Total		**2,420**	**$153,925**		

Table 7. ***(continued)***

RTL - CCA	3.270.60	Plant establishment administration	191	$15,313	$26,033	78
	3.270.70	Updated environmental commitments record	64	$4,585	$17,159	109
	3.270.75	Resource agency permit renewal and extension requests	127	$6,799	$17,416	20
	3.270.80	Long-term env mitigation/mitigation monitoring during construction contract	228	$16,267	$45,025	101
	3.295.35	Certificate of environmental compliance	42	$3,445	$7,495	46
	3.295.40	Long term env mitigation/mitigation monitoring after construction contract acceptance	46	$3,390	$3,668	9
	Total		**698**	**$49,798**		
	Total		**6,206**	**$396,712**		

Table 8.
Caltrans Staff Hours and Costs for Key Tasks in Environmental Mitigation
(Level 5 Reporting: Less task detail; more records.)

Mile-stone #	Mile-stone Name	WBS Code	Description of Activities (from Caltrans' Work Breakdown Structure, or WBS)	Hours Estimated at Completion (Avg)	Cost Estimated at Completion (EAC) (Avg)	St. Dev. of EAC Cost	*N*
1	BES - DED	0.165	Perform environmental studies and prepare draft environmental document	1,545	$83,931	$193,915	1,461
		Total		**1,545**	**$83,931**		
2	DED - PA&ED	0.170	Permits agreements and route adoptions during PA&ED component	146	$11,682	$47,750	251
		0.175	Circulate DED and select preferred project alternative identification	395	$26,325	$82,814	489
		0.180	Prepare and approve project report and final environmental document	663	$50,394	$157,472	1,207
		Total		**1,204**	**$88,401**		
3	PA&ED - RTL	1.205	Permits and agreements during Plans, Specifications and Estimate (PS&E) component	417	$29,238	$128,614	990
		1.230	Prepare draft PS&E	4,658	$300,956	$694,035	2,010
		1.235	Mitigate environmental impacts and clean up hazardous waste	440	$29,426	$94,569	1,267
		1.255	Circulate review and prepare final district PS&E package	1,962	$134,271	$265,762	1,825
		Total		**7,477**	**$493,891**		
4	RTL - CCA	3.270	Construction engineering and general contract administration	10,476	$717,635	$2,620,887	1,125
		3.295	Accept contract prepare final construction estimate and final report	318.37	$27,903	$82,992	736
		Total		**10,794**	**$745,538**		
Total				**21,020**	**$1,411,761**		

A second observation concerns improving Caltrans ability to quantify the amount of staff time and cost devoted to environmental mitigation activities. If the agency wishes to do this, or to discern which tasks are most time consuming, we recommend encouraging or (perhaps selectively) requiring staff to use higher level, more specific WBS codes when inputting project data into PRSM.

2.2.2. Time between Project Milestones (using STEVE)

The Standard Tracking Exchange Vehicle for Environmental (STEVE) is an environmental statewide tracking system / database to document environmental commitments for transportation projects. Caltrans environmental staff use STEVE to collect, track, and report data for the environmental review process, and to communicate project status across teams.

While STEVE's primary application is to help district staff document and track the environmental process, it also has a role to play in documenting and ultimately enhancing data on mitigation costs. STEVE and PRSM are not dynamically linked, but STEVE is updated regularly to reflect changes in PRSM. Similarly, the same unique identifier (the EA - expenditure authorization or EA number) for every Caltrans project is used across both systems; allowing data on the environmental process to be cross-referenced with data on staff resources and project expenditures.

For instance, in this analysis, we use STEVE data to calculate the time it takes on average for projects to pass from one key milestone of the environmental and project delivery process to the next. We also draw on the data to explore non-staff mitigation expenditures including mitigation credit purchases.

Records used in the analysis
To complete this analysis, we drew on the STEVE database query provided to us from Tammy Massengale, the Environmental Management System Project Manager at Caltrans, on May 1, 2014, which contained records for 10,091 active projects, which are also identified in PRSM by unique project EA numbers. From this universe of some 10,000-plus projects, we then selected those for which milestone data were available for at least one major milestone phase, resulting in a sample of 4,074 projects. We selected records for each milestone with a date on or before May 1, 2014, to ensure we were looking at records for which the milestone had already passed. In general, the oldest dates of recorded project activity in the PRSM and STEVE system stretched to the mid-1980s. Most projects, however, were far more recent.

Approach
For each of the selected project records, we calculated the time it took for the project to pass through key points of the environmental process by tallying the days between date-stamps for important environmental milestones. Using date fields and simple subtraction, we calculated the number of days between each milestone and any later milestone and then converted days into months, assuming one month equals 30 days.

Results
We report the average and median time between each of the four major milestones (Figure 2.A.), as well as between different combinations of earlier and later milestones (Figure 2.B.) to provide additional detail. Because we use different combinations of start and end milestones to provide as comprehensive a picture as possible (Figure 2.B.), the results reported for each phase or combination of phases draw on somewhat different sets of records. Nonetheless, together, the

two tables provide an accounting of the amount of time it takes for projects to pass through the milestone phases.

The median figures we reports are more representative of Caltrans' projects overall than are the averages, as projects with anomalously long project delivery trajectories appear skew the average upward. This skewness is visible in that average times are all either higher than or equal to the reported median. Thus, where advance mitigation is expected to shorten the duration of the environmental processes for projects, one might apply percentage reductions to the median. The factors causing some projects to have anomalous lead times were not reviewed in this study, but could include delays due to environmental regulations and challenges, as well as other factors not directly associated with environmental costs.[12]

Figure 2.A. Graphical Summary of Time between Milestones

BES	Draft ED	PA&ED	RTL	CCA	# Records	Median Months	Avg Months (SD)
→	→				791	21	29 (36)
	→	→			788	6	13 (24)
		→	→		2,023	14	23 (29)
			→	→	1,801	6	6 (7)

Figure 2.B. Graphical Summary of Time between Milestones (All Milestone-to-Milestone Combinations)

BES	Draft ED	PA&ED	RTL	CCA	# Records	Median Months	Avg Months (SD)
→	→	→			1,781	16	27 (33)
→	→	→	→		1,365	35	48 (43)
→	→	→	→	→	1,178	45	57 (45)
	→	→	→		584	38	47 (41)
	→	→	→	→	529	45	57 (41)
		→	→	→	1,723	21	30 (29)

[12] For more on this subject, see: TransTech Mangement Inc., 2003.

2.2.3. Costs of Mitigation Bank Credits (Species and Wetlands)

In this analysis, we also report the non-staff costs Caltrans has incurred to mitigate species and wetlands, namely the cost of purchasing mitigation bank credits. This analysis is possible only with STEVE data. In addition to tracking the environmental process overall, STEVE also tracks some non-staff expenditures specific to environmental review and mitigation. In contrast, PRSM tracks largely personnel expenditures for project tasks.

We performed two separate analyses: one for species listed under State or Federal law as endangered or threatened, and one for wetland and water resources mitigation. We sought to document the cost per acre to mitigate different endangered or threatened species, and to mitigate different wetland habitat types.

Records used in this analysis

For this analysis, we sought to identify details on mitigation acreage, mitigation credits, mitigation dollar amounts spent or estimated, and species mitigated. We again drew on the 10,091 projects with distinct EA numbers in the STEVE database. We first selected only those records including milestone data, to provide confidence that the mitigation details queried would reflect actual project activities that had already occur or were projected to occur. Further, we selected only those projects with information in key fields pertaining to mitigation bank purchases for species [Cost of Bio Bank (MCCE); Bio Bank Acres (MCCE); Bank Cost (ESA); and Bank Credits (ESA)] and to wetlands [Credits or in-Lieu – Acres (W), Credits or in-Lieu Cost (W), and Impact Acres (W)][13]. Where a project had mitigation details for both species and wetlands, but did not differentiate those associated with species from those for wetlands, that record was not used.

Results: Using Mitigation Banks for Species and Wetlands

We identified 106 mitigation bank credit transactions, representing 86 unique transportation projects (Table 9). Credit purchases tended to be for small amounts of acres, with about 2 acres representing the median purchase. The largest acreage purchases (400 acres at maximum) likely skew the average upward somewhat, to 16 acres. The cost per acre of mitigation bank credits varies widely, likely determined by the relative value of the species habitat or landscape type in question. Again, high cost purchases drive the average (about $155,000/acre) well above the median (roughly $56,000/acre).

Table 9. Projects Costs for Mitigation Banks (Species and Wetlands)

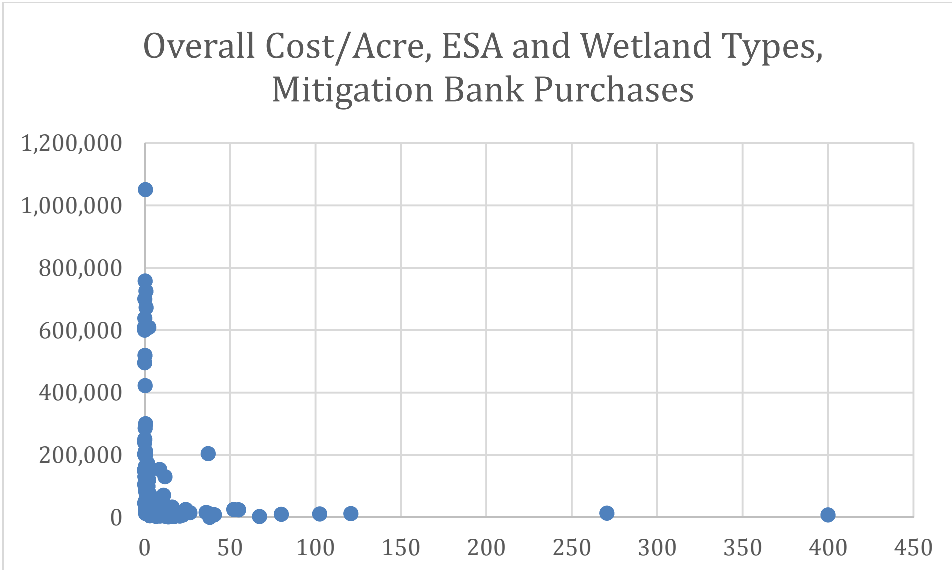
(*n*=109)

	Mean	Median	Min	Max	St. Dev.
Bank cost	$365,724	$81,850	$2,250	$7,588,000	$895,378
Bank acres	16.6	2.0	0.0	400.0	49.7
Cost/acre*	$155,356	$56,007	$1,437	$757,130	$208,611

*For overall cost/acre, costs from species and wetland mitigation types are both treated as "mitigation bank cost."

[13] Letter abbreviations are the data field labels in the database.

Figure 3. Mitigation Bank Purchase Costs/Acre (Endangered Species & Wetland Mitigation)



The differences in cost for mitigation bank purchases addressing species issues can also be compared with those addressing wetland habitats. We identified 65 projects that had used banks for species mitigation and 41 that had used banks for wetland mitigation, in which we include resources such as riparian habitat, open water, and vernal pools.

Table 10. Caltrans' Mitigation Bank Purchases (*n* = 106)

	Mean	Median	Min	Max	St. Dev.
	Endangered Species Act (ESA) Mitigation (*n*=65)				
Bank cost	$486,328	$90,300	$3,600	$7,588,000	$1,108,708
Bank acres	26.6	8.9	0.1	400.0	61.5
Cost/acre	$48,918	$15,000	$1,437	$518,750	$82,543
	Wetland Mitigation (*n*=41)				
Bank cost	$174,523	$60,000	$2,250	$1,520,750	$276,743
Bank acres	0.59	0.30	0.02	2.57	0.70
Cost/acre	$324,098	$200,000	$12,336	$757,130	$236,091

Figure 4. Mitigation Bank Purchases for Endangered Species Act (ESA)

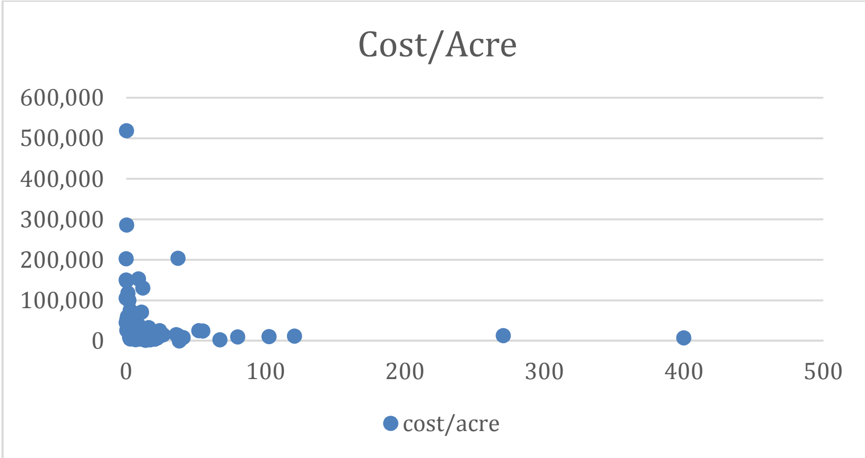
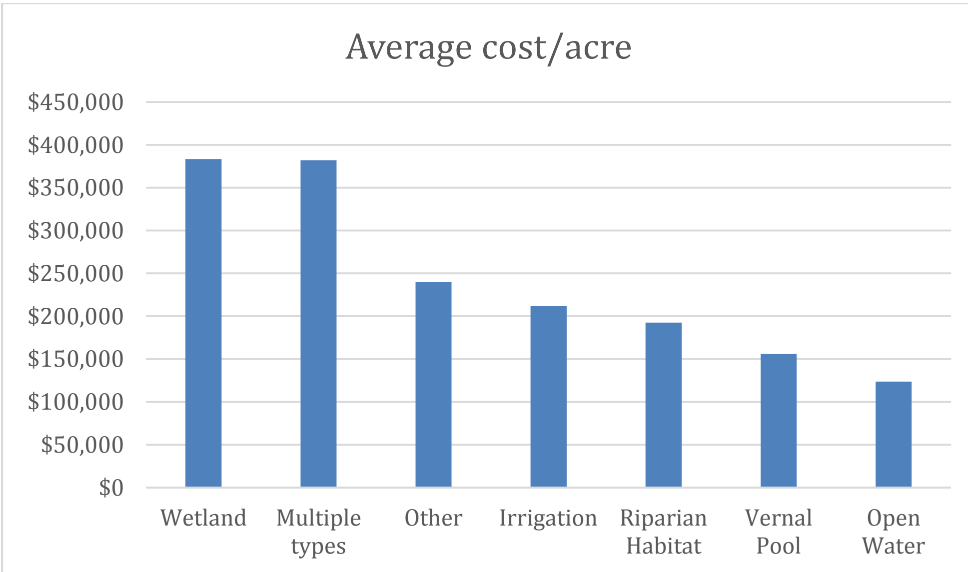


Figure 5. Mitigation Bank Purchases for Wetlands, by Type



Results: Species Credit Cost Variation

Given California's high level of biodiversity, variation in species mitigation cost is expected. To examine such variation, we identified the species mitigated and costs incurred in each of the 65 records. While the records are too few to support general rules about the cost to mitigate particular species, the data provide snapshots of cost. Species that have proven most costly to mitigate among the projects studied include elderberry shrub (habitat for the listed Longhorn Elderberry beetle), Lahontan cutthroat trout, bald eagle, and vernal pool fairy shrimp. For roughly one-third of the projects reviewed, multiple species were mitigated, but records provide no further detail.

Table 11. Mitigation Bank Purchases for Species

Species mitigated	Average cost/acre	No. projects
Elderberry shrub (Valley Elderberry Longhorn Beetle)	$518,750	1
Lahontan cutthroat trout	$202,500	1
Bald eagle	$150,000	1
Vernal pool fairy shrimp	$100,000	1
Least Bell's vireo	$75,000	1
Chinook salmon CV dps	$45,000	1
Delta smelt	$44,040	1
California red-legged frog	$42,884	3
Giant garter snake	$40,716	5
Desert tortoise	$50,000	2
California tiger salamander	$34,328	8
Swainson's hawk	$12,500	1
Blunt-nosed leopard lizard	$10,500	1
San Joaquin kit fox	$7,289	9
Valley elderberry longhorn beetle	$4,958	4
Mohave ground squirrel	$1,437	1
Multiple species	$51,428	24
Total		65

Results: Wetland Credit Cost Variation

To study variation in credit costs to mitigate different kinds of wetlands, we identified the different kinds of natural land or habitat referenced in the 41 STEVE records with wetland mitigation credits. Again, there are simply too few records to support any generalization about mitigation bank costs for each type; the data provide only snapshots of costs.

Table 12. Mitigation Bank Costs for Wetlands

Mitigation Type	Average cost/acre	No. records
Wetland	$383,344	22
Multiple types	$381,851	8
Other	$240,000	1
Irrigation	$211,946	1
Riparian Habitat	$192,500	2
Vernal Pool	$156,014	3
Open Water	$123,664	4
Total		**41**

2.2.4. In-house Mitigation Land Acquisition vs. Mitigation Banks (Staff Time and Cost)

One of the promised advantages of advance mitigation is the reduction of per-project transaction costs associated with mitigation. In principle, when larger packages of more comprehensive mitigation are undertaken, they provide transactional efficiencies across multiple projects.

Given this potential, it is valuable to understand the per project quantities of staff time and costs associated with mitigation requirements met conventionally. Here, we extend the analysis above by exploring differences in staff time and associated cost when Caltrans accomplishes mitigation via land acquisition done in-house versus via purchase of bank credits.

Records used in this analysis

We cross referenced the three databases analyzed in this study to identify projects using one of two different options for mitigation (using mitigation banks or acquiring mitigation lands in-house) and to associate staff costs with each. First, we used the environmental database (STEVE), drawing on the 10,091 projects with distinct EA numbers, to then identify projects for which milestone data were recorded and where mitigation obligations had been fulfilled via bank credit purchases. Second, we used the Right-of-Way Management Information System database (ROWMIS) to identify projects where mitigation obligations had been fulfilled via land acquisitions done in-house. The ROWMIS system contains parcel and acquisition data for all Caltrans projects requiring a Right-of-Way purchase, and projects requiring parcel acquisitions specifically for environmental mitigation are flagged with the number 12. With help from Tom Sparks, Senior Right-of-Way Agent for Right-of-Way Data Systems at Caltrans, we queried acquisition records associated with environmental mitigation. Third, we cross-referenced project management (PRSM) data for those STEVE and ROWMIS project records showing mitigation bank credits or in-house land acquisitions; to do this, we searched PRSM for the EA numbers of those records and examined relevant data fields documenting staff time and costs.

To draw on the most relevant PRSM data, we first identified in Caltrans' work breakdown structure (WBS) project tasks that would be explicitly related to mitigation and be performed during the four major project phases. We consulted with Caltrans staff (Amir Taba, Statewide PRSM Implementation Manager, and Stuart Kirkham, Senior Environmental Planner at Caltrans Headquarters) to understand the meaning of specific WBS codes and project environmental tasks. We then related staff hours and costs to each mitigation-related project activity. We used "Estimate at Completion" (EAC) data for staff hours and staff costs, as "Actual Cost" would provide complete information only for projects that were completed. EAC is an estimate, but reflects the total cost at completion of the project.

To maximize the records in the analysis, we sacrifice some precision in the tasks for which we account and use the more general "Level 5" data fields. Level 5 is the reporting level most commonly used for capturing project activities in PRSM. More detailed Level 6 data might have allowed us to better isolate tasks explicitly related to mitigation, but would have yielded far fewer records. Thus, some of the staff hours and costs we link to key project phases may reflect tasks not directly related to mitigation.

In the summary table below, for each project task (WBS code) we report the number of projects used to compute the average of associated staff time and cost. Projects typically incur (and hence report) staff time and cost for some WBS codes while not others. Thus, the average for each task activity draws on a somewhat different set of records. We summed those averages to arrive at the total staff time dollar amount for each milestone.

Results: Staff Costs of Mitigation via Bank Credits vs. In-House Land Acquisition

Our results suggest that across the environmental process, staff time and costs are most noticeably greater for in-house parcel or land acquisition in the fourth and final phase, moving from "Ready to List" to "Construction Contract Acceptance," followed by the third phase, moving from "Project Approval & Environmental Documentation" to "Ready to List." In particular, Phase 4 work performed for "Construction engineering and general contract administration" (WBS 3.270) consumes visibly more staff hours and costs than does the same work done when mitigation banks are used.

Distinctions between projects using mitigation banks versus in-house land acquisition are not as stark when comparing dollar costs across the first three phases of the environmental process; staff time, however, is lower for mitigation banks in every major phase. Thus, we reason that in-house land acquisition may require more staff time across the process, but that this leads to appreciably greater staff costs only in the final phase.

Considering individual project tasks, aggregated at Level 5, in-house land acquisition appears to demand considerably more staff time and somewhat higher costs for:

- circulating the draft environmental document and selecting the preferred project alternative (WBS 0.175);
- preparing the draft plans, specification, and estimates, or PS&E (WBS 1.230); and
- construction engineering and general contract administration (WBS 3.270)

As with other analyses drawing on Caltrans information systems, the relatively small number of records in many instances make it difficult to draw definitive conclusions. However, these results do provide a snapshot for comparing costs across Caltrans projects approaching mitigation in different ways. In all cases, the data reflect the staff hours and costs for *Caltrans' own personnel*, not for expenses related to third-party contractors working for Caltrans. They suggest that in-house land acquisition may be more staff-intensive than bank credit purchases, a finding that is consistent with our expectations.

Table 13. Staff Time and Costs Associated with Use of Mitigation Banks vs. In-house Land Acquisition

			Mitigation Banks				In-House Parcel Acquisition			
Milestone Name	**WBS Code**	**WBS Description**	**Hours Estimated at Completion (Avg)**	**Cost Estimated at Completion (Avg)**	**Std. Dev.**	***n***	**Hours Estimated at Completio n (Avg)**	**Cost Estimated at Completion (Avg)**	**Std. Dev.**	***n***
BES - DED	0.165	Perform environmental studies and prepare draft environmental document	4,967	$247,214	$252,830	48	6,391	$280,415	$486,378	30
	Total		**4,967**	**$247,214**			**6,391**	**$280,415**		
DED - PA&ED	0.170	Permits agreements and route adoptions during PA&ED component	136	$10,077	$10,733	13	54	$3,327	$1,306	5
	0.175	Circulate draft env'tl document and select preferred project alternative identification	433	$24,095	$35,433	43	1,299	$58,600	$69,360	16
	0.180	Prepare and approve project report and final environmental document	1,509	$102,495	$167,839	49	1,499	$96,287	$124,035	22
	Total		**2,078**	**$136,667**			**2,851**	**$158,214**		
PA&ED - RTL	1.205	Permits and agreements during PS&E component	1,181	$93,416	$261,551	46	426	$23,581	$38,029	24
	1.230	Prepare draft PS&E	9,173	$683,875	$639,822	52	16,098	$971,236	$2,091,174	26
	1.235	Mitigate environmental impacts and clean up hazardous waste	1,323	$107,793	$203,030	50	1,612	$99,888	$119,664	34
	1.255	Circulate review and prepare final district PS&E package	3,839	$303,550	$298,938	52	4,118	$271,862	$302,916	28
	Total		**15,517**	**$1,188,634**			**22,254**	**$1,366,567**		
RTL - CCA	3.270	Construction engineering and general contract administration	18,014	$1,675,158	$2,625,868	53	29,924	$2,101,125	$2,343,775	30
	3.295	Accept contract prepare final construction estimate and final report	1,479	$100,780	$143,699	53	1,614	$135,447	$90,161	32
	Total		**19,493**	**$1,775,938**			**31,538**	**$2,236,571**		
		Total		**$3,348,453**				**$4,041,767**		

3. Advance Acquisition of Mitigation Land: Potential Savings and Risk

This section explores the early acquisition of needed mitigation land as one discrete way through which cost savings may be realized with advance mitigation. In various situations, a transportation agency needing to mitigate environmental impacts of its projects will face a legal obligation to conserve or restore specific types of natural lands or species habitats to compensate for those project impacts. Arguments made in favor of advance mitigation suggest that purchasing land in advance of and in eventual satisfaction of such potential future obligations can save the agency money (Greer and Som 2010). Purchasing land in advance of need and across multiple projects can avoid costs associated with land price escalation and purchases made under duress. Advance purchase contrasts with conventional mitigation, where needed land is acquired for individual projects on a mitigate-as-you-go basis and later in the project development cycle.

Here, we seek to better understand the potential for savings associated with early acquisition of mitigation land under advance mitigation. To do so, we examine, first, one of Caltrans' own experiences with advance mitigation – the Beach Lake Mitigation Bank – and, second, a series of hypothetical advance mitigation scenarios illustrating the effects that timing of mitigation purchase and timing of mitigation use or need can have on costs. In using hypothetical scenarios, we attempt to use conditions that reflect scenarios that Caltrans might actually face in creating an advance mitigation program. We use 1- and 5-year advance purchase scenarios to reflect the fact that Caltrans is most likely make advance mitigation purchases on a relatively short time horizon, along with longer term (10- and 15-year) advance purchase scenarios to explore potential rare acquisition opportunities that may arise and are worth acquiring for use much later. It should be noted that these results are not necessarily generalizable, but provide examples of savings and loss potential under various historical market conditions.

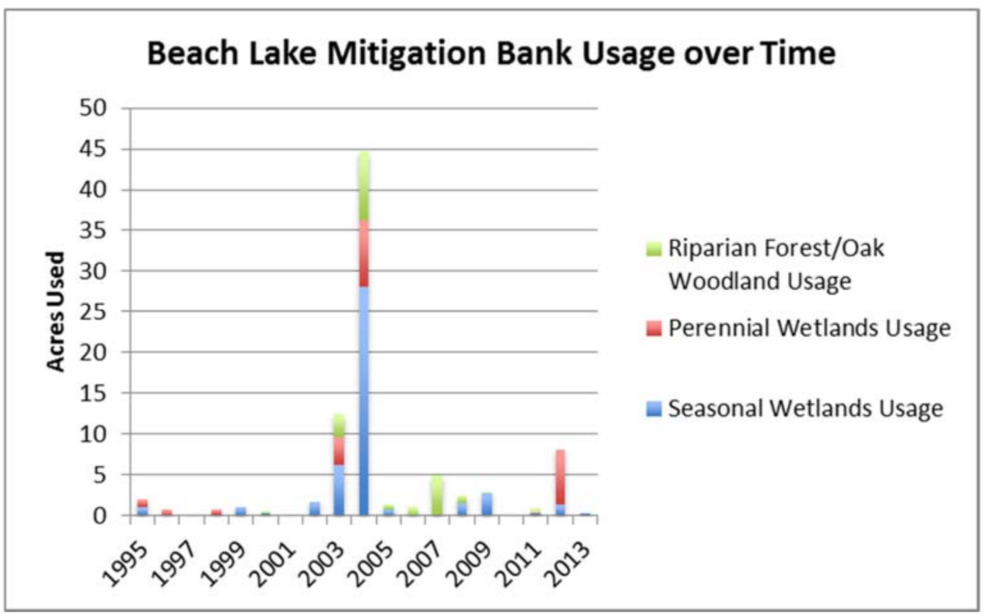
Overall, this analysis suggests that where land prices follow a consistent upward trend and escalate at a rate greater than general inflation, mitigation land can likely be acquired more cost-efficiently one or more years before mitigation is needed than in real-time, on an as-needed basis. In particular, the following analysis suggests that among the scenarios explored the greatest savings occurred when mitigation land was needed during the real estate bubble of 2002-2008, but was purchased in advance, before prices escalated. Conversely we see the greatest potential for losses when advance land purchases are made at the height of the market and needed after prices drop. In this case, acquisitions could have been made at lower cost if purchased annually. Whether and to what extent cost savings may be realized from such advance acquisition will depend on land market conditions both in the year(s) of acquisition and in the year(s) of mitigation use, as well as on levels of inflation over time.

The level of estimated potential savings is also influenced by the inflation index used for analysis, a choice which in part reflects the opportunity costs of investing available capital in mitigation land instead of other agency activities. We conclude that the potential for realizing savings from advance acquisition of mitigation land appears promising and that well considered pilot efforts are worthwhile. Yet, there always exists a risk that unexpected changes in land market conditions may negate expected savings from advance purchases or even penalize such purchases, making it less costly to purchase needed land in real time than to have done so in advance.

3.1. Empirical Case: Caltrans' Beach Lake Mitigation Bank

In 1991, Caltrans in collaboration with federal and state resource agencies established the Beach Lake Mitigation Bank (BLMB) on Caltrans property that was purchased in the 1970s (the exact purchase date is not available from Caltrans records) to stage project construction materials and had since been held as "excess land" for many years by the agency. When Caltrans moved to sell the property in the late 1980s, a Caltrans environmental staffer visited the property as part of the disposition processes and recognized its value for mitigation. The land boasted seasonal and perennial wetlands, oak woodland and riparian forest habitat, as well as upland habitat hosting threatened giant garter snakes and Swainson hawks. Collaborative efforts began in 1990 among Caltrans, California Department of Fish and Wildlife (CDFW), U.S. Army Corps of Engineers (USACE), Federal Highway Administration (FHWA), U.S. Environmental Protection Agency, and U.S. Fish and Wildlife Service (USFWS) to create the Beach Lake Mitigation Bank for Caltrans' own use. From 1995 through mid-2014, 49 Caltrans projects either debited (43 projects) from the Beach Lake bank or had credits in reserve (6 projects) to do so. Caltrans staff recorded usage of the mitigation over time in a ledger supplied to the UCD research team.

Figure 6. Caltrans Project Debits Drawn against Beach Lake Mitigation Bank



Although the agency's own business practices were not then set up to do so, Caltrans acted opportunistically to create a mitigation bank at Beach Lake and to provide mitigation in advance of future projects in 14 counties in the lower Sacramento Valley and upper San Joaquin Valley. As such, Caltrans' experience with the bank offers an empirical case through which to examine the value to the agency of having mitigation land in hand well before project-specific mitigation needs arise.

In the analysis that follows, we provide several estimates of the savings to Caltrans of purchasing Beach Lake decades before the mitigation site was needed or used. To do this, we compare the estimated purchase price for Beach Lake in the late 1970s with the estimated cost of purchasing the same acreage in increments, beginning in 1995 and reflecting as-needed, project-by-project mitigation. Further, we present the cost estimates and differences between them in constant dollars using different inflation indices, to convey savings in current values and to illustrate how estimated savings may vary by the index used.

Overall, this analysis suggests that considering only the cost of land acquisition for mitigation used in Beach Lake having the site well in advance may have saved the agency between $22.8 (2013$) and $27.3 million (2013$) over what it might have otherwise spent to acquire mitigation parcels one by one, on an as-needed basis for individual projects.

Methodology

Our goal was to estimate whether Caltrans saved money (and how much) by establishing Beach Lake rather than purchasing mitigation land incrementally. Our overall approach was to use an index of land prices to estimate what the mitigation credits used in a single year (and measured in acres) would have cost in that year and what they would have cost in 1979. Then, inflating both prices to 2013 dollars we subtract the two to arrive at the annual savings from early acquisition. Summing across years then gives us the total savings from acquiring the property early.

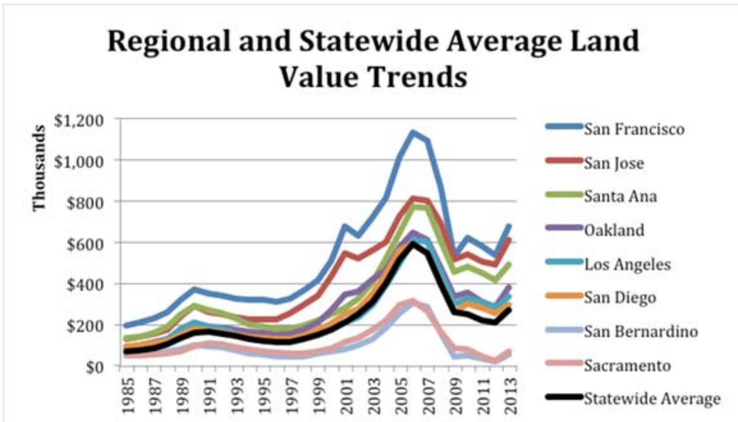
Further, when converting costs into constant 2013 dollars, we apply three different indices of inflation to yield three discrete estimates of total savings. This allows us to suggest a range of estimated savings, based on different inflationary assumptions embodied in the consumer price index (CPI), the gross domestic product chained price index (GDP index), and the California construction cost index (CCI). The CPI is a standard measure of inflation that tracks changes in prices paid by urban consumers for a representative basket of goods and services, the GDP (Chained) Price Index is used as a standard index applied by the U.S. Office of Management and Budget to express budget figures over extended periods, and the California CCI tracks prices for selected highway construction items and is created by the state Department of Transportation. While the latter two are broadly standard indices for considering inflationary pressures, CCI-based estimates may more accurately reflect the opportunity cost to the state of investing transportation dollars on advance mitigation rather than on project construction, the likely replacement / alternative expenditure.

A first step in our analysis was to establish the cost to Caltrans of acquiring the Beach Lake site. Historical records of the original land purchase and purchase price were not available, requiring us to make assumptions about when and for what price Caltrans purchased the land. We assume the land that would later become Beach Lake was purchased in 1979, at the latest. Caltrans staff report that the land was purchased during the construction of Interstate 5, completed in the late 70s. Although it may have been acquired well before 1979, we chose 1979 as the latest year the land might have been bought. This is a conservative assumption in that it avoids the risk of over-inflating any savings estimate by using an earlier purchase year. Further, any bias it introduces is likely to push savings estimates downward, assuring that estimates of savings are more likely to be under- than over-stated.

Next, to estimate the cost of Beach Lake as a single parcel in 1979, we use the Palumbo-Davis land price index from the Lincoln Institute of Land Policy. This index reports quarterly estimate between 1984 and 2012 of the average value of housing, land, and structures, in each of 46 large metropolitan areas in the United States. We use this index for several reasons. First, it isolates the cost of underlying land from the cost of any overlying structure, providing land-specific real estate values. Second, the index tracks values in individual states, proving appropriate for our

California-based analysis.[14] While region-specific Palumbo-Davis indices are also available, those indices only go back as far as 1984, making it impossible to apply them to the Beach Lake example, where land was originally purchased in the early 1970s. While it may be ideal to use the Sacramento index, which is closest to Beach Lake, the California statewide index closely follows trends in the regional indices. (See Figure 7) However, it should be acknowledged that since the statewide average land prices increase more steeply than Sacramento prices during the real estate bubble, we can expect using the statewide average to overstate somewhat our estimates of savings. Finally, the index also provides actual land values that are useful for our analysis.

Figure 7. Historical Land Values in Metropolitan California



(Source: Davis and Palumbo 2008)

We acknowledge the index yields an imperfect estimate of mitigation costs, as the price for open space land is likely to differ from land more suitable for housing development. Also, the index does not reflect the economies of scale that can be realized by purchasing larger parcels (Thorne et al 2009). Nonetheless, we maintain that it provides a reasonably appropriate, relative gauge of California-specific land price movements over time. Our application of the index to different scenarios suggests the magnitude of potential savings possible, though one might place less stock in the precise dollar amounts.

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14 The Palumbo-Davis index is created in two steps. First it estimates home value, inclusive of land and structure in 1980, 1990, and 2000 based on micro data from the Decennial Census of Housing and scales the series by quarter for the periods in between, before and after these data points using the Federal Housing Finance Agency's quarterly repeat-sales house price index for each state. It then isolates Land Value by subtracting the Structure replacement cost from the Home Value.

We had also considered using the USDA state-level data on agricultural land values for this analysis, however these data go back only to 1997. We sought a single index that would allow us both to study the Beach Lake case, acquired in 1979, and also to examine more contemporary hypothetical scenarios. The Palumbo Davis index met these criteria. It reflects all land transactions, and it excludes the value of any structures to provide a picture of undeveloped land costs, even in residential areas. Still, preliminary analysis using the USDA agricultural land value data index suggests that application of the Palumbo Davis index produces estimates at the high end of land values and would therefore produce higher end estimates of cost savings, but savings nonetheless.

Results

For 1979, the index reports an average per acre land cost in California of just under $51,000; our assumed cost to Caltrans for acquiring Beach Lake's 97 acres is $4.95 million in nominal 1979 dollars, or $16.7 million expressed in 2013 dollars using the CPI. We also estimate what the Beach Lake acreage would have cost if purchased in increments beginning in 1995, when Caltrans first began to debit its mitigation needs from the bank. We estimate these hypothetical incremental purchases in nominal dollars based on the Palumbo-Davis land cost per acre in the year the mitigation was debited and on parcel size debited, as recorded in the Beach Lake ledger. These hypothetical incremental purchases suggest what it would have cost to buy mitigation parcels on an as-needed, project-by-project basis, had the in-house mitigation bank not been available.

We inflate prices in our analysis to 2013 dollars to enable comparison over time. We use three different indices—the Consumer Price Index-Urban (CPI-U) from the Bureau of Labor Statistics, the GDP Chained Price index, commonly used for inflating public budget figures, and the California Construction Cost Index (CCI) from the California Department of Transportation—to develop a range of estimates of cost savings that is sensitive to various inflationary pressures. The three indices yield final estimates of cumulative cost savings from Beach Lake that range from $20.5 million using the CCI to $24.5 million using the GDP Chained Price Index. At $22.6 million, the CPI estimate falls between these two, as a geometric average of both.

Figure 8. Advance vs. Incremental Purchases at Beach Lake

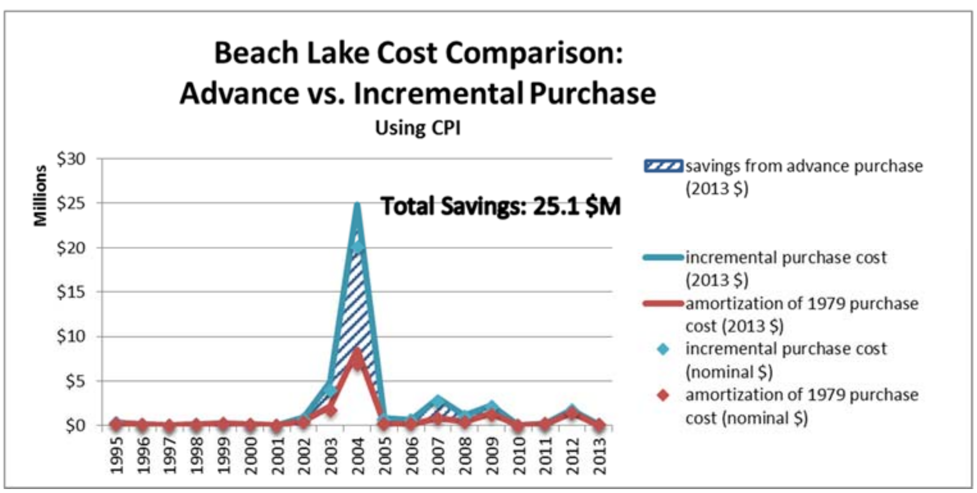


Table 14. Estimates of Savings from Advance Mitigation Purchase (All $ in 2013)

Inflation index used	Estimated Land Acquisition Cost		Total Savings	Per Project Savings
	Incremental, as-needed purchases (1995-2013)	Single advance purchase (in 1979)		
GDP Chained Price Index	$40,395,104	$13,143,614	$27,251,491	$511,469
Consumer Price Index	$41,754,120	$16,692,161	$25,061,959	$556,153
Construction Cost Index	$36,437,963	$13,652,770	$22,785,193	$465,004

We estimate that purchasing the Beach Lake property in 1979, rather than purchasing needed mitigation land in increments from 1995 to 2013, saved the state on the order of $22.8 million to $27.3 million. Considered across the 49 projects that used Beach Lake for mitigation, this estimate suggests savings ranging from $465,000 to $556,000 (2013$) per project.

Beach Lake is anomalous in some respects. The land was acquired 15 years in advance of use, which is a longer time horizon than might be expected under a potential advance mitigation initiative. Considering the timelines for Caltrans' own recently established SHOPP 240 advance mitigation initiative, we expect that advance mitigation purchases would be made 5 or fewer years in advance. Also, contemporary mitigation banking practices would not allow a single bank to mitigate for projects over as wide a geographic service area as was permitted for Beach Lake (14-county service range) when it was established. However, this offers a rare empirical illustration of potential cost savings from advanced mitigation when increasing land costs are avoided.

3.2. Hypothetical Scenarios with Variously Timed Mitigation Purchase and Need

Our above analysis using records of Beach Lake's mitigation debits to estimate savings born from land purchase timed far in advance of mitigation need raises questions about what drives the estimated savings. For instance, would the magnitude of estimated savings change if less time had elapsed between the land's purchase and its use for mitigation? Also, the ledger tracking Beach Lake's usage shows a clear mid-way spike or concentration in mitigation usage, in years 2003 and, especially, 2004. Would savings be impacted if mitigation need were instead distributed evenly over time? Although project schedules dictate mitigation needs, we reason that an agency acting in advance, for example by planning for a five to seven year horizon of mitigation needs, may be able in some instances to spread its mitigation burden over time, smoothing land acquisition activity. Alternatively, when spikes in mitigation need are unavoidable, due to a concentration of projects being delivered or unforeseen significant impacts, how does the correlation of these spikes with real estate prices affect overall savings or loss from advance mitigation? Ultimately the main determinants of savings or loss from advance mitigation are the underlying trends in the land market and the timing of mitigation purchase and mitigation need in relation to those trends. We present here a range of scenarios to inform understanding of this relationship.

Methodology

To explore these questions, we first develop four sets of scenarios in which 150 (or 152) mitigation acres[15] are acquired in advance and used over a 15 year stretch. In each set of scenarios, we vary mitigation purchase and need parameters to estimate the potential for savings or loss under the following conditions:

1. when mitigation is purchased at once and always before use, but at a varying number of years in advance, and when mitigation need is debited evenly;
2. when mitigation is purchased at once and always before use, and when mitigation need is debited unevenly, with early-, mid-, and late-term spikes; and
3. when mitigation is purchased in periodic installments for a 3-4 year planning horizon, either fully before use or, more realistically, with mitigation purchases and debits overlapping to different degrees.
4. when advance purchases of mitigation land might prove vulnerable to land market bubbles. This fourth set of scenarios explicitly explores the potential for financial loss.

In a fourth group, we estimate what happens when 152 acres are acquired in advance and when mitigation is debited evenly over 10 years; however, we deliberately time land purchase and mitigation debits to coincide with periods of land market volatility (i.e. real estate bubbles).

For each set of scenarios, we compare the cost of mitigation land purchases made in advance to the base case cost of those made incrementally, on an as-needed basis. As with our approach for the Beach Lake analysis above, we assume per acre land costs from the Palumbo-Davis land index, and we inflate all costs to constant 2013 dollars before subtracting the incremental purchase costs from advance purchase costs to calculate estimated savings. Finally, when inflating costs to constant dollars, we apply both the CPI and CCI to derive a range of potential savings.

Overview of Results

Based on the hypothetical scenarios explored in this section, land costs appear to be a promising dimension of mitigation costs where savings can be realized. However, advance acquisition is not without risk. While many of the scenarios we explore are profitable, some clearly are not. The factors determining findings of savings or loss in each scenario are the underlying trends in real estate prices and the exact timing of mitigation land purchase and need in relation to those trends.

Whereas in the empirical cases of Beach Lake and the SR-76 advance mitigation produced cost-savings, here we examine hypothetical scenarios where there is potential for either profit or loss. In general, we can expect overall loss from advance mitigation during periods of decreasing prices, when it would be more profitable to wait and purchase later as prices decrease, and overall savings during periods of increasing prices when purchasing in advance means avoiding higher prices later. For any period of study, savings or loss depends on whether increases or decreases in real estate prices dominate. When knowledge of real estate market is fairly secure (i.e. there is

[15] In the first three sets of scenarios, 150 mitigation acres are considered. In the fourth set, 152 acres are considered. This addition of two acres simplifies calculation in the fourth set and does not materially affect comparison of results.

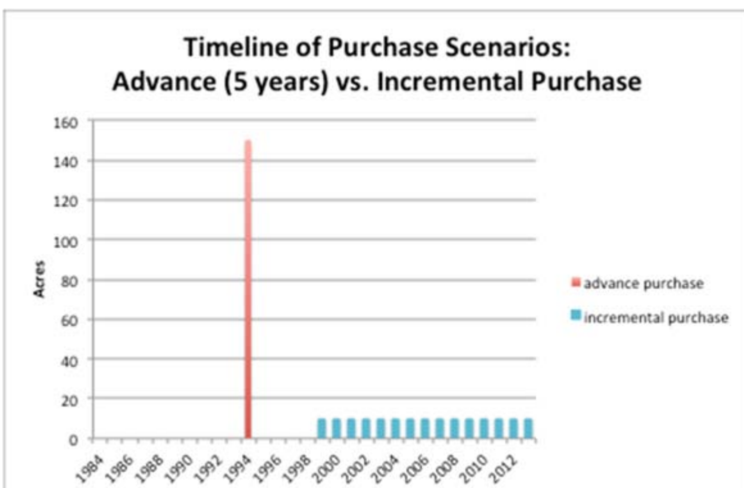
clear up or down momentum), having the flexibility either to purchase opportunistically or to defer purchase for strategic reasons can offer a clear advantage. However when considering investment decisions into the future, risk of loss under decreasing real estate market prices is unavoidable and difficult to predict. Looking at long-term trends in the real estate market and considering limitations on the supply of land, we can expect that prices will increase over the long-term, indicating that a long-term advance mitigation plan could be expected to be cost-saving. However, loss is also a possibility over the short-term when either the timing of mitigation purchase or mitigation need align poorly with real estate cycles.

Although 5-year and 1-year advance purchase scenarios are likely more realistic for Caltrans typical operations, we also explore advance purchase horizons of 10- and 15-years, as might arise when rare acquisition opportunities appear and are worth acquiring for use later in time.

3.2.1. Group 1 Scenarios: Variation in Mitigation Purchase Timing

In these scenarios, we estimate savings from advance mitigation while varying the amount of time that mitigation land is purchased in advance of use. To examine how purchase timing, a parameter over which agencies may have some control, impacts purchase cost savings, we create a hypothetical case modeled after Beach Lake, but somewhat simplified, to isolate the effect of purchasing land further in advance. As with Beach Lake, we assume a single mitigation purchase, always timed before the mitigation is needed, but at a varying number of years in advance. We assume that mitigation is needed over a 15-year period, from 1999 to 2013, and that ten acres are debited annually for a total of 150 acres. We estimate the costs for four advance mitigation scenarios where the land is purchased either 15-, 10-, 5- or 1-year in advance of onset of need. We compare each of these to a base case representing conventional mitigation, where land is purchased annually on an as-needed basis rather than in advance.

Figure 9. Visual Timeline of Advance vs. Incremental Purchase



Other variations explored in this group consider
earlier and later advance purchase years (moving the red bar).

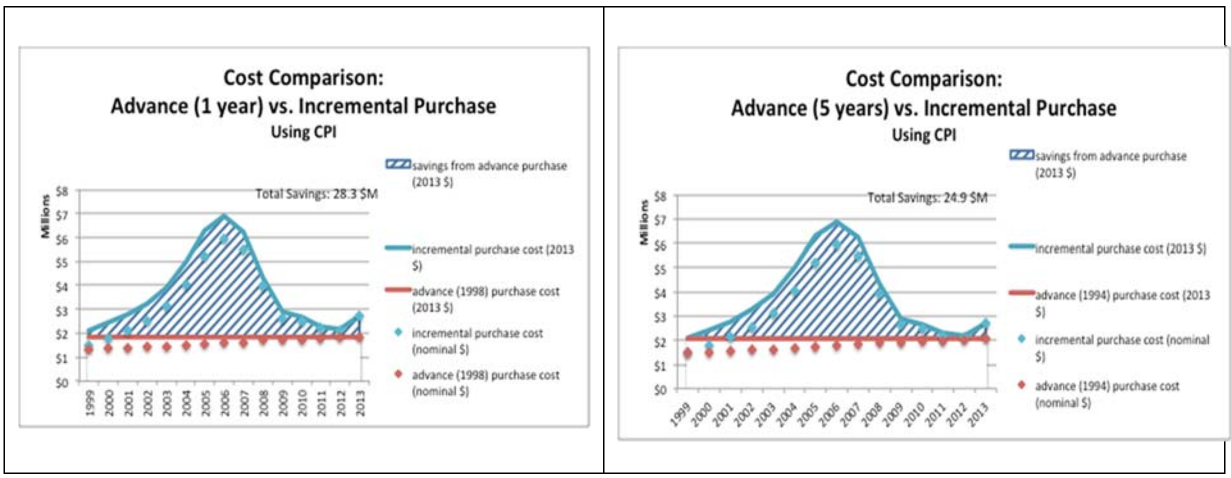
To make each comparison, we first apply the average land value in the year of advance purchase (1984, 1989 [Figure 3], 1994, and 1998) to the total 150 acres and inflate the cost to 2013 dollars. We then estimate the base case or business-as-usual case, by estimating for each of the 15 years the purchase cost of 10 acres, using the respective year's average land value; inflating that year's purchase cost to constant 2013 dollars; and then summing across years to arrive at a total cost.

We find in these scenarios that purchasing mitigation land under business-as-usual, on an as-needed basis, costs $55.9 million, and that purchasing the same amount of acreage in advance is cost-saving across the different scenarios. Our results suggest that advance purchase savings in this case could range roughly from $17 million to $34 million, when inflation adjustments are made with the CPI. As with Beach Lake, the results using the CCI produce more moderate savings estimates, ranging from $12 million to $27 million, a more conservative picture. While we anticipated that advance purchases would yield greater savings the farther in advance they are made, we find that the savings levels vary; the greatest savings resulting from a 1984 purchase (15-years in advance) and a 1998 purchase (1-year in advance). We attribute this to variation in average land prices over time, and reason that land prices over the late 80s and early 90s were relatively high. Purchasing when the land market is high may decrease potential savings from advance mitigation; though still positive and sizeable. Overall, in these purchase timing scenarios, savings ranges from 30- to 60-percent of the business-as-usual cost.

Table 15. Savings Estimated under Various Purchase Timing Scenarios

	Using CPI		Using CCI	
Purchase Approach	**Acquisition Cost ($ 2013)**	**Total Savings Compared to Business-as-Usual**	**Acquisition Cost ($ 2013)**	**Total Savings Compared to Business-as-Usual**
Business-as-Usual (incremental purchase in the year needed)	$55,907,042	NA	$49,264,576	NA
1-year in advance (1998)	$27,590,168	$28,316,874	$31,350,920	$17,913,656
5-years in advance (1994)	$30,974,687	$24,932,354	$34,392,795	$14,871,782
10-years in advance (1989)	$38,618,821	$17,288,221	$37,379,524	$11,885,052
15-years in advance (1984)	$22,152,512	$33,754,530	$21,879,819	$27,384,757

Figure 10. Scenarios with Shortest Advance Purchase

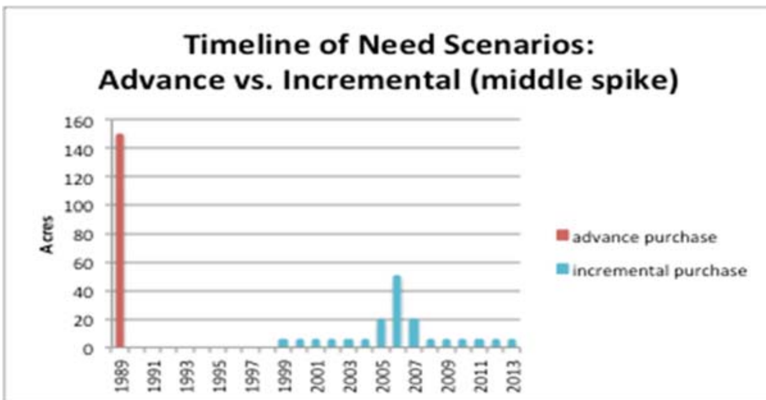


3.2.2. Group 2 Scenarios: Varying the Temporal Distribution of Mitigation Need

In a second group of scenarios, we vary how mitigation land is needed over the same hypothetical 15 year period from 1999 to 2013. We assume first that mitigation is purchased once, 10-years in advance, and that mitigation need is distributed evenly over the 15-year period (10 acres per year) for a total of 150 acres, as in Figure 3 above. However, because real world mitigation needs may fluctuate, with spikes in need during periods of heavy infrastructure investment, we then compare three different scenarios with a clear spike in mitigation need, keeping the overall acreage needed at 150 acres. In each scenario, we assume a spike of 90 acres is needed over a three year period; in one scenario, the spike emerges early in the 15-year period, in the second scenario, it emerges in the middle; and in the third scenario, it comes late in the 15-year period. As with the first set of scenarios, we always compare the cost of mitigation land purchased in advance to a base case cost which assumes purchases are made incrementally, on an as-needed basis, matching the specific timeline of mitigation need.

We also explored scenarios where advance purchase is made on a shorter time horizon of five years. While this scenario results in slightly higher savings (by $1 million to $2 million), the results are not appreciably different. As a result we present here the 10-year advance purchase scenario, which represents a more conservative estimate of savings.

Figure 11. Visual Timeline of Advance Purchase & Spike in Need



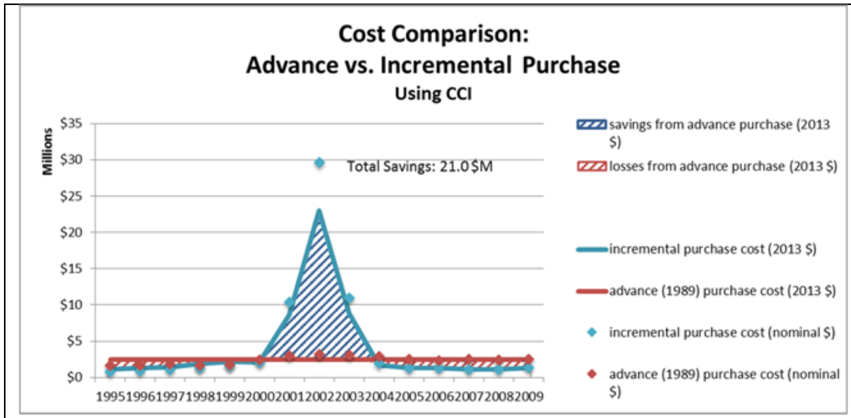
Other variations explored in this group consider earlier and later spikes in mitigation need (blue bars).

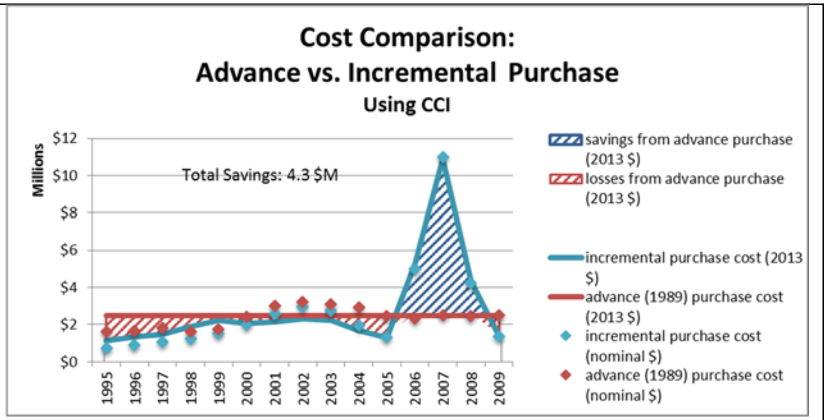
Estimating the cost savings from early acquisition both when mitigation need is evenly distributed and when, as in the three scenarios outlined, mitigation needs are concentrated, we find that early acquisition consistently yields cost savings over as-needed acquisition. Using CPI-inflated estimates, savings range from nearly $7 million with a late spike in need to $39 million when mitigation need is concentrated in the middle. The same is true for the more conservative CCI-inflated savings estimates, ranging from $4 million under a late spike to $21 million under a middle spike. We reason this pattern is explained by the fact that the middle years spanned the time of the U.S. housing and real estate bubble. When mitigation needs are concentrated during a land market peak, mitigation purchases made well before the peak can be particularly cost saving, providing insurance against having to make acquisitions in an especially costly future period.

Table 16. Savings Estimated under Scenarios Varying Temporal Distribution of Mitigation Need

	Advance purchase of mitigation	**Incremental Purchased of Mitigation (as-needed)**			
		Distribution of Mitigation Need			
	Single purchase (1989)	evenly distributed (no spike)	early spike	middle spike	late spike
CPI inflated estimates					
Total Cost	$38,618,821	$55,907,042	$49,037,086	$77,694,525	$45,528,228
Cost Savings of Early Acquisition		$17,288,221	$10,418,265	**$39,075,704**	**$6,909,408**
CCI inflated estimates					
Total Cost	$37,379,524	$49,264,576	$47,525,279	$58,398,616	$41,647,046
Cost Savings of Early Acquisition	$0	$11,885,052	$10,145,755	**$21,019,092**	**$4,267,522**

Figures 12: Advance Purchase Savings under Middle- and Late-Spike in Need Scenarios



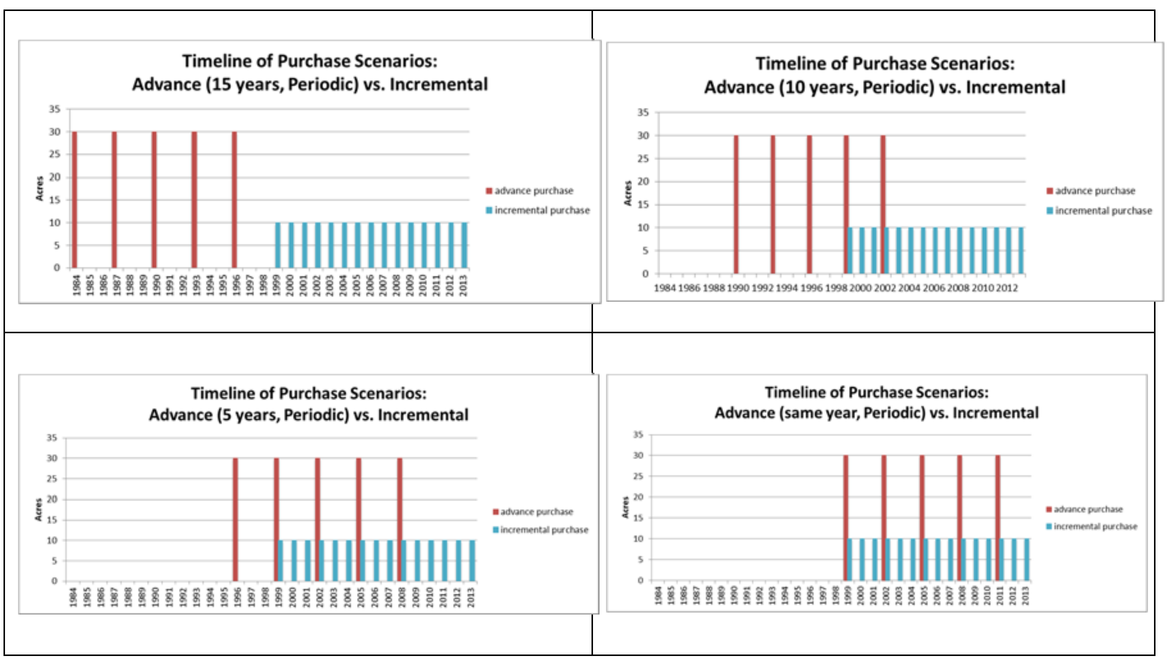


3.2.3. Group 3 Scenarios: Periodic Purchase with Temporal Purchase & Need Overlap

What happens when a transportation agency undertakes a program of periodic mitigation purchases while concurrently debiting against those for its projects? Unlike previous scenarios where mitigation is acquired at once and entirely before the onset of need, we explore here a scenario where advance mitigation purchases are made over a period of time rather than in a single year and when there is temporal overlap between purchase and need. We choose for the period of need the most recent 15-year period from 1999 to 2013, reasoning that more recent scenarios will better inform decisions going forward than older scenarios. However, this period also coincides with the years of intense real estate price escalation and the subsequent 2008 real estate and economic crash. The results from these scenarios are very much determined by this choice, since prices before this period relative to prices during this period are likely to result in savings while purchases made during this high-price period are likely to result in losses. To counterbalance this factor, we also complete a similar analysis, exploring overlapping purchases in periods of need that begin in 1984 and 1990 and are thus well outside the real estate bubble.

In these scenarios, we again assume a 15-year period of mitigation need, with 150 acres of need distributed evenly from 1999 to 2013 (10 acres/year). However, we assume acquisitions are made in installments of 30 acres every three years over 13 years. Further, we vary when the 13-year acquisition period begins relative to the onset of mitigation need. We examine savings when acquisition begins (and thus is entirely completed) 15-years before the onset of need, and when it begins 10-years prior, 5-years prior, or at the same time as need onset. In each instance, we compare estimated savings with the base case in which mitigation is purchased conventionally, on an as-needed basis rather than in advance.

Figure 13. Representation of Scenarios
Varying Timing of Periodic Purchases Relative to Onset of Need



We find that potential for savings for the scenario set in this period (1999-2013) increases the farther in advance the purchase period begins when compared to annual as-needed acquisition, but that potential also exists for loss. Purchases starting 10- and 15-years in advance produce savings because they are made before the real estate housing bubble when prices were relatively low, and when such purchases create sizeable savings compared to those made at the height of the bubble.

Yet, when purchases are made periodically in 3 year increments and when those purchases overlap the period of need, we see losses of $5.4 million. This result does not necessarily reflect poorly on periodic advance purchase per se. When we test the same overlapping scenario for 1984-1998 period, before the bubble period, and for the 1990-2004 period, which includes only early bubble price increases, we find savings with both CCI and CPI indexing. For the 1984-1998 period, we calculate savings of $81,000 using CPI and $675,000 using CCI; for the 1990-2004 period we calculate savings of $2.3 and $1.3 million for CPI and CCI respectively. This again reflects the influence that real estate prices trends play in determining cost savings under advance mitigation.

Overall, savings estimated using CPI adjustments range from $1.2 million for purchases beginning the same year as mitigation need onset; to $4.9 million, for purchases beginning 5-years before; $20.9 million, for those beginning 10-years before; and $25.2 million, when 15-years before. In these scenarios, the CCI-adjusted numbers again provide more conservative estimates. In the overlapping and mostly overlapping scenarios, when mitigation is purchased barely far enough in advance to keep ahead of need, the more conservative estimates outweigh savings, resulting in a net loss for advance mitigation over as-needed mitigation.

We can also compare these savings to those estimated in the Group 1 scenarios above (see Table 15), where advance purchases are made not in periodic installments but in a single year, 15-, 10-, 5-, and 1-year in advance. The savings from early acquisition made in a single year are comparable to those made periodically over 13 years when both are initiated far in advance. However, savings are more pronounced from a single purchase made close to onset of need than from periodic purchases initiated at the same time. In these scenarios, a one-shot mitigation purchase made 5-years before need onset can save $14.9 million or $99,000 per acre (CCI estimate, Table 15), while periodic purchases that begin at the same time produce a loss of $3.8 million, or $25,000 per acre (CCI estimate, Table 17).

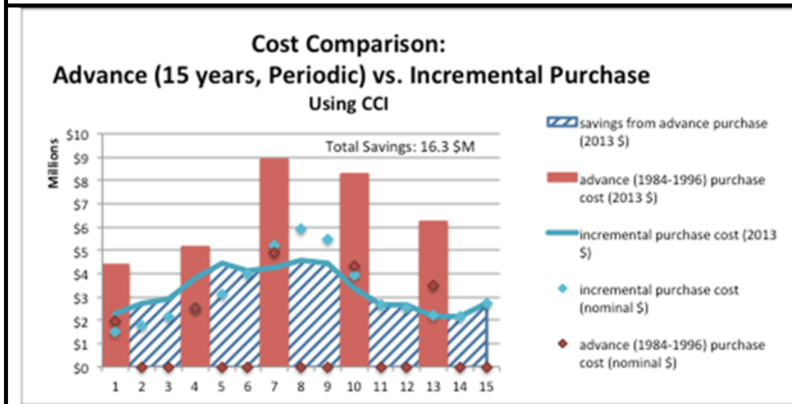
Table 17. Savings Estimated under Periodic Mitigation Purchases & Temporal Overlap

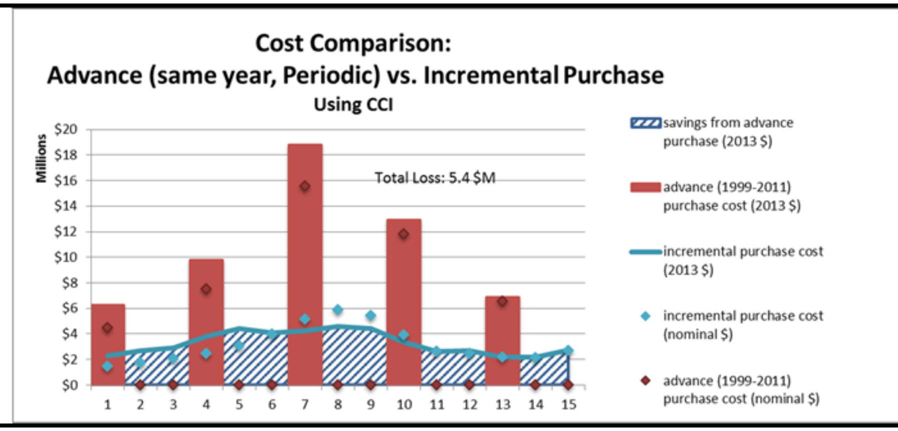
Start & frequency of mitigation purchases, relative to onset of need (150 acres total)	**Using CPI:** Total Cost ($ 2013)	Savings Over As-Needed Acquisition	**Using CCI:** Total Cost ($ 2013)	Savings Over As-Needed Acquisition
As needed; 10 acres/year (1999 to 2013)	$55,907,042		$49,264,576	$0
Same year (1999 to 2011) 30 acres every 3 years	$54,708,274	**$1,198,767**	$54,708,274	**-$5,443,698**
5-years prior (1996 to 2008) 30 acres every 3 years	$53,043,852	$2,863,190	$53,043,852	**-$3,779,275**
10-years prior (1990 to 2002) 30 acres every 3 years	$37,122,899	$18,784,143	$37,122,899	$12,141,677
15-years (1984 to 1996) 30 acres every 3 years	$30,723,984	**$25,183,057**	$32,981,131	**$16,283,445**

Figure 14. Upper End and Lower End Savings Estimates
Under Period Purchase and Temporal Overlap (CCI and CPI adjusted)

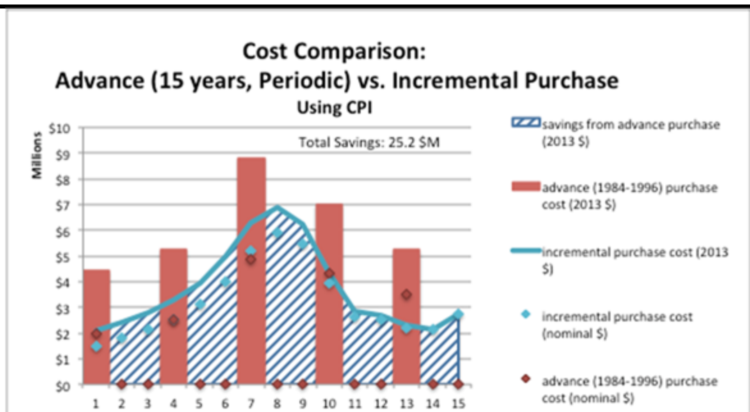
Upper End Savings Estimates	Lower End Savings Estimates

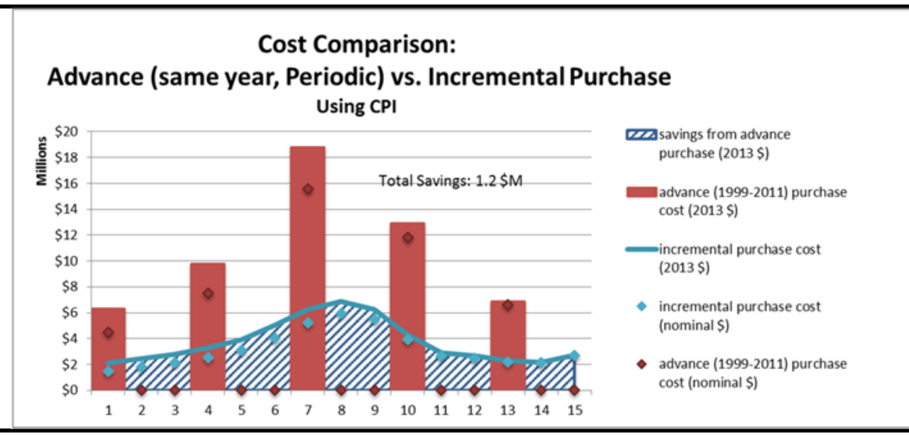
Construction Cost Index-adjusted (CCI)





Consumer Price Index-adjusted (CPI)

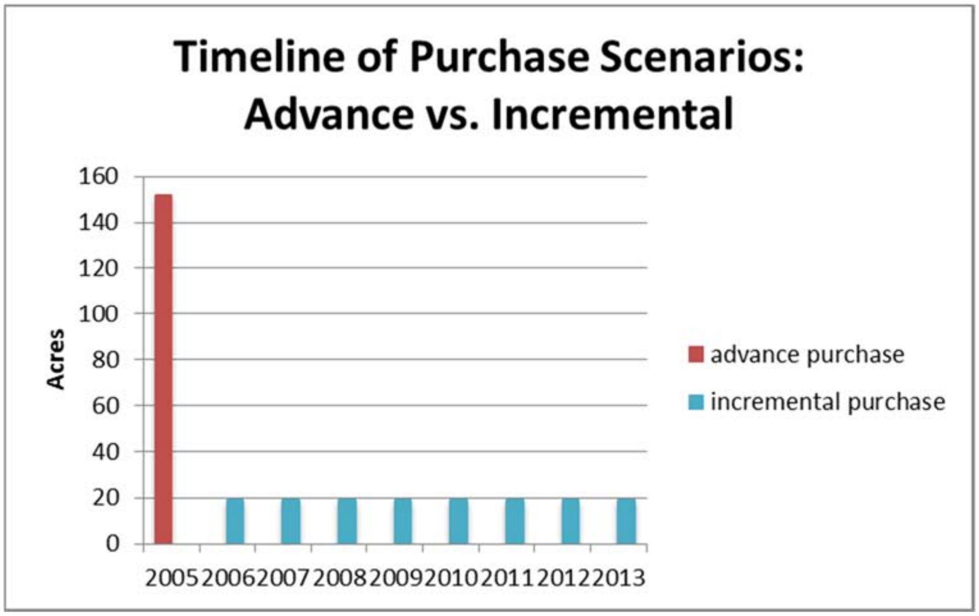




3.2.4. Group 4 Scenarios: Mitigation Purchase and Need Timed for Loss

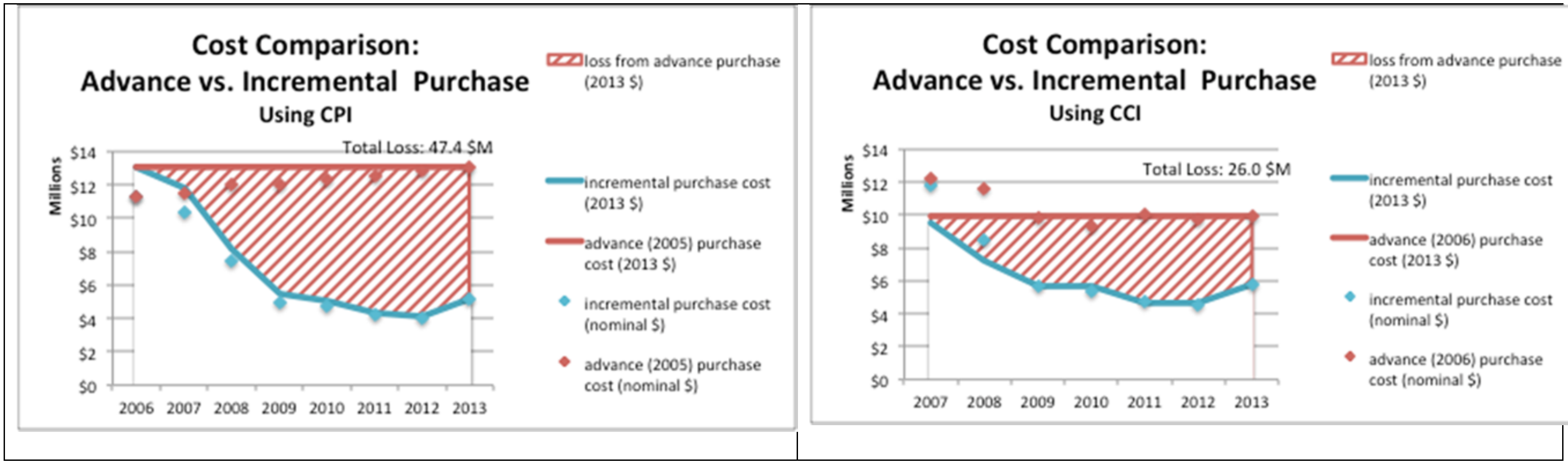
While in most of the scenarios sketched above, advance mitigation saves land acquisition costs compared to conventional, as needed mitigation, some instances have also shown that advance acquisition can cost more than conventional acquisition, depending on the timing of acquisition and need and on underlying land market conditions. Because the potential for loss exists, it is important to understand the circumstances that may produce it. Thus, in this final set of scenarios, we have deliberately adjusted the parameters for mitigation purchase and need timing to create two hypothetical instances where financial loss occurs.

Figure 15. Exploring Potential for Loss from Advance Mitigation: Purchasing Land during the Mid-2000s Real Estate Bubble



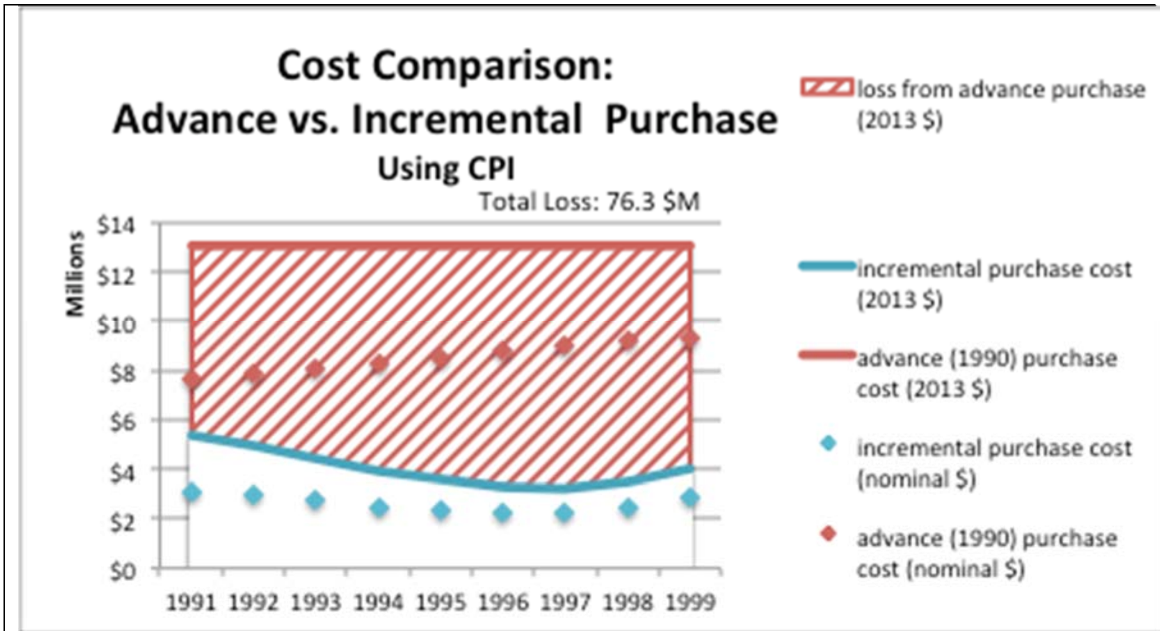
In the first scenario, we explore the potential for loss from mitigation purchases made during a period of high real estate inflation: the U.S. housing bubble which occurred of the mid-2000s. We assume here that 152 acres of mitigation land are purchased in 2005 and that transportation projects subsequently debit against the mitigation at a steady rate of 19 acres per year from 2006 to 2013, a period marked by lower land values due to the financial crisis that followed the housing bubble peak. An agency would have purchased land when it was at peak value and then used the land after prices had fallen below the purchase price. Under these circumstances, it would have been more cost effective to purchase the mitigation on an as needed basis each year from 2006 to 2013. Our estimates of accrued loss in this scenario range from $26.0 million (CCI) to $47.4 million (CPI).

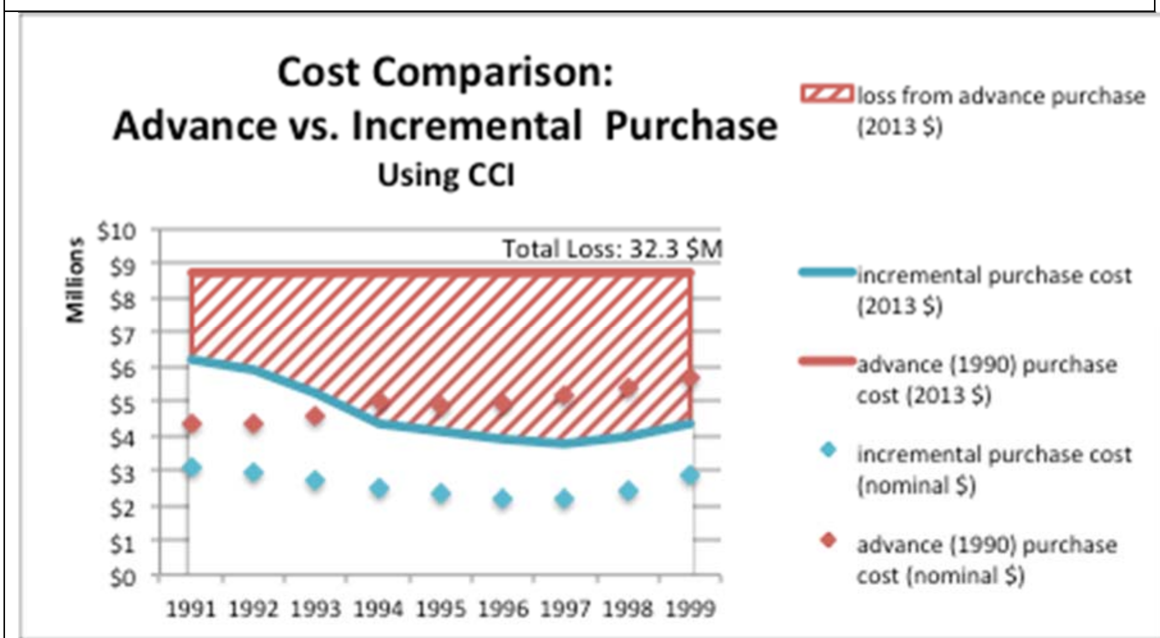
Figure 16. Exploring Potential for Loss:
Advance Purchase Scenarios during Real Estate Price Peaks (mid-2000s)



In a second scenario, we assume the same number of mitigation acres, but place the experience in the 1990s, with acquisition occurring in 1990 and mitigation need arising from 1991 to 1999. With all the land acquired prior to the early 1990s economic downturn, an agency would have paid more for the land in that single acquisition than it would if buying the land as needed in increments throughout the decade. Our estimates of accrued loss in this scenario range from $32.3 million (CCI) to $76.3 million (CPI).

Figures 17. Exploring Potential for Loss:
Advance Purchase Scenarios prior to Economic Downturns (early 1990s)





4. Advance Mitigation in Action

4.1. The SR-76 Middle Project

Case Highlights

This case study of the SR-76 Middle Segment expansion project examines how advance mitigation can shape the delivery, costs, and benefits of a regionally significant transportation project. The SR-76 Middle in San Diego County is, as of mid-2014, one of only a few transportation projects in California to have been completed under a truly large-scale advance mitigation program. The project is part of the San Diego Association of Government's (SANDAG) *TransNet* Transportation Investment Plan, funded by local sales tax receipts. The larger SR-76 corridor is one of 11 freeway corridors benefitting from the *TransNet* tax measure's innovative and comprehensive advance mitigation program, the Environmental Mitigation Program (EMP).

As a roadway expansion project once strongly opposed by environmentalists, the SR-76 Middle is a noteworthy case. Viewed by opponents as a "poison project" in the proposed sales tax investment plan, the project initially threatened to derail the prospect of winning voter approval for the entire *TransNet* measure. Ultimately, however, and largely due to *TransNet*'s advance mitigation program, the environmental community accepted the project within the sales tax expenditure package. Construction of the SR-76 Middle proceeded without litigation and was completed quickly, from 2010 to 2012.

Our analysis of the SR-76 Middle project and its place within the *TransNet* EMP suggests that key benefits were realized due to the advance mitigation planned and implemented within *TransNet*. These include:

1. Avoided Land Cost Escalation due to Early Acquisition of Mitigation Parcels

The SR-76 Middle project benefitted from the early access to funding that the *TransNet* EMP enabled for the acquisition of strategic mitigation parcels. Key purchases made to satisfy SR-76 Middle's mitigation obligations under the EMP include the Groves, Morrison, and Zwesteria properties, totaling 424 acres.[16] SANDAG acquired these parcels from 2008-2009, when the U.S. economic recession had driven land costs down significantly. SANDAG originally estimated that it would save would roughly 25 percent of conventional mitigation costs by acquiring parcels early and avoiding land price escalation. We estimate actual savings in three different ways, and find that – depending on the underlying assumptions and baseline used in such calculations – SANDAG may have saved from 34 to 60 percent through these early acquisitions.

2. Avoided Project Development and Delivery Delay

SR-76 Middle benefitted from early coordination of and communication among federal, state, and local transportation agencies; federal and state natural resource agencies; and local environmental and conservation planners and stakeholders that occurred through several contemporaneous

[16] Mitigation plans involving the Groves and Morrison properties also included native habitat restoration activities. While Caltrans staff suggest that undertaking such restoration activities in advance can produce further cost and time savings over restoration implemented project-by-project, such savings are not estimated here.

initiatives. These included planning for the *TransNet* ballot measure and its implementation, planning for the SR-76 Middle itself, and planning for various regional parks, conservation, and habitat preservation initiatives.

While this case study cannot provide estimates of savings from these early communications, it is likely that these efforts increased the ease with which suitable mitigation parcels for the SR-76 Middle could be identified. Further, they likely also facilitated the development of consensus among this broad array of interests that the proposed mitigation properties were appropriate.

3. Avoided Legal Costs and Delays

Advance mitigation played a role in developing a plan for the SR-76 corridor that was acceptable to environmental stakeholders. It is impossible to attribute the absence of SR-76 legal challenges to its mitigation; however, observers suggest that the EMP advance mitigation framework along with the "net benefit" mitigation standard applied to improvements in the SR-76 corridor and two other freeway corridors helped to defray concerns among civic and environmental groups that may otherwise have spurred legal action. The net benefit provisions also added to the EMP's cost, however; for the SR-76 corridor, net benefit has entailed $20.8 million in expenditures not related to required mitigation.[17]

Why use SR-76 Middle as a case study

The SR-76 Middle Segment expansion is one of the first projects completed under the *TransNet* Transportation Investment Plan and undertaken within *TransNet*'s innovative advance mitigation program. It is one of the few cases in California to date which can be used to study how an advance mitigation program may shape the delivery, costs, and benefits of a significant transportation project.

Originally a rural, two-lane road not part of the state highway system, State Route 76 (SR-76) had been the subject of widening and realignment proposals since the 1960s. The road crosses northern San Diego County from I-5 near the Pacific Coast to its inland juncture with I-15 and beyond. Improvements have been planned and undertaken in three installments, with a first set of enhancements constructed from the western I-5 terminus to Melrose Drive between 1994 and 1999. Two additional SR-76 improvement projects – SR-76 Middle and SR-76 East—are funded under SANDAG's *TransNet* local sales tax measure. We chose expansion of the SR-76 Middle segment, from Melrose Dr. to Mission Rd., from two- to four-lanes, as the subject of this case study, as it was completed in 2012. Completion of the Eastern Segment widening, from Mission Road to the I-15 juncture, and associated improvements to the SR76/I-15 interchange are not expected until 2022. Both the Middle and East projects were considered highly contentious by the environmental community, given the sensitive habitat through which the corridor passes. And both are being mitigated under the *TransNet* Environmental Mitigation Program (EMP).

In addition to being covered by *TransNet*'s advance mitigation program, the SR-76 Middle project is of interest because the corridor is one of three slated for significant expansion under *TransNet* and to which a "net benefit" mitigation standard was applied, as negotiated under the *TransNet*'s EMP (SANDAG 2005). This feature of the EMP is discussed further below.

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[17] Greer, Keith. April 23, 2014. Personal Communication.

4.1.1. Advance Mitigation under *TransNet*'s Environmental Mitigation Program (EMP)

TransNet's Environmental Mitigation Program (EMP) is a path-breaking component of the 2004 sales tax measure approved by voters to fund highway, transit and local road improvements and administered by the San Diego Association of Governments (SANDAG). The EMP allocates funds to pay for direct mitigation of *TransNet*'s transportation projects, which include an ambitious program of freeway and transit improvements in 11 major corridors and are drawn largely from SANDAG's 2030 Long-Range Regional Transportation Plan (LRTP). For such freeway projects, the state transportation department, Caltrans, receives *TransNet* dollars to fund a share of total project construction costs. Also, *TransNet*'s EMP fully pays for their direct mitigation.

Of the $14 billion the *TransNet* tax is projected to generate over its 40-year lifespan, $850 million is reserved for the EMP. The $850 million EMP not only covers the $650 million in direct mitigation costs associated with *TransNet*'s highway, transit, and local road projects, but also delivers $200 million in "economic benefit" for region wide habitat preservation. The *TransNet* ordinance uses the term "economic benefit" to monetize the savings expected to accrue from implementing direct mitigation in advance, and it makes those savings available for habitat investment beyond *TransNet*'s mitigation obligations.

As a *TransNet* transportation project under the EMP, the SR-76 Middle project benefitted from (a) pre-established frameworks for identifying appropriate mitigation and (b) for seeking resource agency approvals for mitigation activities, required for project construction; and from (c) available funding to support early development, implementation and acquisition of mitigation, enabling the project to meet environmental obligations well prior to project construction. Procedural and funding benefits such as these are expected to make advance mitigation less costly than conventional project-by-project mitigation.

Further, because of the sensitive habitat through which the SR-76 passes and the major impacts associated with laying new alignment to double the roadway's capacity, the SR-76 Middle project provides an example of a project initially viewed by the environmental community as a non-starter and "poison project." Project developers and stakeholders alike credit the ambitious mitigation program attached to *TransNet* – and specifically to this and two other highly controversial projects (SR-67 and SR-94) – as the reason why environmental stakeholders ultimately did not challenge the *TransNet*'s investment plan and why planning and construction of the SR-76 has been completed without facing legal challenges from the environmental community.

Net Benefit Provisions

The significant expansions planned for SR-67, SR-76 and SR-94 segments under *TransNet* would have substantial impacts to plant and animal species and to wildlife movement corridors in the region. Because the environmental community was unlikely to support the *TransNet* tax measure without such a provision,[18] the *TransNet* Extension Ordinance and Expenditure Plan includes language to ensure that a "net benefit" mitigation standard applies to projects in these corridors.

The *TransNet* ordinance refers to the net benefit standard as providing environmental enhancements beyond the required mitigation and as targeting on-site improvements, "in order to

[18] Greer, Keith. April 23, 2014. Personal communication.

produce an on-site 'net benefit' to species and to the movement of wildlife along these wildlife corridors." For the SR-76 Middle, achievement of the net benefit has relied in part on the addition of numerous wildlife underpasses and design elements to make the highway more permeable for species. While some underpasses would have been built anyway to serve roadway hydrology, these were constructed to additional specifications to accommodate wildlife.

While these net benefit provisions helped the entire *TransNet* program to succeed, they carry a cost. For the SR-76 Middle and East projects together, the cost of mitigation required to compensate for species and landscape impacts under federal and state law had been estimated at about $40 million, yet *TransNet* provides roughly $40 million more in "net benefit" mitigation spending.[19] As of the date of this report, SANDAG is tallying the precise additional expenditure on SR-76 Middle wildlife underpasses to achieve the net benefit standard, but estimates roughly $12 million in capital improvements have been made for wildlife crossings.[20] Further expenditures have been made for key parcel acquisitions.

Accordingly, SANDAG tracks required mitigation and net benefit activities (e.g. parcel acquisitions) separately. Further, the cost-savings that accrue from advance mitigation (called "economic benefit" in the ordinance and this case study) are distinct from the "net benefit." In fact, expenditures on net benefit activities reduce the overall cost savings (or economic benefit) of advance mitigation.

The SR-76 Middle Project and its Environmental Impacts

Figure 18.
Bedrock blasting
for SR-76 Middle (2010)

The SR-76 Middle project upgrades the existing five-mile stretch of road from Melrose Dr. to Mission Rd. from two- to four-lanes, widening existing alignment in most places and adding new alignment in others.

The SR-76 follows the San Luis Rey River, and expanding the facility from two- to four-lanes involved constructing a new 1,700-foot two-lane bridge eastbound over the San Luis Rey River and converting the original bridge to westbound traffic only. Construction involved bedrock blasting and cut-and-fill work transferring earth from the north to the south side of the road to raise the grade level for future westbound lanes.

A rough assessment of SR-76 Middle impacts, used in 2004 to estimate mitigation costs for the *TransNet* transportation program, suggested that the project would impact 25 acres of non-coastal wetlands and 60 acres of upland habitat. Further, the road segment traverses a highly sensitive environmental setting home to several species of concern, including the arroyo toad, coastal California gnatcatcher, southwestern willow flycatcher, least Bell's vireo, and San Diego ambrosia.

[19] Chavez, Richard. April 8, 2014. Personal communication.
[20] Greer, Keith. April 23, 2014. Personal communication.

Planning for Environmental Review and Mitigation of the SR-76

The SR-76 Middle project benefitted from several individual but overlapping planning efforts. These facilitated the development of consensus among numerous stakeholders about the project's feasibility in spite of documented impacts, about the appropriate ways to mitigate its impacts, and about financial resources that could be used to do so.

Early Multi-agency Environmental Consultations on the SR-76 Middle

Early coordination meetings among Caltrans, the Army Corps of Engineers, the Environmental Protection Agency, the local Regional Water Quality Control Boards, the California Department of Fish and Wildlife, and the Federal Highway Administration to prepare for environmental review and permitting processes provided a platform for stakeholders to consider potential project approaches and mitigation actions.

Specific mitigation parcels were discussed as early as 2006, and later that year the USFWS provided Caltrans with concurrence that five proposed sites – known as the Morrison, Singh, Zwesteria, and Groves properties and the Pilgrim Creek mitigation site—were generally biologically appropriate for off-site preservation, creation and restoration of habitat to offset affects to the arroyo toad, gnatcatcher, vireo, flycatcher, ambrosia and their habitats (State of California DOT 2008, p. 1).

Caltrans began acquiring mitigation sites in 2007, and the USFWS biological opinion (BO) was issued in 2008. In the BO, USFWS concluded that "the activities associated with the Existing Alignment Alternative, with mitigation incorporated into the project, would not be likely to jeopardize the continued existence…[of the affected species]… nor would the project destroy or adversely modify…critical habitat" (State of California DOT 2008, Appendix F, page F-23).

As one Caltrans environmental planner described, "We started acquiring properties early. By the time we got to the environmental stage we already had mitigation sites and were ready to move forward to construction…[Caltrans] had been meeting with parties at SANDAG, USFWS, Cal Fish and Game [Wildlife]…monthly to identify potential properties for different projects. Then through NEPA 404 process, we got concurrence on what we could use on the SR-76 project."

TransNet Measure Planning

In the early 2000s, SANDAG led development of the *TransNet* sales tax extension, drafting and negotiating its Expenditure Plan and Environmental Mitigation Program. SANDAG staff worked to sketch mitigation costs associated with *TransNet* projects, and executive negotiations proceeded among transportation and environmental stakeholders. These activities provided a platform for considering the significant expansion in the SR-76 corridor.

Improvements to SR-76 Middle and East would receive partial funding from *TransNet* for construction. Further, the *TransNet* measure funded ambitious advance mitigation via EMP which would fully cover the costs of SR-76 mitigation to the "net benefit" mitigation standard. Environmental interests agreed to support *TransNet*—and within it the SR-76 and three other highly controversial projects—because the tax measure funded mitigation activities to meet this higher standard.

While planning for advance mitigation within a local tax measure is beyond Caltrans' control, future state led efforts to develop new or to direct existing state transportation revenues could conceivably include similar provisions to support advance mitigation.

Natural Community Conservation Plan (NCCP) and Habitat Conservation Plan (HCP) Efforts
The SR-76 project falls partially within the boundaries of existing NCCP/HCP planning areas. Such plans and planning efforts provided a framework in which potential mitigation sites for the SR-76 Middle project could be considered. They could serve Caltrans and SANDAG as a guide in identifying acquisition sites that enhance existing regional conservation efforts and find ready public support.

Existing plans and plans under development in the early and mid-2000s included the Multiple Habitat Conservation Program (MCP) (March 2003), the City of Oceanside's Subarea Plan (2006), the County of San Diego's North County Multispecies Conservation Plan (NCMCP) (in preparation in 2006). Additionally, the County of San Diego was developing a plan for a 1,600 acre regional park preserve following the San Luis Rey River.

Other Factors Quicken Project Delivery
Although the SR-76 Middle project clearly benefitted from early multi-stakeholder planning efforts relevant to the corridor, and from efforts to identify and secure mitigation parcels prior to construction, other factors likely also contributed to the project's rapid construction. It is important to acknowledge that other innovations in project delivery may also have accelerated construction. For instance, Caltrans used a "design sequencing model" which allowed the agency to build such project components as the new San Luis River Bridge where designs were complete, while simultaneously designing remaining project pieces (SANDAG 2010). Further, Caltrans also pursued an aggressive work schedule with its staff and construction contractor. The road's accelerated construction was targeted for December 2012 completion, and Caltrans credited the contractor with high levels of performance to achieve this goal.

Figure 19. SR-76 Middle Project Map & Schedule

<table>
<tr><th colspan="2">SR-76 Middle Widening Project
Melrose Drive to Mission Rd (1207602)</th></tr>
<tr><td>Middle Segment Map</td><td>Middle Segment Project Schedule</td></tr>
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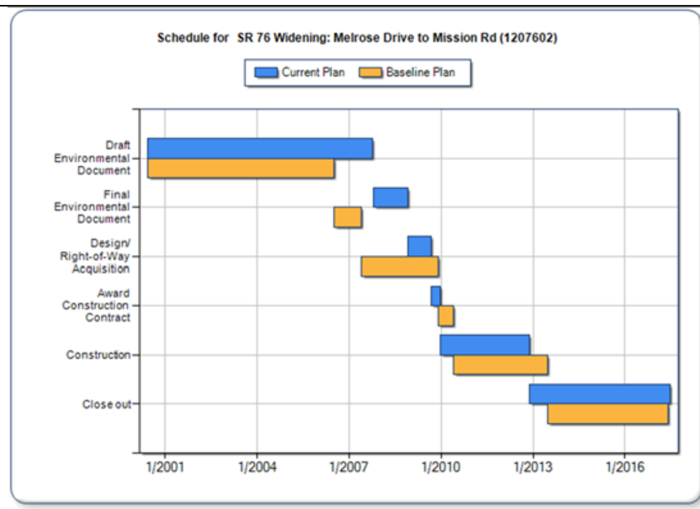

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4.1.2. Estimating SR-76 Middle Acquisition Cost Savings from Advance Mitigation

Methodological Approach

To understand whether and to what extent advance land acquisition reduced mitigation expenditures for the SR-76 Middle project, we compare SANDAG data on actual expenditures for advance mitigation land acquisition with its original 2002 projections for SR-76 Middle project costs for both conventional mitigation and advance mitigation. Data provided by SANDAG document the acquisition costs for the three properties (Groves, Morrison, and Zwesteria) used to satisfy the legally required mitigation of SR-76 Middle impacts. To compare fairly the 2002 projected mitigation costs (both conventional and advance) to actual advance mitigation acquisition expenditures made in various purchase years, we convert all monetary figures to constant 2013 dollars using the GDP Chained Price Index, published by the Office of Management and Budget and commonly used to develop public budgets.

Although part of the Groves property was used to satisfy mitigation requirements for the SR-76 East segment as well, we attribute the entire cost of this parcel to the SR-76 Middle. We reason this computational simplification is acceptable, as it could only serve to make our results more conservative. That is, this simplification can only make actual advance mitigation expenditures costs appear greater than they were, biasing downward and any estimated savings from advance mitigation.

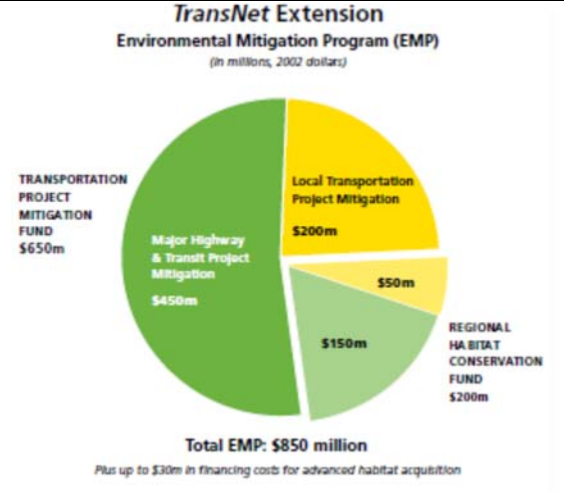
Further, because they figure centrally in our analysis of savings specific to the SR-76 Middle project, SANDAG's own assumptions about the overall savings from *TransNet*'s advance mitigation program deserve consideration. (They are described in the box below.)

SANDAG Assumptions about Cost Savings from the *TransNet* EMP

In rough terms, conventional project-by-project mitigation of *TransNet*'s major highway and transit investments was estimated in 2002 to cost $600 million, while advance mitigation would cost only $450 million. For local road projects, conventional mitigation would cost $250 million in 2002, while advance mitigation would cost $200 million. Thus, for the combined program, $850 million would be needed for mitigation if undertaken conventionally, but only $650 million if structured in advance. SANDAG estimated in 2002 that advance mitigation saves it $200 million across the whole program. *TransNet* reserves those funds for further investment in regional habitat restoration. (Figure 20). Appendix A details the approach used by SANDAG to estimate mitigation needs and costs under the sales tax measure.

The *TransNet* allocation for the estimated $200 million in "economic benefit" dedicates $40 million (20 percent) of the savings to support regional habitat management and monitoring activities, as specified by the TransNet MOA (SANDAG 2005, p. 3, #4). Reserving these funds off the top reduces the project-level allocation of economic benefit; thus the $8.084 million in estimated benefit for SR-76 Middle represents a 21 percent savings, not 25 percent, over conventional mitigation (Table 18).

Figure 20. *TransNet* EMP Economic Benefit and Rationale



According to SANDAG, the *TransNet* EMP "mitigation requirements for covered species to be fixed, and [allows] mitigation requirements to be met through purchase of land in advance of need in larger blocks at a lower cost."[1] It "allows SANDAG to buy land early…and bank it for future mitigation needs as opposed to buying land in small pieces to satisfy mitigation requirements project by project… [P]ortions of the land purchased earlier will be used as mitigation. The economic benefit will be the difference between the cost of the land purchased in large parcels earlier, and the higher price if acquired in smaller parcels at later dates."[2]

[1] *TransNet* Ballot and Ordinance, p. 36.
[2] SANDAG. Environmental Mitigation Program Fact Sheet. September 2012.

Table 18. Cost and Benefit Estimates in the *TransNet* Measure (2002)

	18.A. Conventional vs. Advance Mitigation Costs of All *TransNet* Investments			
	Projected Mitigation Costs (2002$)		**Projected Savings ("Economic Benefit") of Advance Mitigation**	
	Conventional Mitigation	**Advance Mitigation (EMP)**	**Dollar Savings**	**Percent Savings**
Major Highway & Transit Projects	$600,000,000	$450,000,000	$150,000,000	25%
Local Road Projects	$250,000,000	$200,000,000	$50,000,000	20%
	18.B. Conventional vs. Advance Mitigation Costs of SR-76 Middle			
	Conventional Mitigation	**Advance Mitigation (EMP)**	**Dollar Savings (2002$)**	**Percent Savings**
SR-76 Middle	$38,500,000 [a]	$28,875,000 [b]	$9,625,000 [c]	25% [d]
	18.C. Allocation of Estimated Savings ("Economic Benefit") to SR-76 Middle			
	Projected Mitigation Costs (2002$)		***TransNet* Project-Level Allocation of Estimated Savings ("Economic Benefit") of Advance Mitigation**	
	Conventional Mitigation	**Advance Mitigation (EMP)**	**Dollar Allocation of Savings**	**Percent Allocation of Savings**
SR-76 Middle	$38,500,000 [a]	$28,875,000	$8,084,933 [e]	21%

[a, c] Author calculations, assuming the $28.875 million budgeted for advance mitigation of the SR76 Middle would represent a 25 percent savings over SR76 Middle mitigation, if undertaken conventionally. Conventional mitigation costs assume mitigation needed for 60 acres of upland and 25 acres of non-coastal wetland habitat.

[b] SANDAG. *TransNet* Environmental Mitigation Program, Memorandum of Understanding (2013), Attachment B. (Estimates in this MOU were produced in 2002.)

[d] Richard Chavez, SANDAG. April 8, 2014. Personal communication; see also, *TransNet* Ballot and Ordinance, "*TransNet*"
Extension Environmental Mitigation Program (EMP) Principles," p. 36.

[e] SANDAG. *TransNet* Environmental Mitigation Program, Memorandum of Agreement (2013), "Proposed Distribution of Economic Benefit Funding by Project," p 11. (Estimates in this MOA were produced in 2002.)

Results

At the time of *TransNet*'s passage, SANDAG projected the cost of advance mitigation for the SR-76 Middle to be $28.875 million. Although no SANDAG documents explicitly state the projected cost for conventional mitigation of this project, we calculate this to be $38.5 million (2002$). We arrive at $38.5 million by applying SANDAG's assumption that, for major highway projects like the SR-76 Middle, the cost of mitigating in advance would be roughly 25percent less than the cost of conventional mitigation.

Focusing exclusively on the parcel acquisitions made for the SR-76 Middle project's required mitigation, we estimate that advance mitigation may have saved between 35 and almost 60percent of projected land acquisition costs, or between $10 million and $29 million. While these results are striking, estimating savings from advance mitigation is complex, and these results necessarily rest on SANDAG's original assumptions about what conventional mitigation would have cost across the EMP as a whole, i.e. the analytical "counterfactual." We further caution that the choice of baseline to which advance mitigation acquisition costs are compared significantly impacts the scale of savings estimated, and that it is difficult to determine which choice of baseline is in principle more reliable.

First, compared to SANDAG's projected cost of advance mitigation, actual costs for advance mitigation of the SR-76 Middle project are almost 35 percent lower, suggesting a savings of $10.4 million (2013$, See Table 19). This comparison is the more conservative one, and it suggests that advance acquisitions to mitigate the SR-76 Middle cost even less than SANDAG had projected they would.

Second, compared to SANDAG's projected cost of conventional mitigation, actual costs for advance mitigation of the SR-76 Middle project are almost 60 percent lower, suggesting a savings of $28.6 million dollars ($2013, See Table 19) over conventional mitigation. This comparison suggests that advance acquisitions to mitigate the SR-76 Middle cost substantially less than the cost SANDAG anticipated for conventional mitigation of the project.

While intentional overestimation of mitigation need would make SANDAG's actual advance mitigation costs look economical, we find no evidence of need inflation in its projections. In fact, substantially more non-coastal wetlands were needed to mitigate the project than originally estimated under *TransNet* (See Appendix B), and under both comparisons, the actual purchase costs for acquiring mitigation land was less than SANDAG projected. The agency's approach to calculating overall mitigation needs for *TransNet* was approximate given the advance nature of planning involved, but it is well documented.

An even more conservative estimate of advance mitigation savings for the SR-76 Middle might reflect the costs that "net benefit" mitigation standards added to the project. SANDAG reports that "net benefit" provisions added $20.8 million in project expenditures not related to required mitigation.[21] Held against projected costs of advance mitigation, net benefit appears to negate the $10 million in savings calculated above, producing a deficit instead. Yet, compared with projected costs of conventional mitigation, actual advance mitigation costs plus net benefit expenditures still produce roughly $10 million in a savings over projected conventional costs.

[21] Greer, Keith. April 23, 2014. Personal communication.

In all of the comparisons explored, savings attributed to advance mitigation depend heavily on analytical assumptions and choices embedded in the calculations, underscoring the importance for clear articulation of such assumptions.

Table 19. SR-76 Middle Advance Mitigation:
Savings Estimated with Different Baselines
(Estimated Savings Realized as of March 2014)

	Baseline A: 2002 Estimates of *Advance Mitigation*			
	Projected Cost (2002) of Advance Mitigation	**Actual Cost of Advance Mitigation (EMP Acquisitions)**	**Dollar Savings**	**Percent Savings**
SR-76 Middle	2002$ $28,875,000[b]	In varied $ years of acquisition $18,233,592[a]	No conversion to constant dollars $10,641,408	No conversion to constant dollars 36.8%
	2013$ $30,011,723	2013$ $19,588,449	2013$ $10,423,274	2013$ 34.6%
	Baseline B: 2002 Estimates of *Conventional Mitigation*			
	Projected Cost (2002) of Conventional Mitigation	**Actual Cost of Advance Mitigation (EMP Acquisitions)**	**Dollar Savings**	**Percent Savings**
SR-76 Middle	2002$ $38,500,000[a]	In varied $ years of acquisition $18,233,592[c]	No conversion to constant dollars $20,266,407	No conversion to constant dollars 52.6%
	2013$ $48,236,259	2013$ $19,588,449	2013$ $28,647,810	2013$ 59.4%

[a] SANDAG. *TransNet* Environmental Mitigation Program, Memorandum of Understanding (2013), Attachment B. (Estimates in this MOU were produced in 2002.)

[b] The sum of SANDAG acquisition expenditures made for the Groves (01/09/2008), Morrison (01/31/2008), and Zwesteria (01/30/2009) mitigation properties.

[c] Author calculations, assuming the $28.875 million budgeted for advance mitigation of the SR-76 Middle would represent a 25 percent savings over SR-76 Middle mitigation, if undertaken conventionally.

Table 20. SR-76 Middle Project Timeline

2002 – 2004	SANDAG leads development of *TransNet* sales tax measure extension, including SR-76 Middle and East improvements in its highway projects and the *TransNet* Environmental Mitigation Program (EMP).
Fall 2004	***TransNet* measure passes**
Sep 2005 - Dec 2006	Coordination meetings among Caltrans, Army Corps of Engineers, Environmental Protection Agency, Regional Water Quality Control Board, California Department of Fish and Game and Federal Highway Administration to prepare for NEPA/404 MOU process.
Aug 2006	**USFWS provides Caltrans concurrence that proposed mitigation sites are appropriate** to offset affects to arroyo toad, gnatcatcher, vireo, flycatcher, ambrosia and their habitats.
(?) 2007	**Draft EIS**
Dec 2007	EPA Comments on Draft EIS http://www.epa.gov/region9/nepa/letters/SR76-melrose-mission-hwy-improve-DEIS.pdf
Jan 2008	Acquisition: Groves Property, San Luis Rey, 268 acres http://keepsandiegomoving.com/Libraries/EMP-doc/1groves.sflb.ashx
Jan 2008	Acquisition: Morrison Property, San Luis Rey, 137 acres http://keepsandiegomoving.com/Libraries/EMP-doc/2morrison.sflb.ashx
May 2008	**Caltrans initiates request for USFWS Section 7 consultation**
Oct 2008	**USFWS Biological Opinion** http://www.keepsandiegomoving.com/Documents/SR76-Corridor/11_appendices_a-h.pdf See: See Appx. H, p. 157 of .pdf
Nov 2008	Final EIS
Jan 2009	Acquisition: Zwesteria Property, 19 acres http://keepsandiegomoving.com/Libraries/EMP-doc/5zwestria.sflb.ashx
January 2010	**Construction begins**
Dec 2010	Project is on schedule Wildlife corridor improvements are 30% complete
Apr 2011	Acquisition: Jeffries Ranch, 80 acres (net benefit mitigation) http://keepsandiegomoving.com/Libraries/EMP-doc/16jeffries.sflb.ashx
Fall 2011	**Project is 50% complete**
Oct 2011	Acquisition: Rancho Lilac, 902 acres (net benefit mitigation) http://keepsandiegomoving.com/Libraries/EMP-doc/19RanchoLilac.sflb.ashx
Dec 2011	Project is on schedule
Mar 2012	San Luis Rey Bridge is complete & open
Dec 2012	Construction complete, excluding ongoing monitoring.

4.2. OCTA Advance Mitigation Acquisitions under Measure M2

In Orange County, the Orange County Transportation Authority (OCTA) and its Renewed Measure M (M2) included a regional advanced mitigation program called the Environmental Mitigation Program (EMP). OCTA's EMP has propelled a flurry of new transportation mitigation-driven land conservation activity in the last few years. Measure M2, a half-cent transportation sales tax measure passed by voters in 2006, supports significant investment in regional transportation projects and also includes a component requiring that a minimum of 5% of the freeway program's net revenues be spent on comprehensive mitigation for the environmental impacts of 13 freeway projects. Although conservation organizations have been acquiring natural lands in and around Orange County for many decades, Measure M2's reliable and dedicated funding stream and its EMP have made the OCTA a significant player in the conservation arena within the span of a few years.

This case explores how the decision to fund early acquisition of mitigation lands, before the measure even started, ultimately allowed OCTA to benefit from cheaper, unentitled land prices, in ideal locations coupled with such other benefits as permit assurances and alignment with impacted habitats as it pursued implementation of its transportation investment program. This summary also documents how trends in conservation activities, the status of the economy, and purchase prices factored into OCTA's effort.

Acquisition of Transportation Mitigation Lands under OCTA's Environmental Mitigation Program

Although the M2 sales tax was approved by voters in 2006, it would not take effect until April 1, 2011. To jump start transportation projects before M2 revenues began to accrue, OCTA issued bonds against future sales tax receipts, funding an "Early Action Plan." Included in this Early Action Plan was $55 million to fund the advanced mitigation program. This figure allowed for funding acquisition, restoration, and management costs, as well as funding to establish the program and its conservation mechanism a Natural Communities Conservation Plan and Habitat Conservation Plan.

By studying the six purchases to date, one can consider how much those purchase would have cost had the agency had to wait an additional five years or more to make them. The purchases allow consideration of how OCTA avoided land cost escalation in its acquisition costs and how it benefitted from ability to act under favorable market conditions.

Between April 2011 and December 2013, OCTA acquired nearly 1150 acres at a total cost of $27 million under the Measure M's EMP. Using biological and non-biological criteria, OCTA's Environmental Oversight Committee prioritized and directed staff to acquire these lands based on factors such as presence of threatened or endangered species, connectivity to existing protected lands, and habitat types—all of which would offset impacts from the freeway expansions funded by M2. Acquisitions to date have targeted the western edge of the Cleveland National Forest and an area adjacent to Chino Hills State Park—all foothill areas.

Table 21. OCTA Preserve Acquisition Properties

Property Name	Date Purchased	Acreages	Cost Per Acre	Total Cost
Saddle Creek South	4/29/2011	83.649	$38,000	$3,178,662
Hayashi	5/18/2011	296	$10,000	$2,960,000
Ferber Ranch	5/31/2011	398.768	$32,000	$12,760,576
O'Neill Oaks	5/31/2011	119.178	$36,000	$4,290,408
Hafen Estates	12/5/2011	47.91	$35,589	$1,705,069
MacPherson	12/24/2013	203.635	$12,266	$2,497,787
	TOTALS:	**1149.14**		**$27,392,502**

Table 21 documents the six mitigation purchases that OCTA has made as of April 2014 in the context of its "Early Action Plan" for the Measure M2 transportation sales tax measure.

In October 2009, the Resources Agencies (Cal Fish and Wildlife and the U.S. Fish and Wildlife Service) signed a Memorandum of Agreement (MOA) and Planning Agreement with OCTA and Caltrans, outlining the coordination and plan to create the NCCP/HCP which would inform acquisitions. It was agreed that through the Environmental Oversight Committee (EOC), on which each agency had a seat, recommendations for early acquisition/restoration expenditures could occur and would be credited towards OCTA's mitigation requirements. The Resource Agencies participated in the creation and adoption of the selection criteria used for evaluating and ranking the properties. The MOA signatories formed an ad-hoc committee to apply the criteria to the acquisition/restoration opportunities and provided rankings to the EOC based on the alignment with the impacted habitats. These recommendations were advanced to the EOC and were ultimately adopted by OCTA's Board of Directors. All votes for acquisition and restoration properties were unanimous on the EOC. In addition, the Resource Agencies provided letters of assurance to OCTA that its acquisition and restoration selections were in alignment with the impacted habitats and met portions of the mitigation requirements.

4.2.1. Using 'Comps' to Approximate Benefits of Advance Acquisition

Reviewing comparable purchases, or "comps," made by conservation organizations allows an understanding of how raw land valuations (using an appraisal method to determine the land's Fair Market Value) in Orange County have increased in just a few short years. One of the foremost authorities in land conservation in Orange County is the Trust for Public Land (TPL). Through its Orange County office numerous conservation acquisitions were completed along the western edge of the Cleveland National Forest, which includes Fremont, Black Star, Silverado, Modjeska, Harding, Santiago, Live Oak, and Trabuco Canyons. The acquisitions were targeted to fill in gaps in the preserve system, connect wildlife movement corridors, and add to the suite of protected natural lands. The majority of those acquisitions occurred between May 2002 and October 2006—a few years before OCTA began implementing its EMP.

As OCTA was beginning to implement its Early Action Plan, the economy was just beginning to decline. Ultimately all land values took a hit when the Great Recession took effect. Home values dropped, some as much as 30 percent; the value of raw land also dropped. Generally raw land values drop as much, instead averaging a decrease of about 6-10 percent. OCTA with its early funding, biologically ranked acquisition opportunities list, and support from the permitting agencies and environmental organizations was in a prime position to acquire lands cheaply and strategically.

Table 22 shows the trend in prices for the same subject areas (western edge of the Cleveland National Forest) between 2002 and 2013. The comps listed in this table show other purchases active in the local land market before, during and after the Great Recession. By the time OCTA was ready to buy land, prices were significantly lower—having been affected by the recession.

Table 22. Conservation Transactions Before, During and After the Great Recession

Purchasing Entity	Low Price/Acre	High Price/Acre	Transaction Timeframes
TPL	$2,093	$4,815	2002 – 2005
Comparable properties ("Comps")*	$17,091	$45,727	2008 – 2012
OCTA	$12,266	$35,397	2011 – 2013

*includes a mix of private party sales and a few conservation sales

Table 22 outlines the advantage of OCTA's commitment to fund the EMP early, local land market had a lot of available properties and land prices were lower. With skillful negotiations on OCTA's behalf it acquired the land at an average of 25 percent lower than before the recession and was able to apply remaining funds toward a long-term non-wasting endowment. OCTA's purchase now become comps for future conservation acquisitions. This is also advantageous because they were successful in negotiating low sale prices, meaning future acquisitions by TPL, OCTA or others for conservation purposes will benefit from these sales.

The prices have increased significantly in just 10 years, suggesting that during the Great Recession, developers were no longer processing developments through cities or the county because they too were impacted by the downturn and no one was buying, selling or building houses. OCTA had an incredible advantage. Now several of the same properties OCTA was looking to acquire are being processed for residential development by the local jurisdictions. In other words, the land values will begin to increase as the economy strengthens and the land stock will decrease.

Some caveats to this overall assessment are warranted. First, a variety of reasons may explain why land can be appraised at or sell at different prices. These may include:

- Appraisal standards
- Funder requirements
- General Plan or Specific Plan designations
- Zoning
- Private party vs. government/non-profit sales
- Listing price vs. actual sale price
- Timing
- Entitlements (i.e. rights to develop)
- Access to infrastructure (services, roads, sewers, power, etc.)
- Highest and best use of a property
- Location and access (ingress/egress)
- Needs of the seller or buyer (short sale, bargain sale or donation opportunities)

This review of acquisition price details points to important lessons for advanced mitigation programs. Land prices are increasing and the following factors seem to influence the prices:

- Timing (earlier acquisition can avoid cost escalation)
- Availability of land (as time passes, natural land inventories are likely to decline)

- Availability of larger parcels decrease (as time passes, the availability of larger parcels is likely to decline)
- Availability of specific habitat types (as time passes, the variety of available habitat types is likely to decline)
- Entitlements are received (acquisitions prior to entitlement approval are more cost effective)

OCTA aptly recognizes that it came into the market at an opportune time, just as land values were decreasing and availability of land was increasing. It took three years to establish the EMP and then acquire the first property, just as prices were at their lowest. Some properties, as noted above, were 25 percent lower than in previous conservation transactions. Timing, availability, size, strategy, and lack of entitlements are key to keeping costs low and ensuring the biggest value for the investment.

Appendix A: Methodological Review for Assessing Advance Mitigation Benefits

This technical appendix summarizes the various methodologies that have been used to quantify the costs and benefits of state and local advance mitigation programs.

SANDAG TransNet Extension Mitigation Cost Estimates

In 2004, SANDAG prepared an analysis estimating the costs of mitigating the impacts of the *TransNet* Extension projects. *TransNet* includes an advance mitigation approach, so these estimates were used to create a budget of the funds to be used for advance mitigation for all of the projects planned under *TransNet*. The analysis employed two different methodologies to estimate costs for the final budget of the program: a basic habitat cost estimate based on historical average habitat costs, and an enhanced habitat cost estimate based on the per acre impact of each project.

The basic habitat cost estimate is based on historical average habitat costs. To calculate these historical averages, 29 completed highway projects and three completed transit projects were identified and each was classified as having high, medium, or low habitat impacts. The basis of these classifications is unclear, though they are likely based on the expert opinion of planners familiar with the projects, based on overall impacts and complexity of mitigation needed. The range of years over which these 29 projects were sampled is also unclear from SANDAG's methodology. Habitat costs were then calculated as a percentage of total project cost and these percentages were averaged across the high, medium, and low categories. This led to standard habitat cost shares of 9% for high impact projects, 3% for medium impact, and 1.5% for low impact projects. Standard rates were then applied to each *TransNet* Extension project, based on its own impact rating. In some cases, particularly at the lower end of impact ratings, smaller percentages such as 1%, 0.5%, or 0.2% were applied to the *TransNet* Extension projects, based on individual circumstances, if the standard percentages were deemed inappropriate. Calculating habitat costs in this way led to a total cost estimate of $180 million, which includes land acquisition and restoration costs, but does not include endowment costs.

The enhanced habitat cost estimate is based on more detailed estimates of habitat impacts for each project, taking into account both differential costs across types of habitat impacted and endowment costs for ongoing mitigation management. First, habitat impacts were estimated for each project across three main habitat types—coastal wetlands, non-coastal wetlands, and uplands—and totals were taken across all projects for each of the three habitat types. Wetlands include open water, marsh, riparian, seep, and vernal pools, and uplands include coastal sage scrub, chaparral, grassland, and forest. For the three main habitat types, average acquisition, restoration/creation, and endowment costs per acre as well as mitigation ratios were estimated based on historical averages for past transportation projects. It is not clear from the methodology over what range of years these past transportation averages were created. These were then applied to the total acres of impacts for each of the three habitat types to arrive at a total estimated habitat cost of $379 million. This figure, unlike the basic habitat cost explained above includes endowment costs.

It should be noted that the analysis was completed in 2002 dollars, and no escalation factors were included in the analysis to account for increasing costs over time.

Oregon Bridge Deliver Program Cost-Benefit Analysis

Oregon DOT along with the Oregon Bridge Delivery Partners undertook a study in 2008 to quantify the benefits of Oregon's OTIA III State Bridge Delivery Program's programmatic permitting process. This study is unique in that it attempts to calculate a ROI or Return on Investment for implementing the Bridge Delivery Program by using a probabilistic approach. This is one of the most methodologically advanced approaches to evaluating an existing program. However, because of this is it also the least easy to understand for a general audience. Overall, the study concluded that as of 2008 the programmatic permitting process used for the OTIA III State Bridge Delivery Program had realized savings of more than $73 million over the traditional permitting process (Oregon DOT 2008, p. 1).

Their study identifies four categories of benefits to be quantified:

1. Reduced costs of obtaining permits;
2. Reduced costs to complete NEPA reviews;
3. Reduced costs to provide wetland and habitat mitigation; and
4. Reduced costs to complete bridge designs.

Category number 3 is the only benefit directly related to advanced environmental mitigation. The other categories of benefits stem from the programmatic or procedural streamlining aspects of the Bridge Delivery Program, and though some of these benefits may apply to other advance mitigation programs, here we will focus on the methodology for quantifying the direct benefits of providing wetland and habitat mitigation. The reduced costs of providing wetland mitigation under category 3 were realized from the establishment of ODOT-developed mitigation banks that could offset expected levels of environmental impacts program wide.

To arrive at estimates of program benefits, the study used actual historical data as well as mutually agreed-upon values reached by consensus. An expert review panel (ERP) was assembled from experts at Oregon DOT and Oregon Bridge Delivery Partners. The ERP helped identify available data sources that should be used in the model of costs and benefits, and came to consensus on appropriate value ranges to be used in cases where historical data was not available.

The estimate of the reduction in costs for wetland/habitat mitigation is based on a probabilistic approach that takes the product of the reduction percentage, the raw cost per acre of mitigation, and the number of acres required. The reduction percentage was a random variable that included a wide range of possibilities. However, the majority range from 9 percent to 15 percent. This category of cost savings along with the other categories enumerated above were combined with five categories of the costs to come up with an ROI for the base case with no streamlining system and for the alternative case with the permit streamlining system in place, in both the construction and design phases. For the base case, actual historical data was used for projects from the start of the program until roughly June 2009. Future costs that were unknown were forecasted based on prior project data and timeline.

Using agreed upon data, economic modeling was then carried out using Monte Carlo simulation. The Monte Carlo method uses repeated random sampling from the range of possibilities to arrive at an expected value and range for the overall return on investment (ROI) values. The 'reduction percentage' used to calculate savings under the advance mitigation program was one of the dimensions of the Monte Carlo simulation. It was modeled and sampled as a Pert distribution, which authors deemed more representative of the normalized range of the aggregated outcomes across the projects. Simulations were carried out over one million times to arrive at 90% confidence intervals for the different categories of ROI.

90% Confidence Interval			
Output	**Lower Bound**	**Mean**	**Upper Bound**
Total Benefit-Cost Ratio Base	0.27	0.75	1.82
Total Benefit-Cost Ratio Alternative	1.73	3.19	5.25
Base Case Design Benefit-Cost Ratio	0.04	0.07	0.11
Alternate Case Design Benefit-Cost Ratio	1.43	2.86	4.89
Base Case Construction Benefit-Cost Ratio	0.20	0.68	1.76
Alternate Case Construction Benefit-Cost Ratio	0.10	0.32	0.67

(Source: Oregon DOT 2008)

Florida DOT Wetland Mitigation Program

Under Florida DOT's Wetland Mitigation Program, the DOT identifies transportation mitigation needs and funds mitigation activities, while the actual mitigation is carried out by the state's Water Management District (WMD). The fee structure under which FDOT makes payments to the WMD for mitigation activities is established in statute. It uses a simple lump sum of $75,000 per acres, multiplied by the number of projected acres of impact identified in FDOT's environmental impact inventory. (The fee of $75,000/acre was derived from estimates of the historical average cost per acre that FDOT had spent on project-by-project basis in the early 1990s.) State law also stipulates that the cost per acre shall be adjusted annually to reflect change in the average of the Consumer Price Index. The current CPI-adjusted costs per acre used by FDOT for making payments to DEP and the WMDs are below. (The first year is the CPI adjusted cost, and the remaining years reflect an estimate for programming future year payments.) (Florida Department of Transportation, 2013, Part III, Ch. 11.)

FISCAL YEAR	COST PER ACRE
2013/14	$ 109,599
2014/15	$ 111,426
2015/16	$ 112,810
2016/17	$ 114,669
2017/18	$ 116,756
2018/19	$ 118,912

(Source: Florida DOT 2013, Part III, Ch. 11)

Lump sum payments to the WMD are intended to fund all mitigation costs, "including, but not limited to, the costs of preparing conceptual plans and the costs of design, construction, staff support, future maintenance and monitoring the mitigation areas" (Florida DOT, 2013, p.7).

Florida Efficient Transportation Decision Making Program

In 2012, Florida DOT undertook an evaluation of its Efficient Transportation Decision Making Program, covering the period from 2009 to 2011. Although not an advance mitigation program in itself, it is intimately related to the Wetland Mitigation Program addressed above, and is one of the few programs to attempt a systematic quantification of time savings associated with process streamlining. The methodologies used by district offices to quantify savings, however, differed from office to office and were not clearly described in the final report.

The evaluation was an attempt to determine whether the FDOT made a significant return on the sizable investment made in the program, by quantifying program savings and costs. The results are based on the 2010 ETDM Biennial Survey of the FDOT district offices and a number of organizations that make up an Environmental Technical Advisory Team (ETAT). All 20 district offices and 17 of the 20 ETAT members responded to the survey. The assessment covers all projects screened at the planning or the programming stage from October 2004 and October 2011, a total of 521 screens for 496 unique projects. Districts each applied their own methodology to estimate average cost and average time to produce an environmental document or individual technical study, on a per project basis. Although these individual methodologies are not outlined in the FDOT analysis, they are likely based on expert opinion within the agency as opposed to a more rigorous approach to quantification. A more consistent methodology across districts is under consideration for future assessments.

Including costs of program implementation, the assessment arrived at a cumulative cost savings of $26.1 million and a time savings of 805 man-months.

Cumulative Comparison Projects Completing a Screening between Oct. 2004 – Oct. 2011				
District	Projected Savings		Projected Savings	
	Dollars	# of Months	Dollars	# of Months
D1	$17,980,000	528	$1,376,000	269
D2	$50,000	1	$0	0
D3	$2,735,000	72	$2,631,000	90
D4	$14,622,000	336	$0	0
D5	$11,844,000	143	$0	0
D6	$14,030,000	230	$780,000	153
D7	$768,520	10	$91,000	3
Turnpike	$0	0	$0	0
Total	$62,029,520	1,320	$4,878,000	515
Total Projected Screening Savings (=Projected Savings-Projected Increase)				$57,151,520
Cumulative Program Administration (2000-2011)				$31,064,176
Projected Net Savings (=Total Projected Screening Savings-Cumulative Program Administration)				$26,087,344
Project Savings/Avoidance in Man Months				805

(Source: Florida DOT 2012)

Appendix B: Calculating Caltrans Mitigation Costs with PRSM

The Project Resourcing and Schedule Management (PRSM) is valuable to this study as a tool for viewing project-by-project detail on staff time (represented in hours and dollars) devoted to activities related to environmental mitigation, as well as detail on the time required for key phases of the project delivery process.

PRSM a database and user entry system to track scheduling and timekeeping of Caltrans projects, including staff time resources used for each step of the project development and delivery process. Project managers input into PRSM estimates of labor hours and schedules needed to complete the array of project tasks and supporting activities needed to deliver a project. Caltrans staff use PRSM to report time spent on project tasks, allowing project managers to examine project costs incurred to date and to forecast final costs by project phase.

PRSM is a dynamic database, with new projects entered into the system on a rolling basis. When projects are complete and have reached financial close-out, their associated records remain in PRSM. (In contrast, the STEVE system moves records for completed projects to an archive database.) Launched in 2010, PRSM replaced Caltrans previous project management system. At that time, records for all then active and some recently completed projects were imported into PRSM. Thus, while PRSM is a robust platform for capturing project delivery detail on projects from 2010 onward, its historical reach is limited.

The view of Caltrans operations that is available from PRSM relates directly to the agency's highly detailed "Work Breakdown Structure" (WBS). The WBS catalogues the entire array of project components and task activities in which Caltrans staff might engage to conduct the agency's business delivering a project, product, or service. Project elements and activities and their associated WBS reporting codes, used by staff to log hours in PRSM, are delineated in a 273-page manual (Workplan Standards Guide for the Delivery of Capital Projects Release 10.2).

The WBS catalogues project activities at different levels of detail, with each descending level representing a more detailed definition of activities and subtasks involved in a project component. For instance, Level 6 is more granular than Level 5, and Level 7 more detailed than Level 6. Level 5 is the *minimum level of detail* at which Caltrans project managers and staff must account for time spent on a project, but decisions about the level to which Caltrans' district staff will report their time (whether Level 5, 6 or higher) are made at the district level. This policy reflects the fact that managing larger, more complex, and more costly projects can require greater differentiation among project tasks and subtasks than does managing smaller projects.

The varying levels of task specificity to which project data are recorded create inherent limitations for analysis. First, this precludes comparison of Caltrans' project management data across all projects at a uniform level of detail. Second, seeking more specificity about task activities typically requires sacrificing a greater number of overall records in any analysis. Being the minimum required reporting level, Level 5 typically boasts the larger number of records with real data. Level 6 is more specific than Level 5, and Level 7 more detailed than Level 6, but querying data to capture further detail usually returns fewer records. Third, data reported at each level are independent of data reported at other levels. That is, the more detailed, lower levels do not nest within higher, more aggregate levels. Thus, one cannot assume that Level 5 data represent the sum of data on further differentiated tasks at Level 6. If staff report time on a project at Level 6, time would not also be recorded at Level 5 for that task. For example, if staff reported 10 hours of time for task 165.05 (Level 6) and 5 hours of time for task 165.10 (Level 6), there would not be 15 hours of time reported for task 0.165 (Level 5) in PRSM.

Universe of records in this analysis. We used PRSM data downloaded by Caltrans staff on May 1, 2014, and transmitted specifically for this analysis. This dataset contained nearly 44,000 records, representing over 4,600 unique projects identified by distinct expenditure authorization (EA) numbers. In the dataset are projects that were initiated as early as May 1986 (although a few outliers reported start dates in the 1930s and '40s) and that are estimated to be complete as late as the year 2029.

We sought first to study the subset of projects that were already completed and thus had reached financial closeout. By selecting records with a finish date of May 1, 2014, or earlier, reflecting the date of data transmittal from Caltrans, the data consisted of 20,516 records representing 3,704 unique projects, with distinct EA numbers. These projects had been initiated as early as May 1986 and were all completed as of May 1, 2014.

This analysis uses data reported at Levels 5 and 6 as defined in the work break-down structure. Recall that Level 6 falls one below, and hence is more specific than, Level 5. Recall further that Level 6 data do not nest within Level 5, and thus do not sum to match Level 5.

Appendix C: SR-76 Middle Advance Mitigation Costs & Benefits

SR-76 Corridor and All *TransNet* Regional Projects (Highways & Transit)
All costs in 2002$

Mitigation activity cost/acre	coastal wetland	non-coastal wetland	upland		
Acquisition	$300,000	$50,000	$60,000		
Restoration	$300,000	$125,000	$60,000		
Endowment	$10,000	$10,000	$5,000		
Total mitigation cost / acre	$610,000	$185,000	$125,000		
Mitigation ratio	5	3	2		
Acres of impact, estimated					
Acres impact (All *TransNet* Hwy & Transit)	45	165	799		
Acres impact (SR-76 Middle)*		25	60		
Acres impact (SR-76 East)		45	110		
Acres of mitigation need, estimated (w/ ratio)					
Acres mitigation (All *TransNet* Hwy & Transit)	225	495	1,598		
Acres mitigation (SR-76 Middle)		75	120		
Acres mitigation (SR-76 East)		135	220		
				Estimated Mitigation Cost (Enhanced Approach)	**Share of Estimated Economic Benefit**
Cost (All *TransNet* Hwy & Transit)	$137,250,000	$91,575,000	$199,750,000	$428,575,000	$120,000,000
Support cost (5%)				$21,428,750	
***TransNet* Mitigation**				$450,003,750	
Cost (SR-76 Middle)	-	$13,875,000	$15,000,000	$28,875,000	$8,084,933
Cost (SR-76 East)	-	$24,975,000	$27,500,000	$52,475,000	$14,692,878

Sources:

- *TransNet Extension Habitat Cost Estimate*. SANDAG. Memo. February 9, 2004
- *Amended and Restated Memorandum of Agreement (MOA) 5000879*. SANDAG, CDFW, Caltrans, and USFWS. Regarding the Mitigation for Transportation Projects under the *TransNet* Extension Ordinance Environmental Mitigation Program. 2013.

Appendix D: SR-76 Middle Impacts – Estimated & Actual

		Estimated (in *TransNet* Ordinance & MOA)					Actual (*TransNet* Dashboard)	
Project	**Habitat impacted**	**Acres Impacted***	**Mitigation Ratio***	**Acres Needed***	**Estimated Advance Mitigation Cost****	**Economic Benefit****	**Acres Needed (actually purchased)**	**Actual mitigation acquisition expenditure**
SR-76 Middle	Upland	60	2	120	$28,875,000 (2002$) $ 36,177,194 (2013$)	$8,084,933 (2002$)	121	$19,588,449 (2013$)[+]
	Non-coastal wetland	25	3	75			149	

**TransNet* Habitat Cost Estimate (2004)
**SANDAG *TransNet* EMP Mitigation MOA (2013), Attachment B.
+ We arrive at this figure by converting to 2013$ the total $18,233,593 in acquisition costs from expenditures in different years for the Groves, Morrison, and Zwesteria properties.

SR-76 Middle Biological Impacts	
Impact	**Extent**
ACOE Jurisdictional Waters Impacts Permanent	0.75 ha (1.83 ac)
CDFG Jurisdictional Waters Impacts Permanent	6.62 ha (16.35 ac)
Arroyo Toad (permanent and temporary, direct and indirect impacts)	4 populations
Coastal California Gnatcatcher (permanent and temporary, direct and indirect impacts)	3 pairs
Least Bell's Vireo (permanent and temporary, direct and indirect impacts)	12 pairs, 12 individuals
Southwestern Willow Flycatcher (permanent and temporary, direct and indirect impacts)	1 migrant
Coastal California Gnatcatcher Critical Habitat (permanent and temporary impact acreages)	18.41 ha (45.5 ac)
Southwestern Willow Flycatcher Critical Habitat (permanent and temporary impact acreages)	13.27 ha (32.78 ac)
Least Bell's Vireo Critical Habitat (permanent and temporary impact acreages)	14.03 ha (34.69 ac)
San Diego Ambrosia (indirect impact only)	1 population

(Source: *State of California DOT 2008)*

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