Project Memorandum #7: Cost Allocation Issues

June 14, 2016

INTRODUCTION

As described in Project Memorandum #1, Delta levees depend on a mix of federal, state, and local funding. Some funding for project levees comes from the U.S. Army Corps of Engineers (USACE), with state cost-sharing requirements. State funding comes primarily from general obligation bonds. Local agencies, such as reclamation districts, assess local property owners for the costs of maintaining and improving levees, however, such assessments do not cover the full costs of levee improvements. Consequently, local agencies rely on state and federal funding for both project and non-project levees.

Funding for Delta levees is in transition. The U.S. Army Corps of Engineers recently found that structural flood risk management projects in the Delta were not economically justified, creating uncertainty about future federal funding for levee improvements.[1] State general obligation bond funds, which have historically paid for levee improvements and maintenance, are running out. And although the principle of "beneficiary pays" has long been discussed as a basis for paying for water infrastructure, the State has not adopted policies or principles for an alternative to bond funding for Delta levees.

Legal constraints on financing mechanisms (assessments, fees, taxes, etc.) dictate which cost allocation methods could be used to collect revenue from various beneficiaries of Delta levees. Where legal constraints create inconsistencies in cost allocation methods, structured stakeholder negotiation leading to legislative action will be necessary. Applying a beneficiaries-pay based approach raises the important policy question of whether the State should adjust its cost share formulas to be consistent with the cost allocation and financial mechanisms that can be used at the local level. Appendix A describes different methods used for cost allocation based on economic principles and policy practices.

Table 1 illustrates current financing of levees and implicit cost allocation among beneficiaries, along with a "beneficiaries-pay" approach that would redistribute cost responsibility. The current cost allocation approach explicitly recognizes only local landowners and agriculture as beneficiaries of Delta levees, and they pay directly for levee improvements and maintenance by assessments or taxes paid on the land. Other beneficiaries of Delta levees are lumped together in the "all else" category, which is paid for by public funds. Under a beneficiaries-pay approach, the different public benefits of levees would be estimated separately; similarly, private benefits would be identified and linked to beneficiaries where administratively feasible. Examples of beneficiaries that receive private benefits, which may be subject to a levy under beneficiaries-pay, include water suppliers and users, cross-Delta infrastructure, and recreationists.

[1] U.S. Army Corps of Engineers, Delta Islands and Levees Feasibility Study, April 2014.

Table 1

Flood Protection Cost Allocation to Beneficiaries		
Source of Funding	Current Approach	Beneficiaries-Pay *% Responsibility are illustrative*
Public financing (State / Federal)	"All else" (as much as 75%)	Public safety (e.g. 10%) Habitat (e.g. 20%) Indirect economic (e.g. 10%)
Assessments, Special taxes, User fees, Regulatory charges, etc.	Agriculture and Local residents /businesses (25% or more)	Agriculture (e.g. 20%) Local residents/businesses (e.g., 5%) *Water supply (e.g. 15%)* *Infrastructure (e.g., 10%)* *Recreation (e.g., 10%)*

This study's approach to identify and screen finance options involves three interconnected, iterative steps to collect data and develop information on costs, benefits, and finance options, as follows:

1. Determine funding requirements (i.e., what cost needs to be covered?)
2. Identify possible financing mechanisms and associated structure (i.e., how will a levee project or investment program be paid for over time?)
3. Identify and assign cost responsibility (i.e. who pays and how much?)

This memorandum discusses step three, the assignment of cost responsibility, and summarizes the legal considerations affecting cost allocation and finance mechanisms. It begins by describing where cost allocation fits into the analysis of the feasibility of a beneficiary pays-based approach to financing levee improvements. It describes the disconnect between the federal/state and local approaches to sharing costs for levees, and the legal constraints that apply to cost allocation at local level depending on the type of charge, tax, levy, assessment or fee. It then describes additional issues that will need to be addressed after this feasibility study in order to implement a beneficiary-pays based approach to financing Delta levees.

WHY IS COST ALLOCATION NECESSARY?

Flood protection, like national defense, creates benefits that cannot be easily divided among beneficiaries. Levees that protect one resident or parcel from floods also protect neighboring residents and parcels. In such situations, standard marketplace conditions do not exist—there are no transactions that set market prices, which would allocate costs among beneficiaries. Some other mechanism must be used to assign the total costs of flood protection to the various beneficiaries (both local and remote).

Although we cannot use markets to allocate costs through prices, we can still apply market principles to allocate cost responsibility. The core principle of this study is that beneficiaries should pay for total costs in a manner that is both transparent and proportionate. If beneficiaries pay only for a portion of the costs, the resulting public subsidies can lead to undesirable results, such as excessive development in flood plains.

This memorandum summarizes the several methods available for allocating costs consistent with the beneficiary-pays principle. These methods generally differ in their reliance on *costs* of protection versus the *benefits* derived from that protection. Selecting a cost allocation method requires consideration of equity, implementation feasibility, or other operational criteria.

We anticipate that implementing a beneficiary pays-based cost allocation will require political calculations and negotiation among stakeholders. The methods described herein are intended as potential starting points to help structure those negotiations.

THE CURRENT TWO-STAGE COST ALLOCATION PROCESS

The existing cost allocation process entails two stages: the first stage divides *costs* among government entities, and the second stage allocates cost responsibility among local taxpayers based on *benefits* (or other criteria, depending on whether the revenues are to be collected via assessment, special tax, user fees, etc.)[2] Figure 1 displays this two-stage cost allocation process for project levees, and Figure 2 displays the process for non-project levees. More specifically:

- In stage one, shares for federal, state and local government contributions must be determined in the aggregate (not yet allocating the shares applicable to individual beneficiaries). This is done by applying state and federal cost share formulas (see Project Memorandum #1, Table 2).
- In stage two, the remaining local share of costs is allocated to individual beneficiaries, consistent with legal requirements. As described in Project Memorandum #2, Propositions 13, 218, and 26 and associated case law restrict how cost responsibility can be allocated, depending on the type of charge, fee, tax or assessment used to collect the revenue. Other constraints apply to local agencies such as special districts or counties.

[2] DWR has developed several reports and guidelines on cost-sharing with various beneficiaries, including: Department of Water Resources, Division of Flood Management, "Cost Share Guidelines for State-Local Cost Shared Flood Programs and Projects," Adopted to Comply with AB 5, Sec. 26, Cal. Water Code § 9625, Final, December 11, 2014; Department of Water Resources, Delta Suisun Marsh Office "Delta Levees Special Flood Control Projects, Near-Term Guidelines for Providing Funding to Local Public Agencies," Final, February 2010; Department of Water Resources, Delta Levees Maintenance Subventions Program, "Guidelines: Procedures and Criteria," Draft, September 30, 2015; and California Department of Water Resources, "Economic Analysis Guidelines," January 2008.

Figure 1

Current Flood Protection Cost Allocation Process
Project Levees

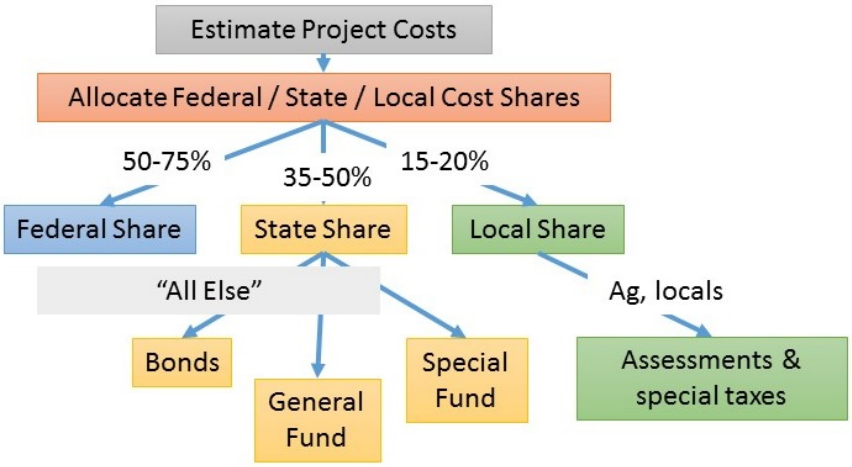
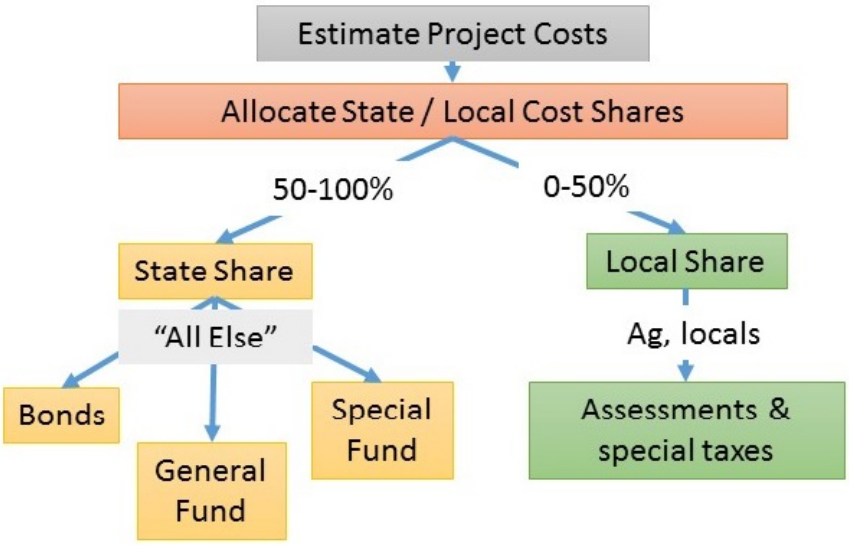


Figure 2

Current Flood Protection Cost Allocation Process
Non-project Levees



Disconnect between Federal/State and Local Cost Allocation Methods

The cost allocations used for the first stage may not match those in the second stage. This results from discrepancies between the state and federal approach to setting cost shares and the state's rules that govern cost allocation for local financing purposes. In particular,

reclamation districts (which are limited to using assessments) must identify the *general benefits* that accrue to the public at large (including state and federal beneficiaries), as well as *special benefits* that accrue to individual property owners. By contrast, the federal cost share of levee projects is 50 to 75 percent for projects that meet federal purposes, with higher shares for projects that protect urban areas. The federal method relies primarily on distinguishing the different costs of flood protection for different *purposes*, while state assessment law requires that local cost allocation must be proportionate to the *special benefits* derived from the project, which may be unrelated to actual costs.

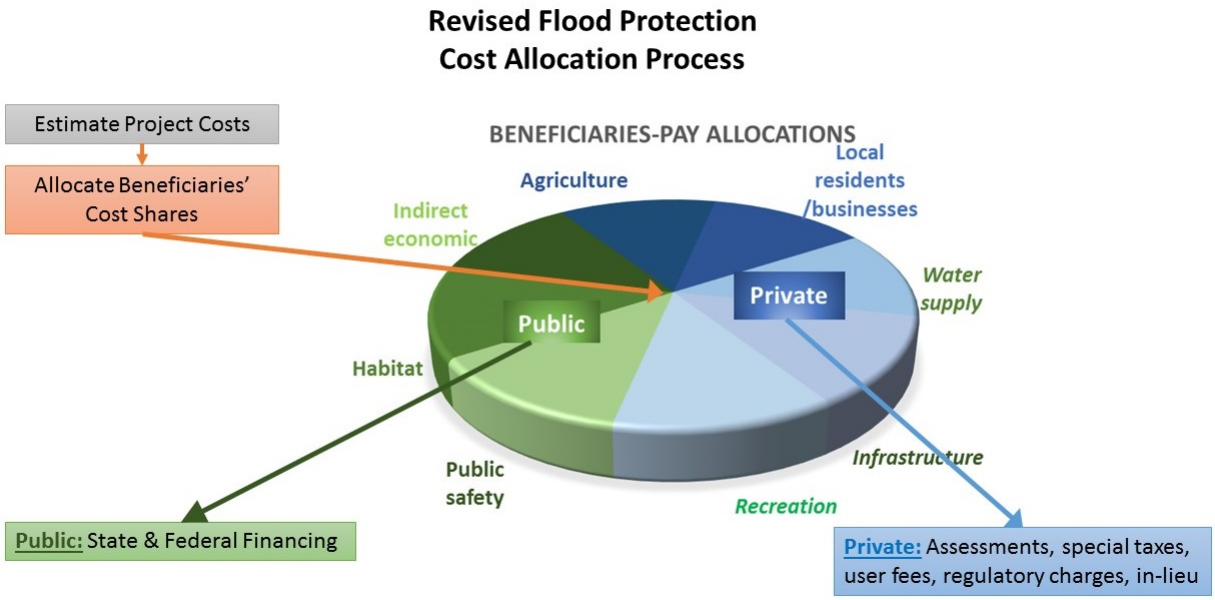
A similar approach cost-based approach sets the State's share as well. Water Code Section 12986 fixes the State's share of Delta levee maintenance and improvement projects at "no more than 75 percent of any costs incurred in excess of $1,000 per mile." In effect, the state formula assumes that the *general* benefit of levee projects is always 75 percent of costs above $1,000 per mile, without regard to the benefits derived by beneficiaries other than the local property owners. The State cost-share formulation does not consider general or special benefits, only costs. However, Proposition 218 and associated case law requires reclamation districts to base their cost allocation on special and general benefits derived from a project.[3] This disconnect in cost allocation methods can cause situations in which local agencies may have difficulty meeting the cost responsibility determined by state and federal cost share formulas.

USING "BENEFICIARIES PAY" FOR COST ALLOCATION

Figure 3 illustrates the shift to a beneficiaries-pay approach. Rather than starting with the allocations among government agencies embedded in law and practice, the beneficiaries-pay approach identifies the benefits accruing to various beneficiaries (see Project Memorandum #5 for the categories of beneficiaries) and matches financing mechanisms with those beneficiaries. Public benefits (such as habitat or "Delta as place") and indirect benefits to the state economy accrue to broadly groups of beneficiaries, against whom it is difficult to apply a specific levy or charge. Such beneficiaries pay for their share of levee costs through state and federal funds, such as the general fund or bonds. Private benefits, such as flood protection to land and structures, accrue to beneficiaries that can be identified, and charged a tax or user fee directly. Private beneficiaries who now pay indirectly through state and federal contributions include water suppliers and users, cross-Delta infrastructure, and recreationists (highlighted in the figure below).

[3] A more detailed discussion of ability to pay issues will be presented later in this study.

Figure 3



A key part of this study is to look more closely at the "general" and "public" benefits, and at the federal and state cost shares implied by those types of benefits. Currently, those benefits are often not rigorously identified and quantified. Project Memorandum #5 and its supporting documentation add specificity to those types of benefits. The cost allocation process described herein, and applied to the archetypes in subsequent study memoranda, will test what are the appropriate levels of general benefits in those types of settings. It also will identify to what degree a disconnect exists between the cost allocations developed in the first and second stages.

This feasibility study has adopted the following guidelines for selecting a beneficiaries-pay cost allocation method:

- Follow a benefits-based approach as applicable under current law or consistent with economic principles where federal or state law does not set specific guidelines;
- Promote cost allocations that encourage participation; and
- Promote cost allocations that avoid or minimize unintended subsidies.

Other criteria for selecting a cost allocation method would need to be considered in implementing a beneficiaries-pay based approach. These could include:

- Achieving equitable allocations that reflect the circumstances of beneficiaries and other parties,
- Ease of application and administration, and
- Reliability of revenue collection over time.

Determining whether allocations are equitable is "in the eye of the beholder" and may not be resolved until a more detailed analysis can be conducted, and the outcome examined by stakeholders and decision makers. Ease of application and administration will depend on data

and resources available when a mechanism is implemented (ease of understanding by decision makers and affected parties falls into this category). Reliability of revenue collection will depend on the underlying economics of the asset or activity being charged—for example, does agricultural land value remain steady? How much do water deliveries vary?

FINANCING MECHANISMS AND CORRESPONDING COST ALLOCATION METHODS

Allocating cost responsibility among beneficiaries and taxpayers mostly occurs within a local jurisdiction, e.g., a reclamation district or a county. However, some beneficiaries (as described in Project Memorandum #5) such as water contractors benefit from the channels created by the levees, but they do not own property or assets within the jurisdiction of the reclamation districts that maintain those levees. This study explores the mechanisms that may be appropriate for collecting revenues from those types of beneficiaries.

Project Memorandum #2 described the various local and state government financing mechanisms available in California. In applying a beneficiary pays-based approach, the law governing the type of financing mechanism would determine the cost allocation method. For example, assessments are based on relative *benefits* while property-related fees are based on relative *costs of service*.

To summarize, the available local and state government financing mechanisms and their implications for cost allocation are as follows:

Assessments

Assessments are based upon and levied in accordance with benefits to the affected property by the governmental service or activity funded by the assessment. Most relevant to cost allocation, Proposition 218 requires that only special benefits (and not general benefits) may be subject to assessment. The required engineer's report quantifies the proportional special benefit derived by each parcel. Special benefits are identified as separable from those conferred generally to the surrounding community. For example, a set of parcels may derive a lower risk from flood protection or may be more susceptible to a flood hazard than surrounding parcels. The assessment cannot exceed the reasonable cost of the special benefit conferred upon the parcel.

General and Special Taxes

"Taxes" (General and Special) are charges on real property which historically are not tied to any particular service or benefit provided by the public agency, and require a two-thirds vote of the electorate. In this case, *costs are allocated on the basis of the average tax burden incurred rather than in relation to either benefits or costs for flood protection*. Proposition 26 exempted some fees and charges from the definition of "taxes" (and the 2/3 vote approval requirement); those exemptions potentially relevant to levee funding are charges imposed for a specific benefit conferred to the payor that is not provided to those not charged, or for services provided, subject to a limitation that the charge not exceed the reasonable cost to the government of providing the benefit or service. Levee maintenance could fall within the scope

of "benefits" conferred or "services" provided and would not be curtailed by Proposition 26, although the scope of the Proposition has not been fully litigated.

Property-Related Fees and Charges

These are considered to be any fees or charges *other than* an *ad valorem* tax,[4] special tax or assessment which are imposed by an agency upon a parcel or person as an incidence of (*i.e.*, connected directly to) property ownership. An example is a groundwater augmentation charge fee collected from overlying property owners. Again, the controlling legal authority pertaining to property-related fees and charges was added by Proposition 218.[5] In contrast to assessments, *these fees and charges are allocated based on the costs of providing those services or activities to each particular property*.

User Fees

These services must be separable from direct use of the property itself. Utilities, such as water, sewer and electricity, fall into this category because use varies without direct relationship to the property's characteristics. An example of a user fee in this situation would be a charge per acre-foot diverted or a kilowatt-hour transmitted using facilities that are benefited by a levee. As a general proposition under Proposition 26, user fees cannot exceed the reasonable cost of providing the benefit, service or regulation, and thus cannot be relied upon for general revenue purposes.

COST ALLOCATION METHODS

All of the methods described here reflect a beneficiary-pays approach, and several are already in current use for allocating flood control costs. However, each differs in the ability to achieve different objectives. The candidate methods for cost allocation, described in detail in Appendix A, include:

- Separable-costs remaining-benefits (SCRB);
- Alternative justifiable expenditure (AJE) or equal percentage marginal costs (EPMC);
- Proportionate use of facilities (PUOF) or embedded costs of service (ECS); and
- Benefits-based allocation (BBA).

Federal and state guidelines direct the use of the SCRB method. However, because this method relies on a mix of costs and benefits, it is not consistent with state law requiring application of either a cost- or benefits-based allocation method for particular types of charges, taxes, fees or assessments. The AJE and PUOF methods are cost-based allocations; the BBA is a benefits based method; and the AJE approach is a means of determining benefits by measuring the avoided costs of delivering services, such as flood protection.

Table 2 summarizes applicable legal requirements for the cost allocation methods. Appendix A describes each method in detail. In the next phase of this study, we will evaluate whether the

[4] "Ad valorem" refers to a tax determined as a proportion of property value.

[5] California Constitution Article XIII D, Section 6.

legal requirements for the financing mechanisms, and the associated cost allocation methods, can be satisfied in the archetypes. We will also determine whether sufficient data is available to implement a specific mechanism.

Table 2

Criteria for Selecting a Cost Allocation Methodology		
Financing Mechanism Category	Corresponding Method	Current Prescribed Shares
Federal		
Project Levees	Separable-costs / remaining benefits	50%-75%
State		
Project levees	Separable-costs / remaining benefits (discretionary)	35%-52.5%
Non-project levees	Separable-costs / remaining benefits (discretionary)	75%-100%
Local / State Agencies		
Assessment	Benefits-based / Alternative justifiable expenditures	
General & Special Taxes	Proportionate use of facilities / Alternative justifiable expenditures	
Property-Related Fees and Charges	Proportionate use of facilities / Alternative justifiable expenditures	
User Fees	Proportionate use of facilities / Alternative justifiable expenditures	
Impact Fees	Proportionate use of facilities / Alternative justifiable expenditures	
Regulatory Charges	Agency-discretion (any method)	

ADDITIONAL ISSUES IN IMPLEMENTING BENEFICIARY-PAYS

In addition to the challenges of identifying the complete range of beneficiaries (discussed in Project Memorandum #4) and selecting an allocation method, other issues will arise in developing a beneficiary-pays based approach to paying for Delta levees. These issues are outside the scope of this feasibility study, and will need to be addressed in a more detailed implementation analysis:

Establish agreement on baseline value and incremental benefit from additional flood protection projects. Where beneficiaries and/or stakeholders do not agree on how to characterize the benefit of a project, and no objective test is available to resolve the disagreement, the analytic team should develop a range of cost allocation examples that incorporates differing views. Such scenarios can inform policymakers about the range of potential benefits and associated costs to beneficiaries.

For example, beneficiaries hold different views on acceptable flood risk and the need for improved flood protection, as well as the baseline (point in time) by which to measure the benefits of a project. A farmer may view current flood protection as sufficient while a developer of a new housing project may want a higher level. There may be no objective test to

resolve this disagreement; various projects and cost allocations should be considered to illustrate the financial impacts of the different views.

Include only beneficiaries above a specified threshold. If a beneficiary group receives very small benefits from a flood protection program or levee project, it can be removed from the cost allocation for that program or project. Any implementation studies should document the determination of incidental beneficiary, however. For example, hydropower users could be expected to receive some benefit from improved downstream flood protection because it relieves them of some flood control storage obligation. However, the expected benefits to this group are very small relative to total program benefits, and highly uncertain. They could therefore be classified an incidental beneficiary and not allocated any costs for a specific project.

APPENDIX A: MECHANICS OF ALLOCATING COSTS

We present here a menu of cost allocation methods that our team believes represent a logical starting point for analysis. These methods have been applied in similar situations related to infrastructure investment and regulation. In some cases, these are used currently for allocating flood control costs; in others, they are used to allocate utility costs. The question of which allocation method to use in each situation depends on several factors—legal, economic, physical—that cannot be completely anticipated in this description of methods.

Each of the methods is based on economic principles, legal requirements, and practicality. Each method is a standard practice in certain settings, as described below. As part of the screening of financial mechanisms in the next step of this study, we will evaluate the use of the appropriate cost allocation methods for the five archetypes.

Overview

DWR has been the lead state agency on developing cost allocations for flood control measures, either directly, through the State and Central Valley Flood Protection Boards, or in concert with the Army Corps of Engineers. In its *Economic Analysis Guidelines,*[6] DWR references three different cost allocation methods: Separable Costs-Remaining Benefits (SCRB), Alternative Justifiable Expenditures, and Proportionate Use of Facilities methods.[7] A summary of these three methods is taken from De Souza et al (2011) and each is described in more detail in the next section on "Specific Methodologies":[8]

> *The **Separable Cost – Remaining Benefits (SCRB)** method is a commonly used approach used by State and Federal funding agencies in allocating project costs…In this method, the cost allocation is based on the economic benefits accrued for each purpose and user...The separable cost, which is the added cost for each participant, and proportion of benefits, is used to determine the proportion of joint costs allocated to each user.*[9]
>
> *The **Alternative Justifiable Expenditure (AJE)** approach is simplified version of the SCRB method. Rather than using the separable cost for each purpose, it only uses the alternative cost to construct a project which meets the same objective [e.g., flood*

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[6] California Department of Water Resources, "Economic Analysis Guidelines," January 2008

[7] The guidelines reference that these are discussed in more detail (with some examples) in the draft DWR *Economics Practices Manual*, Chapter VII (1977), but the Economics Practices Manual appears to no longer be readily available.

[8] Sachi De Souza, Josué Medellín-Azuara, Jay R. Lund, and Richard E. Howitt, "Beneficiary Pays Analysis of Water, Recycling Projects," A report prepared for the State Water Resources Control Board Economic Analysis Task Force for Water Recycling in California, U.C. Davis, March 9, 2011.

[9] De Souza, et al 2011, op. cit.

protection]. [10] [The ***Equal Percentage Marginal Cost (EPMC)*** method is a form of the AJE approach.][11]

*The **Proportionate Use of Facilities (PUOF)** cost allocation can be based on non-monetary benefits such as physical benefits or costs caused by each participant.* [12] *Under this methodology, a volumetric water allocation may determine the cost allocation scheme. For example, those using 30% of the water supply would pay 30% of the cost.* [***Embedded Cost of Service (ECS)***, the most common method for setting water and energy utility rates, is a variation on the UOF approach.][13]

In addition to the three methods cataloged in the DWR *Guidelines*, there is ***Benefits-Based Allocation (BBA)***. This method is required under Proposition 218 for assessment districts, which are allowed only to charge for the special benefit that each property receives from a flood protection project. "A special benefit is a particular and distinct benefit over and above the general benefits conferred on real property located in the district or provided to the public at large. The cost of the improvements must be apportioned among the properties being assessed based on the proportionate special benefit these properties will receive."[14] "The assessment rate for each parcel…is calculated by dividing the amount of annual revenue required to support each funded set of projects by the total relative flood damage reduction benefits for all parcels within the benefit zones protected by that set."[15]

General Cost Categories

Cost allocation techniques generally identify three categories of costs: specific, separable, and joint or non-separable (also known as general). As part of the process of allocating costs among beneficiaries, implementing a financing mechanism may require identifying specific, separable or joint.

Specific costs are those costs that can readily be identified with producing a specific product or service. For example, a water recycling facility clearly produces additional water supply and reduces the costs of wastewater treatment and/or disposal. These benefits can typically be traced directly to one or more distinct beneficiary groups.

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[10] De Souza, et al 2011, op. cit.

[11] EPMC is a new method has been developed over the last two decades that draws from optimal commodity taxation. In this approach, the marginal or incremental costs of providing a service or product to each group of customers is calculated, and then the total costs are allocated in proportion to those marginal costs.

[12] De Souza, 2011, op. cit.

[13] Costs are allocated based not on benefits but on physical criteria. In the simplest terms, the level of service to a customer is measured in physical units. Total revenue requirements (i.e.., costs), sometimes specified by customer class, are divided by the appropriate physical unit. For example, "Embedded cost studies rely on the same costs used to determine the revenue requirement — that is, the historic accounting, or actual, costs that the utility incurs — and divide those costs among the customer classes in the various ways…About 30 states rely on embedded cost studies to allocate costs." (Jim Lazard, "Electricity Regulation in the US: A Guide," The Regulatory Assistance Project, March 2011.)

[14] WSP Parsons Brinckerhoff, "SAFCA Consolidated Capital Assessment District No 2, Draft Engineer's Report," Prepared for Sacramento Area Flood Control Agency, February 1, 2016, p. 5-1.

[15] Ibid, p. 5-15.

Separable costs are those costs that can be attributed to providing a particular benefit (or group of benefits) by comparing the cost of the project with and without the components needed to produce that benefit. One common example is a multipurpose reservoir. For instance, assume a reservoir is designed to provide only water supply, and costs $400 million. Then assume the reservoir design can be modified to provide the same level of water supply, but also provide some flood protection, and the new design costs $500 million. The separable cost for providing flood protection at a cost of would be $500 million minus $400 million, or $100 million. Estimating separable costs requires fairly detailed incremental designs and cost estimates of programs / projects.

Joint or non-separable costs are those costs that are neither specific nor separable. These costs are costs that cannot be avoided even if a benefit or subset of benefits is removed from the program's design and operation. For instance, assume the previous example reservoir can be designed and built to provide different levels of flood protection and different levels of water supply levels, all with varying different costs. However, in order for the reservoir to provide benefits in either category it must be built to a minimum size and safety standard, at a cost of $300 million. If the project were built to provide both flood control and water supply, the joint cost would be at least $300 million. In practice, many costs that under ideal circumstances could be estimated as separable are treated as joint costs by necessity. This compromise often results from the many complex interactions among costs and benefits and from the lack of reliable information, and the significant expense required to estimate separable costs.

Specific Methodologies

Separable Cost Remaining Benefits (SCRB) Cost Allocation

The SCRB method distributes costs among the project purposes by identifying separate costs and allocating joint costs or joint savings in proportion to each purpose's remaining benefits. This method is commonly used in many water-resources related projects because the U.S. Army Corps of Engineers selected this method in its guidance manual.[16] When sufficient data exists, the SCRB method follows an economically based approach to allocate costs as follows:

1. **Assign specific costs.** Where possible, the method identifies specific costs and assigns them directly to appropriate beneficiary group (or groups). For example, if recreation facilities are constructed as part of a flood control project, the costs for these facilities are assigned to recreational users. Likewise, if a project component of a project is providing specific services to an identifiable user group (e.g. farmers on a specific island) then the cost for that component is assigned to that group.
2. **Assign separable costs.** Where possible, separable costs are identified and assigned.
3. **Allocate joint costs.** Two or more of the following approaches can be applied to allocate joint costs for each program / project:

[16] U.S. Army Corps of Engineers, "Principles and Guidelines," Retrieved June 9, 2016, http://planning.usace.army.mil/toolbox/guidance.cfm?Id=269&Option=Principles%20and%20Guidelines, 2016.

a. *Allocate joint costs in proportion to economic benefits.* This method assigns costs to different beneficiary groups in proportion to the economic benefits they are expected to receive. This traditional approach has been used often for allocating costs of public projects, and is broadly consistent with the beneficiaries pay principle. In most cases, this approach required an estimate of physical change (e.g., water supply, habitat, water quality) that can be used to produce an estimate of the economic benefits for all major benefit categories. Benefits can then be measured as expected costs avoided if the benefits would be obtained in some other reasonable way. One example is to estimate the costs for each beneficiary (or group of beneficiaries) to develop an alternative project that provides the same benefits.

b. *Allocate joint costs in proportion to physical changes.* This method can be applied when there are quantitative estimates of physical changes which produce the same type of benefit across different beneficiary groups (e.g. increased water supply *or* reduced flood risk). If the program / project is expected to produce jointly different beneficial physical changes (e.g., increased water supply *and* reduced flood risk), the approach does not work because the different types of changes are not directly comparable.[17]

Another situation where this approach can be used is when existing contracts or operational agreements among beneficiaries govern how benefits are divided and costs allocated. An important example is operational agreements between the CVP and SWP on how to divide existing and new conveyance capacity in joint-use.

We can illustrate how SCRB works with two examples:

1. Beneficiaries class A can derive $5 million in flood protection benefits at a cost of $2 million with separate facilities costs of $1 million; beneficiaries class B derives $10 million in benefits with $5 million in costs with separate facilities costing $2 million. Assume total project costs are $6 million.
2. Beneficiaries class A is as above; beneficiaries class C derives $45 million in benefits with $1 million in costs and no separable costs. Assume project costs are $3 million.

In example 1, the separable costs allocated to A are $1 million, and to B $2 million. The remaining $3 million is divided one-third to A or another $1 million and two-thirds to B or $2 million based on relative benefits. Total allocation to A is $2 million and $4 million to B.

In example 2, the separable costs for A are $1 million and none for C. The remaining $2 million is divided 10% to A or $100,000, and 90% to B or $1.9 million. Total allocation to A is $1.1 million and $1.9 million to B.

[17] Assigning dollar values to physical benefits is the usual solution to such situations. However, if economic data is unavailable or unreliable, some other allocation method is needed.

Alternative Justifiable Expenditure (AJE)

AJE begins with identifying the total project cost, as defined in the financial analysis, and the benefits for each purpose, as defined in the economic analysis. For each purpose, the cost of an alternative project resulting in the same benefit is also calculated. The lowest of the benefits and cost of alternative, is selected and used as the justifiable cost. The justifiable cost represents the minimum value each participant should contribute to the multi-purpose project. The specific cost for each purpose is then defined. This value represents the cost of each purpose in the multi-purpose project. By subtracting the sum of the specific costs from the total project cost, the total joint cost is defined. The remaining justifiable cost is then calculated as the difference between the justifiable cost and the specific cost. The sum of all the remaining justifiable costs represents the total remaining justifiable cost. The proportion of the remaining justifiable cost to the total remaining justifiable costs then represents the present distribution for joint costs. Therefore, by multiplying the total joint cost by the representative proportion of remaining justifiable costs, joint costs are distributed among project participants. The total contribution by each party is equal to the specific cost and their proportion of the joint costs. [18]

Using the same examples as for SCRB, in example 1, costs are divided based solely on relative costs. The $6 million cost is then divided 2/7 to A or $1.7 million, and 5/7 to B or $4.3 million. In example 2, the allocations are $1 million to A and $2 million to C.

Equal Percentage Marginal-Cost (EPMC) Cost Allocation

For at least three decades, energy utility regulation in California has been guided by two key principles long accepted in the economics literature,[19] as tempered by equity and environmental concerns. First, in competitive markets, prices are set at the marginal cost of the last firm to enter the market; if higher profits are available, another higher-cost firm will be induced to compete.[20] Yet, it is assumed that "natural" monopolies, such as utilities and government services such as flood control, will exhibit increasing returns to scale, i.e., average costs decrease as total size increases. As a result of this characteristic, representative marginal costs should typically be below average costs; that means that competitive market prices are likely to fall below a level sufficient to cover average costs and firms will not be able to survive. In such situations, competitive markets will not function properly and regulation is likely needed to mitigate undue exercise of market power.

Optimal commodity taxation theory shows that a "second-best" efficient allocation is possible using marginal costs to allocate total average costs proportionately to those marginal costs.[21] In the preferred approach, the marginal costs to serve each customer are calculated as well as the

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[18] De Souza, et al, 2011, op. cit.

[19] *See, e.g.,* Alfred E. Kahn, 1971. *The Economics of Regulation: Principles and Institutions*. New York, John Wiley and Sons, Inc. Decisions 92-12-057 and 92-12-058 rely on Kahn's framework for developing marginal costs and revenue allocation.

[20] This principle holds for all assets and commodities traded in the market, regardless of whether the asset investment appears to be sunk or the asset is bundled with other attributes to create a super-asset (*e.g.*, customer services as part of a building).

[21] This principle was established by Frank Ramsey in 1928 in what is now termed "Ramsey pricing." (Frank P. Ramsey, "A Contribution to the Theory of Taxation," *Economic Journal* 37 (1927): 47-61.)

elasticity of demand for the product or service.[22] The total costs are then allocated in proportion to the relative products of the marginal costs multiplied by the demand elasticities. The challenge with implementing this approach is that demand elasticities frequently are not easily estimated by individual customers or customer groups. So as an alternative based on the notion that all customers have the same price elasticity of demand (*i.e.*, that they all respond equally to price changes), the equal percent marginal cost (EPMC) revenue allocation method has been employed by the California Public Utilities Commission under the assumption that it likely results in the most efficient allocation possible of costs incurred above marginal costs.[23]

The first step of the analysis is to calculate what it would cost to provide incremental (additional) service at the current costs of adding facilities and acquiring additional resources. This may come to more or less than the actual costs, both because of inflation (that is, changes up or down in prices throughout the economy), and because the agency may not have exactly the right mix of resources and facilities to serve its current needs. Marginal cost studies then apportion the revenue requirement between the customer classes, in proportion to the costs each class would pay if the utility expanded, based on the incremental costs of adding to the system rather than the average costs of the existing system. For example, if the total cost of flood protection is $10 million, and the marginal costs to group A is $8 million and group B is $12 million, then the allocation would be 40% or $4 million to group A and 60% or $6 million to group B. About 20 states, including California, use marginal cost studies to set energy utility rates.

Proportionate Use of Facilities and Embedded-Cost of Service Allocations

The Proportionate Use of Facilities and Embedded Cost of Service methods are essentially identical. They each take total project costs and divide those over a physical usage metric to derive an average cost value. For energy utilities this is relatively straight forward, by using units of energy delivered and/or number of customers. For flood protection, it can be more complex because it can be difficult to identify a unit of consumption metric. Acreage or square footage protected could be one such metric.

A disadvantage of this approach is that the economic benefit per unit of water may differ across users, introducing a bias on efficient resource allocation.[24] The use of facilities method is acceptable where the use of facilities is clearly determinable on a comparable basis and where use of this method would be consistent with the basis of project formulation and authorization.[25]

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[22] Elasticity of demand is the amount that the demand for a product or service changes by a customer given a change in the price.

[23] The EPMC method is consistent with the Shapely Value game-theoretic approach described in CALFED (undated), op. cit. The Nucleolus game-theoretic method is not discussed here; however, it is in essence the result of a negotiation process which would be the end-product of any successful cost allocation process.

[24] In the efficiency criteria, a key principle is that all users realize the same value for the last increment used; otherwise they would find it beneficial to trade among themselves to improve their situation.

[25] CALFED, “Cost Allocation Strategy Report,” Discussion Draft, Admin Record C-097696, date unknown, retrieved April 27, 2016.

Embedded Cost of Service

As described in testimony submitted to the CPUC by the Southern California Gas Company, "(t)he embedded cost-based cost allocation methodology uses the [agency's or] utility's recorded expenditures and allocates them to customer classes based on cost causality. Most often, that cost causality is measured in physical units of use of specific facilities. Using embedded costs takes into account the current operations and maintenance costs and the embedded capital costs and the capital planning and implementation costs and, therefore, provides a verifiable cost starting point when allocating costs to customer classes.[26]

The embedded cost method is the least consistent with economic principles of those presented here, but it is relatively easy to implement and fairly transparent in most situations.[27] However, a key issue has been defining "cost causality." Not all beneficiaries use the same physical unit in the same way. For example, a square foot of a barn will not require the same flood protection as a square foot of a factory. This issue in particular has led to the adoption of the other methods described in this study.

In both examples, the allocations are the same as for AJE because the alternative and realized costs are the same, but that may not always be true. In example 1, the $6 million cost is divided 2/7 to A or $1.7 million, and 5/7 to B or $4.3 million. In example 2, the allocations are $1 million to A and $2 million to C.

Benefits-Based Allocation under Proposition 218

The benefits-based allocation method is called for in Proposition 218. It requires distinguishing "special" benefits from "general" or incidental benefits. General benefits accrue to all beneficiaries, including those who may reside outside of the affected jurisdiction. For example, a homeowner can gain protection of the specific structure, and the local economy can generally benefit from avoiding disruption.[28]

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[26] Prepared Direct Testimony of Herbert S. Emmrich, Southern California Gas Company, A.08 02 001, Before the Public Utilities Commission of the State of California, December 5, 2008, p. 10.

[27] See for example Emmrich (2008): "One of the other important advantages of using embedded costs [over the EPMC] approach to allocate costs by customer class is that EC studies exhibit relative computational simplicity. Because marginal costs are estimates, they must be created, requiring a complex process that is based upon numerous assumptions and analyses. Embedded cost allocation methodologies do not create this problem because, by definition, the method is directly linked to recorded historical costs that are known and measurable. Validation is therefore much simpler using recorded embedded costs... [E]mbedded cost allocation studies exhibit relative computational simplicity compared to the [long-run marginal cost] (LRMC) cost studies for two important reasons. First, the embedded cost studies do not contain the types of long-term planning assumptions required in LRMC studies simply because the underlying costs are known with certainty. Second, the embedded cost allocation studies do not require complex forecasting techniques, including computer models and other analytical tools, to derive the starting point for the analysis... Since the embedded cost allocation methodology is based upon the same cost information used to determine the utility's overall revenue requirement, there already exists a strong familiarity with the type and level of costs included in embedded cost allocation studies. Many of these advantages work directly towards streamlining the [cost-allocation] process by reducing the degree of controversy in the selection of the costing methodology and assumptions, minimizing the opportunity for biasing results, simplifying the computational process, and enhancing the level of understanding of the underlying cost allocation theory and methodology. The distinct advantage to using embedded cost is that all of the foregoing benefits are achievable without many of the problems associated with the use of the [California Public Utilities] Commission-adopted LRMC methodology."

[28] WSP Parsons Brinckerhoff (2016), p. 5-1.

To date, these benefits are typically determined through an Engineers Report.[29] "The special flood damage reduction benefit that will be provided to all of the properties in [the jurisdiction] is based on avoidance of damage to structures, to the contents of the structures, and to land."[30] In the allocation method used for assessment districts, the first step is to evaluate potential structure content damage. This involves looking at relative structure values and relative flood depths at the targeted hazard level (e.g., a one in 200 years occurrence). Depth-damage relationships between depth of flooding and damages to structure and contents are then calculated to determine relative benefits. Damages to land values are calculated in a similar manner. The relative shares of special benefits are used to allocate the total revenues across the beneficiaries. "The amount of the annual assessments collected from each project benefit zone is sized to be sufficient to cover the local share of the cost of the improvements protecting that zone and the system operation and maintenance costs associated with those improvements."[31]

But as noted in this passage, the benefits assessed have been limited to property-based purposes such as agriculture, residence and commercial activity. Other beneficiaries such as network utilities with distant users and ecosystem maintenance have not been consistently captured with this method. In cases where a beneficiary does not own property within an assessment district, such water conveyance that relies on the channels created by the levees, the assessment district may not have a means of assessing those beneficiaries. No legal precedent has been yet established on how costs might be allocated to those beneficiaries beyond the boundaries of an assessment district.

In reviewing several recent engineer's reports, their standard approach used three fundamental premises based on the engineer's interpretation of governing legal precedents:

- All parcels within the boundaries of the flood control agency (e.g., a reclamation district) received special benefits that are then subject to assessment;
- The cost shares from the federal and state governments represented an initial estimate of the general benefits accruing to those outside of the agency's jurisdiction, (e.g., up to 75% of costs for the federal share on project levees, and up to 100% for the state share on non-project levees); and
- Certain activities within the jurisdictional boundaries, such as recreating at a local marina, are additional general benefits that are not subject to assessment but to which some costs are allocated.

In example 1, the total cost of $6 million is divided one-third to A and two-thirds to B based on relative benefits. Total allocation to A is $2 million and $4 million to B. In example 2, $6 million is divided 10% to A, and 90% to B. Total allocation to A is $0.6 million and $5.4 million to B.

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[29] Appendix B discusses how benefits assessment for flood protection can differ from other benefit assessments for other types of services.

[30] WSP Parsons Brinckerhoff (2016), p. 5-2.

[31] Ibid, p. 5-15.

APPENDIX B: USING RISK ASSESSMENT TO DERIVE BENEFITS FOR COST ALLOCATION PURPOSES

Flood control benefits differ from those derived from most other infrastructure projects. Unlike a water or energy project, benefits are not tangible products that we can use every day. Instead, benefits are the *avoidance* of a potentially damaging event; the benefit accrues as a counterfactual state in the absence of a flood. Whether such an event will occur is inherently speculative, even if we can attempt to quantify its probability. For this reason, we need to rely on assessing the risk of the event and translating that into a benefit.

For the purposes of our analysis, we define risk as being equal to economic value multiplied by the exposure to flood control failure. Economic value is represented by the capital investment in infrastructure and associated economic activity. This can include activities beyond the usual market transactions, such as recreational and ecological benefits. The owners, producers and consumers of these activities represent the beneficiaries of flood control actions.

Exposure is the probability of failure multiplied by the magnitude of the threat. Threats can range from storm events to sea level rise to earthquakes. The intensity of the threat drives the magnitude. Resiliency of land use can mitigate the exposure; for example, an electric transmission line is much more resilient than a neighborhood, and the proportionate damage from an identical flood event can differ among exposed assets.

Finally, the costs of flood protection should be related to the expected risks avoided. Delta Vision and the Delta Stewardship Council (DSC) have developed a full list of levee types and the land uses appropriate to each type based on risk assessments. Protection must cover the weakest link; cost of protection will be roughly proportional to the miles of levee that must be maintained, repaired or upgraded. Levee quality and the associated repair costs vary greatly by type. The key is to identify levee and land use congruence—is protection commensurate with risk?