REVISED
DIRECT COST ANALYSIS FOR THE PROPOSED POLICY FOR MAINTAINING INSTREAM FLOWS IN NORTHERN CALIFORNIA COASTAL STREAMS

Prepared for:
State Water Resources Control Board
Division of Water Quality
1001 I Street
Sacramento, CA 95814

Prepared by:

CHAMBERS GROUP, INC.
302 Brookside Avenue
Redlands, CA 92373

and

STETSON ENGINEERS INC.
2171 East Francisco Boulevard
San Rafael, CA 94930

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EXECUTIVE SUMMARY

The proposed Policy for Maintaining Instream Flows in Northern California Coastal Streams (Policy) contains permitting requirements for applications to appropriate water by diversion. These requirements may apply to applications that involve direct diversions and both dams that provide onstream water storage and regulatory dams that enable direct diversion or diversion to offstream storage. In particular, Policy requirements would apply to applications that involve: 1) existing unauthorized dams (i.e., dams that divert without a water right permit) that were diverting water prior to the State Water Board's July 19, 2006 issuance of Notice of Preparation for the Policy and 2) new dams that have not yet been constructed.

This report presents an analysis of the potential direct costs to applicants to comply with the proposed Policy. This report evaluates the direct costs of foreseeable methods of compliance but does not include an economic impact analysis. The estimated potential costs represent typical costs based on the professional judgment and experience of Stetson Engineers Inc., R2 Resource Consultants Inc., and Chambers Group Inc. The costs presented in this report are based on the use of outside contractors to provide labor and materials in connection with compliance activities. Three existing onstream dams were selected as case studies for the purpose of aiding in estimating typical costs associated with complying with the Policy. These dams cover a range of sizes and are representative of onstream dams that would be affected by the adoption of the Policy.

The potential costs to the applicants to comply with the Policy would vary widely from applicant to applicant depending on many factors. It is impossible to predict how applicants would choose to comply with the Policy. This report provides estimates of a range of representative typical costs that applicants may incur to comply with the Policy. Additionally, this report identifies possible sources of funding to assist the applicant with implementation costs.

Subsequent to the initial version of this document dated December 2007, the State Water Board received several comments from the public asking that the Draft Policy be revised to describe the site-specific study requirements in more detail. After careful consideration, in response to these comments, Staff revised the Policy to describe the site-specific study requirements in more detail. Staff then re-examined the December 2007 Direct Cost Analysis Report to determine whether or not the estimated cost to complete typical a site specific study should be revised to reflect the more detailed study requirements contained in the Policy. Table 3-4 in this Revised Direct Cost Analysis report presents updated estimated costs that reflect the level of effort that would be required to comply with the more detailed site-specific study requirements described in the revised Policy.

CHAPTER 1 - INTRODUCTION

Assembly Bill 2121 (Statutes 2004, Chapter 943, § 3) added Water Code Section 1259.4 requiring the State Water Resources Control Board (State Water Board) to adopt principles and guidelines for maintaining instream flows in coastal streams from the Mattole River to San Francisco and in coastal streams entering northern San Pablo Bay (North Coast streams) for purposes of water right administration by January 1, 2008. The State Water Board is proposing the North Coast Instream Flow Policy (Policy) in order to satisfy the requirements of the Water Code.

The Policy applies to new and pending water right applications; small domestic use and livestock stockpond registrations; and petitions. The Policy also includes an enforcement element governing water right enforcement in the Policy area. The Policy area covers all coastal streams from the mouth of the Mattole River south to San Francisco Bay and coastal streams entering northern San Pablo Bay. The policy area includes approximately 5,900 stream miles and encompasses 3.1 million watershed acres (4,900 square miles) in Marin, Sonoma, and portions of Napa, Mendocino, and Humboldt Counties, as indicated on Figure 1-1.

This report presents an analysis of the potential costs to applicants to comply with the proposed Policy. This cost analysis is required by Water Code § 13141 which requires, to the extent that the Policy includes agricultural water quality control measures, the State Water Board to estimate the total cost of such measures and potential sources of funding prior to implementation. This report evaluates the direct costs of reasonably foreseeable methods of compliance, such as the costs of preparing permit applications, including required studies and analyses, and implementing fish and habitat protection measures as expressly required by the Policy. This report does not and is not required to conduct an economic impact analysis on potential indirect effects that may arise from the Policy, such as the economic impact developing alternative water supplies.

The Policy requires applicants to provide certain information, developed through studies and analyses, as part of their applications, registrations, or petitions. This information is needed by the State Water Board to determine whether water is available for appropriation, adequate instream flows will be maintained, and habitat will be protected based on regionally protective criteria contained in the Policy. The Policy allows applicants to propose a site-specific study in order to develop site-specific diversion season, MBF, or MCD. In these cases, applicants must provide supplemental information. This should be developed through further detailed studies and analyses and should demonstrate that the site-specific season of diversion, MBF, or MCD would still maintain adequate instream flows and protect habitat at the specific site.

The Policy also requires applicants, in certain circumstances as conditions of the water right permits, to prepare plans and incorporate certain measures or design features into the diversion facility. Finally, the Policy requires periodic monitoring and reporting on the performance of the measures or design features to ensure compliance with the Policy.

The potential costs to the applicants to comply with the Policy would vary widely from applicant to applicant depending on many factors. Because the Policy applies to new permits, it is impossible to predict how applicants would choose to comply with the Policy. Accordingly, this report provides estimated ranges of representative typical costs that applicants may incur to comply with the Policy. The estimated ranges of costs are based primarily on engineering judgment and reasonable expectations. The costs also are based on the use of outside contractors to provide labor and materials in connection with compliance activities. To provide added information on which to base the estimates, three existing dams were selected as case studies. These dams cover a range of sizes and are representative of onstream dams that would be affected by the adoption of the Policy (see Appendices A and B for a detailed discussion of the case study costs). Conceptual layouts and estimated costs for implementing the specific requirements of the Policy were developed for each case study dam. The estimated costs derived from the case studies provided added basis for the development of the estimated ranges of costs. Generally, the estimated ranges of costs bracket the estimated case study costs. Throughout this report, it is

acknowledged that many of the potential costs are subject to variation based on site-specific circumstances.

1.1 SCOPE OF THE ANALYSIS

The scope of this analysis covers the potential costs that pending and new applicants for water right, small domestic use and livestock stockpond registration, and petitions, may incur in complying with permitting requirements set forth by the Policy. In particular, the Policy contains permitting requirements for all diversions, including direct diversions that do not completely block flow and onstream dams. The requirements for onstream dams would apply to both impoundment dams that provide onstream water storage and regulatory dams that enable direct diversions or diversion to offstream stream storage. These requirements would affect: 1) existing unauthorized dams that were diverting water prior to the State Water Board's July 19, 2006 issuance of the Notice of Preparation for the Policy and 2) new dams that have not yet been constructed. As part of coming into compliance by applying for a water right permit, owners of existing unauthorized dams may choose to modify or remove their dams.

1.2 ORGANIZATION OF THE REPORT

This report is organized as follows: Section 2 briefly describes the North Coast Instream Policy. Section 3 presents the estimated ranges of representative typical costs to applicants, including application and implementation costs. Section 4 identifies possible sources of funding to assist the applicant. Appendices A and B provide more detailed information on the three case studies used in this report to aid in developing the estimated ranges of representative typical costs.

Figure 1-1. Policy Area

CHAPTER 2 - DESCRIPTION OF PROPOSED POLICY

The Policy would operate to protect the threatened and endangered anadromous salmonids species and their habitat and other public trust resources in the Policy area by ensuring that water rights are administered in a manner designed to maintain instream flows pursuant to Water Code Section 1259.4. The Policy applies to administration of water rights in coastal watersheds that include all streams and tributaries discharging into the Pacific Ocean from the mouth of the Mattole River south to the San Francisco Bay and all streams and tributaries discharging to northern San Pablo Bay (State Water Resources Board, 2007). The Policy describes the processes by which the State Water Board will use in the administration of water rights within the Policy area to maintain instream flows pursuant Water Code 1259.4.

The Policy would apply to new water right applications, including pending and future applications and petitions, and would contain permitting requirements for all diversions. These requirements would apply to direct diversions and to both impoundment dams and regulatory dams, and would affect existing unauthorized dams that were diverting water prior to the State Water Board's July 19, 2006 issuance of the Notice of Preparation and new dams that have not yet been built.

The Policy would apply certain permitting requirements on diversions using a stream classification similar to the one developed by the California Department of Forestry (CDF: California Code Regulations title 14, section 916.5 table 1):

- Class I: Fish always or seasonally present, either currently or historically; or habitat to sustain fish exists.
- Class II: Seasonal or year-round habitat exists for aquatic non-fish vertebrates and/or aquatic benthic macroinvertebrates.
- Class III: An intermittent or ephemeral watercourse having a defined channel with a defined bank that shows evidence of periodic scour and sediment transport.

The proposed requirements for permitting new diversions, particularly onstream dams, differ depending on the classification of the stream on which the diversion is located.

CHAPTER 3 - ESTIMATED COSTS

This section provides a detailed discussion of estimated potential costs to applicants to comply with the Policy. The costs that applicants would incur are presented in section 3.1. The additional costs that would be incurred by applicants whose diversions include onstream dams are presented in section 3.2. Within sections 3.1 and 3.2, the estimated potential costs for preparing the water right application are presented separately from the costs for implementing the requirements of the Policy.

The estimated potential costs are representative typical costs that would be anticipated based primarily on Stetson Engineers,' R2s,' and Chambers Groups' professional judgment and experience. The costs also are based on the use of outside contractors to provide labor and materials in connection with compliance activities. To provide added information on which to base the estimates, three existing dams were selected as case studies. These dams cover a range of sizes and are representative of onstream dams that would be affected by the adoption of the Policy (see Appendix A for a detailed discussion of the case studies).

3.1 COSTS FOR NEW PERMITS FOR ALL NEW DIVERSIONS

3.1.1 Application Costs

3.1.1.1 Water Availability Analysis

The Policy requires applicants to prepare a water availability analysis (WAA) and describes detailed procedures to be followed in completing the analysis as part of the application for a water right permit. A WAA determines the regional minimum bypass flow (MBF) and maximum cumulative diversion (MCD) for the proposed diversion, evaluates the impacts of the proposed diversion on existing senior diverters located along the stream downstream of the point of diversion (POD), and evaluates the cumulative hydrologic impacts of the proposed diversion on instream flows needed to protect fish habitat. This section provides the estimated cost to prepare a typical WAA. It is important to note that a WAA is currently required and the cost to prepare it is incurred by the applicant: This will continue with or without the Policy.

The estimated cost to prepare a typical WAA is based on the following assumptions:

- The analysis is prepared by a civil engineer with a valid civil engineering license issued by the State of California and a qualified fisheries scientist with experience in evaluating fish habitat conditions. The Policy does not require preparation by an engineer but it is anticipated that most applicants will hire an engineer for this work.
- The analysis requires office work only (no field work) consisting of the following main tasks: (a) research and compilation of records from State Water Board files of senior water rights located within the watershed of the POD and gathering of suitable watershed maps, such as USGS 7.5-minute, 1:24,000-scale quadrangle topographic maps (USGS quads) or digital Geographic Information System (GIS) maps, recorded streamflow data from USGS databases, and other hydrologic data needed for the hydrologic analysis; (b) hydrologic analysis to determine the regional MBF and MCD by calculating mean annual unimpaired streamflow and the 1.5-year peak flow using watershed maps, gathered recorded streamflow data and other hydrologic data, and compiled water rights; (c) hydrologic analysis to evaluate impacts on existing senior diverters by determining appropriated water and computing unappropriated water availability at the POD and at all points of interest (POIs) located directly downstream; (d) hydrologic analysis to evaluate impacts on fish habitat by calculating cumulative hydrologic impacts to spawning and passage flows and to channel maintenance flows; and (e) documentation of the WAA in a report.

The cost to prepare a WAA will vary from application to application depending on several factors, including the following:

- Engineer's working efficiency and hourly rates;
- Size of the stream and geographic extent of the watershed;
- Number of senior water rights; and
- Ready availability of streamflow data and other pertinent hydrologic data, and suitable watershed maps.

The cost to prepare a typical WAA was estimated based on Division records that identify such costs for performing such analyses. The breakdown of the estimated cost is provided in Table 3-.

3.1.1.2 Possible Supplement to the WAA: Determination of the Upper Limit of Anadromy

Under certain circumstances, the WAA may be supplemented by a determination of the upper limit of anadromy. The Policy provides that, for purposes of calculating the regional MBF, the POD is initially presumed to be located within the range of anadromy and the drainage area as measured at the POD is used in the calculation of the regional MBF. But the applicant may choose to overturn this initial presumption by demonstrating that the upper limit of anadromy is located below the POD, in which case the drainage area as measured at the upper limit of anadromy is used in the calculation of the regional MBF, which effectively lowers the MBF. The applicant must provide documentation justifying the location of the upper limit of anadromy acceptable to the Division.

The estimated cost to prepare a determination of the upper limit of anadromy is based on the following assumptions:

- The study is prepared by a qualified fisheries scientist with experience in evaluating fish habitat conditions, as required by the Policy.
- The study involves office work or field work depending on the method that is used (office method or field method). The office method consists of the following main tasks: (1) research previous studies that determined the farthest upstream location known to have anadromy along the POD stream and consultation with federal and state resource agencies; (2) compilation of topographic maps covering the POD stream, including USGS quads or digital GIS maps; and (3) use of the compiled maps to locate permanent, impassable barriers along the POD stream and thereby determine the upper limit of anadromy. The field method consists of the following main tasks: (1) research previous studies that determined the farthest upstream location known to have anadromy along the POD stream; (2) field inspection of the stream channel from the farthest upstream location known to have anadromy to the POD; and (3) documentation of determination in a report.

The cost to prepare a determination of the upper limit of anadromy will vary from application to application depending on several factors, including the following:

- Fisheries scientist's working efficiency and hourly rate;
- Distance from the farthest upstream location known to have anadromy to the POD;
- Method used; and
- The accessibility to the stream and ease of walking along the stream for the field inspection (field method only).

The cost to prepare a typical determination of the upper limit of anadromy was based on R2 staff's experience in performing similar work using the field method under field conditions representative of the Policy area. The breakdown of the estimated cost is provided in Table 3-.

3.1.1.3 Possible Supplement to the WAA: Site-Specific Study

Under certain circumstances, the WAA may be supplemented by a site-specific study. The Policy provides that if the results of the water availability analysis show that the proposed diversion would cause potentially significant impacts to base flows for spawning and passage or high flows for channel maintenance, the applicant may propose site-specific criteria for diversion season, MBF, and/or MCD. If the applicant proposes site-specific criteria, then the applicant must provide documentation demonstrating that the site-specific criteria are protective of anadromous salmonids by providing instream flows that meet the habitat flow needs for the specific POD stream at the POIs. The Policy sets forth the requirements of the site specific study documentation. The site specific study documentation must contain certain elements depending on the site-specific flow criteria requested (e.g., Diversion Season, MBF, and/or MCD) and the fish species life history stage(s) of concern. Table 3-1 summarizes the study elements that are likely to be required for a given requested site-specific criterion and the associated estimated cost per site-specific study location.

Table 3-1. Summary of Site Specific Study Elements Required for Various Requested Site-Specific Flow Criteria

	Requested Site-Specific Flow Criteria		
Study Element Required	MBF	MCD	Diversion Season
Habitat Assessment	X	X	X
Upstream Passage	X	X	
Spawning	X	X	
Incubation[1]	X		
Juvenile Rearing	X	X	
Temperature			X
Maintenance of Natural Flow Variability		X	

1 The revised Draft Policy assumes spawning flows will provide protective incubation flows.

The estimated cost to prepare a typical site-specific study is based on the following assumptions:

- The study is prepared by a fisheries scientist with experience in evaluating fish habitat conditions.
- For a site-specific MBF and/or MCD, the study would involve office work and field work associated with the required study elements listed above consisting of the following general tasks: (1) research of previous studies on the historical and current presence of anadromous salmonids by fish species and life history stages at all POIs and consultation with federal and state resource agencies; (2) field inspection and field survey data collection along the stream channel~~at all POIs~~, including measurement and assessment of all physical and biological parameters needed to determine habitat flow needs; (3) analysis of the field survey data and determination of habitat flow needs; and (4) documentation of the site-specific study in a report.
- For a site-specific diversion season, the study would involve field work and office work associated with the required study elements listed above consisting of the following general tasks: (1) research of previous studies on the historical and current presence of anadromous salmonids by fish species and life history stages and consultation with federal and state resource agencies; (2) collecting field temperature data at multiple locations along the stream~~study reach at several POIs~~ over the proposed extended diversion season; (3) analyzing the temperature data and determination of potential affects of the extended diversion season on fish habitat; and (4) documentation of the site-specific study in a report.

The cost to prepare a site-specific study will vary from application to application depending on several factors, including the following:

- Fisheries scientist's working efficiency and hourly rate;
- Number of POIs (for site-specific MBF and/or MCD~~variances~~) and/or distance from the POD downstream to the confluence with the next stream of similar size (for site-specific diversion season~~variances~~); and
- Accessibility to the stream for the field data collection.

The cost to prepare a typical site-specific study was based on R2 staff's experience in performing similar work under field condition representative of the Policy area. The breakdown of the estimated cost is provided in Table 3-2 based on one site-specific study location.

3.1.1.4 Possible Supplement to Permit Application: Determination of Stream Classification

The Policy requires the installation of fish screening on diversions on Class 1 streams. The Policy also restricts the permitting of onstream dams or applies certain conditions to the permitting of onstream dams depending on the classification of the stream where the dam is proposed and whether it is an existing unauthorized or new dam. The Policy provides that, for purposes of permitting new diversions, including onstream dams, the diversion is initially presumed to be located on a Class I stream, unless the Division initially presumes otherwise.

The applicant may choose to overturn the Division's initial presumption by demonstrating that the diversion is located on a different stream classification with less restrictive conditions. The applicant must demonstrate that the stream classification is different from Class I (or the Division's initial presumption if other than Class I), and provide documentation justifying the different stream classification that is acceptable to the Division.

The estimated cost to prepare a determination of stream classification is based on the following assumptions:

- The study is prepared by a qualified fisheries scientist with experience in evaluating fishery and aquatic habitat conditions, as required by the Policy.
- The study involves office work and field work consisting of the following main tasks: (1) research previous studies that determined the farthest upstream location known to have anadromy along the POD stream and the presence of fish at the POD; (2) at least two years of quarterly field surveys of the stream channel in the vicinity of the POD to determine the presence of fish/non-fish vertebrates/macroinvertebrates; (3) a visual inspection of the stream channel in the vicinity of the POD during winter base flow conditions to measure channel characteristics; (4) a visual inspection of the stream channel in the vicinity of the POD immediately following runoff events to identify any evidence of sediment transport; (5) analysis of the field survey data and determination of stream classification; and (6) documentation of the study in a report.

The cost to prepare a stream classification will vary from application to application depending on several factors, including the following:

- Fisheries scientist's working efficiency and hourly rate;
- Availability of suitable maps; and
- Accessibility of the stream and ease of walking along the stream for the field inspection.

The cost to prepare a typical determination of stream classification was based on R2 staff's experience in performing similar work under field condition representative of the Policy area. The breakdown of the estimated cost is provided in Table 3-.

3.1.1.5 Summary of Application Costs

Table 3-2. Summary of Estimated Costs for Permitting All Diversions -- Application Costs

Task	Engineering Labor @ $120/hr	Fisheries Scientist Labor @ $100/hr	Project Management, Other Supporting Labor, and Expenses	Total
WAA				
(a) Research and Compilation of Water Rights Data	1,800	-	200	2,000
(b)(c)(d) Hydrologic Analysis	10,800	2,000	1,300	14,100
(e) Report Documentation	1,800	-	200	2,000
Subtotal WAA	**14,400**	**2,000**	**1,700**	**18,100**
Supplemental Anadromy Determination	**-**	**7,000**	**700**	**7,700**
Supplemental Site-specific Study				
MBF[1,2]	-	15,000	1,700	16,700
MCD[1,2]		36,500	4,000	40,500
Diversion Season[1,2]	-	~~10,000~~ 6,500	~~1,000~~ 700	~~11,000~~ 7,200
Supplemental Stream Class Determination	**-**	**~~14,000~~ 9,200**	**~~1,400~~ 1,000**	**~~15,400~~ 10,200**

Notes:
1. Based on one requested site-specific flow criterion and one site-specific study location.
2. For requests for multiple site-specific flow criteria (e.g., a request for site-specific MBF and MCD) and where multiple study locations are required, the costs would probably be less than the sum of the individual site-specific flow criterion costs given above. This would be expected because some study elements apply to multiple site-specific flow criteria, as indicated in Table 3-1. In addition, there would be cost efficiencies associated with multiple site-specific flow criteria during study planning, mobilization, analysis and reporting, and during field work due to proximity between study locations.

3.1.2 Implementation Costs

The Policy requires a passive bypass system as part of the diversion facility or, where infeasible, an automated bypass system. In addition, for diversions on Class I streams section 11.1 of the Policy requires fish screens (and, at existing unauthorized onstream dams, fish passage).

3.1.2.1 Cost to Furnish and Install, Operate, and Maintain Flow Monitoring Systems and Periodic Reporting on Diversion Activities

The Policy does not require compliance monitoring of the rate of flow for passive bypass systems. But for automated bypass systems the Policy requires that the rate of flow be measured and recorded on an hourly basis and the averaged on a daily basis.

The costs to furnish and install flow monitoring equipment that would comply with the Policy requirements were estimated at about $10,000 for automated bypass systems, which would necessitate that two flow points be monitored. This is based on an estimated cost of about $5,000 per flow point for furnishing and installing a flow monitoring unit (flow/stage sensor and recorder; refer to Appendix A). The additional cost for operating and maintaining the flow monitoring equipment and submitting periodic reports on diversion activities in compliance with the Policy is estimated at an annual cost of $1,200 per year. These costs assume use of

contractor-furnished and -installed flow monitoring and recording equipment and use of a professional engineer for periodic equipment O&M and reporting, and are detailed in Table 3-3. and summarized in Table 3-7.

Table 3-3. Summary of Estimated Cost to Furnish and Install and Operate and Maintain Flow Monitoring Equipment and Periodic Reporting on Diversion Activities

Item	Furnish and Installation	Operation and Maintenance	Annual Reporting	Total
Costs for Automated Bypass (2 flow points) Flow Sensors, Totalizers and Recorders for Inflow and Outflow	$10,000	$600/yr	$600/yr	$10,000 + $1,200/yr

3.1.2.2 Cost to Provide Passive Bypass System or Automated Bypass System

The Policy requires that a passive bypass system be installed at a diversion, except where passive bypass is infeasible, an automated bypass system may be installed.

For a direct diversion facility with no onstream dam, passive bypass may be provided simply by designing the intake structure, pump, or discharge conduit to prevent diversion of water in violation of the minimum bypass flow condition and maximum diversion rate condition. The additional cost for such design features on a new direct diversion facility is considered negligible; however, additional costs would be incurred to modify an existing unauthorized direct diversion.

For an onstream dam, either new or existing unauthorized, passive bypass would necessitate that the inflowing stream channel be routed around the onstream dam to afford bypassing of flows less than the minimum base flow and bypassing of high flows. The additional cost for such design features on a new onstream dam or an existing unauthorized dam new direct diversion facility would not be negligible.

Conceptual layouts and estimated costs for implementing passive bypass and automated bypass systems were developed for the case study dams and are detailed in Appendix A. The estimated costs derived from the case studies provided the basis for the development of the estimated ranges of costs, which bracket the estimated case study costs. These estimated costs are summarized in Table 3-7.

For the purpose of comparison, conceptual layouts and estimated costs for implementing active bypass systems were also developed for the case study dams and are detailed in Appendix B.

3.1.2.3 Cost to Provide Fish Screening

The Policy requires fish screening at diversions on Class I streams. Screening would be required at the intake structure or pump in compliance with National Marine Fisheries Service (NMFS) screening guidelines. The additional cost for screening features would vary widely depending on site-specific circumstances and how NMFS guidelines would apply to the site. An example of a simple and low cost screening feature would be a screen on a pump intake. An example of a more complicated and higher cost screening feature would be a screen on a gravity intake with an automatic self-cleaning apparatus. Estimated costs for these two examples of fish screening features bracket the estimated cost ranges which are summarized in Table 3-7.

3.2 ADDITIONAL COSTS FOR PERMITTING OF ONSTREAM DAMS

In addition to the application and implementation costs discussed in Section 3.1, the applicant would incur additional permitting costs if the proposed diversion includes an onstream dam.

Table 3-4 identifies the appropriate mitigation plans and fish screening/passage facilities required by the Policy according to stream classification

Table 3-4. Fish Passage and Mitigation Plans Required by Policy

	Mitigation Plans				
Stream Class	**Fish Screening/Passage**	**Non-Native**	**Gravel/ Wood**	**Riparian**	**Monitoring/Reporting**
I	Yes	Yes	Yes	Yes	Yes
II	No	Yes	Yes	Yes	Yes
III	No	Yes	Yes	No	Yes

Note: Existing unauthorized onstream dams built before July 19, 2006 may be permitted on Class I, II, and III streams. No new onstream dams are permitted on Class I and II streams.

3.2.1 Application Costs

3.2.1.1 Mitigation Plans for Existing Unauthorized and New Onstream Dams

Construction and operation of onstream dams have the potential to adversely affect instream flow and fishery resources by interrupting fish migratory patterns; creating invasive species habitat; or interrupting downstream movement of gravel and woody debris. Onstream dam can also result in loss of riparian habitat or wetlands. For water right applications that include onstream dams, the applicants may be required to prepare mitigation plans for the eradication of non-native species, gravel and wood augmentation, and/or riparian habitat replacement. The Policy restricts the permitting of onstream dams or applies certain conditions to the permitting of onstream dams depending on the classification of the stream where the dam is located and whether it is an existing unauthorized dam (e.g. built before July 19, 2006) or a new dam. The cost to the applicant to prepare the appropriate mitigation plans is presented below.

3.2.1.1.1 Non-native species eradication plan

The estimated cost to prepare a non-native species eradication plan is based on the following assumptions:

- The plan is prepared by a biologist with experience in developing non-native species eradication plans.
- Plan preparation involves office work and field work consisting of the following main tasks: (1) research of previous studies to identify non-native species that could be potentially present at the site; (2) field survey of the onstream dam site to identify types, varieties, and abundance of non-native species present; (3) development of an approach to eradication, criteria for evaluating the effectiveness of the approach, a monitoring program, and a contingency plan if monitoring finds that the initial approach is not effective; and (4) documentation of the plan in a report.

The cost to prepare a non-native species eradication plan will vary from application to application depending on several factors, including the following:

- Biologist's working efficiency and hourly rate;
- Type and variety of non-native species present and abundance; and
- Size of the onstream dam and storage area.

The cost to prepare a typical non-native species eradication plan is based on R2 staff's experience in performing similar work under field condition representative of the Policy area. The breakdown of the estimated cost is provided in Table 3-4.

3.2.1.1.2 Wood and gravel augmentation plan

The estimated cost to prepare a wood and gravel augmentation plan is based on the following assumptions:

- The plan is prepared by an engineer, fisheries biologist, or fluvial geomorphologist with experience in developing wood and gravel augmentation plans.
- Plan preparation involves office work and field work consisting of the following main tasks: (1) field inspection and field survey data collection along the stream channel at and upstream of the onstream dam and the upstream watershed lands to assess ongoing fluvial processes and provide data on quantities and size characteristics of sediment and wood supply; (2) analysis of the field survey data and estimation of the quantity and size characteristics of wood and gravel supply; (3) development of an approach to augment wood and gravel to the stream below the onstream dam, criteria for evaluating the effectiveness of the approach, a monitoring program, and contingency plan if monitoring finds that the initial approach is not effective; and (4) documentation of the plan in a report.

The cost to prepare a wood and gravel augmentation plan will vary from application to application depending on several factors, including the following:

- Engineer's, biologist's, or fluvial geomorphologist's working efficiency and hourly rate;
- Size and geologic and vegetative variability of the upstream watershed, amount of wood and gravel supply; and
- Size of the onstream dam and storage area.

The cost to prepare a typical wood and gravel augmentation plan is based on R2 staff's experience in performing similar work under field condition representative of the Policy area. The breakdown of the estimated cost is provided in Table 3-5.

3.2.1.1.3 Riparian habitat replacement plan

The estimated cost to prepare a riparian habitat replacement plan is based on the following assumptions:

- The plan is prepared by a biologist or restoration ecologist with experience in developing riparian habitat replacement plans.
- Plan preparation involves office work and field work consisting of the following main tasks: (1) field survey of the onstream dam site to characterize the habitat type, species composition and abundance, and functions of the habitat that will be adversely impacted by the onstream dam; (2) development of an approach to replace the adversely impacted habitat, criteria for evaluating the effectiveness of the approach, a monitoring program, and a contingency plan if monitoring finds that the initial approach is not effective; (3) documentation of the plan in a report.

The cost to prepare a riparian habitat replacement plan will vary from application to application depending on several factors, including the following:

- Biologist's or restoration ecologist's working efficiency and hourly rate;
- Type(s), variability, and abundance of the riparian habitat; and
- Size of the onstream dam and storage area.

The cost to prepare a typical riparian habitat replacement plan is based on R2 staff's experience in performing similar work under field condition representative of the Policy area. The breakdown of the estimated cost is provided in Table 3-5.

Table 3-5. Summary of Estimated Costs to Prepare Mitigation Plans

Task	Fisheries Scientist/ Biologist Labor @ $100/hr	Project Management, Other Supporting Labor and Expenses	Total
Non-Native Species Eradication Plan			
Research Previous Studies	300	-	300
Field Survey	1,000	100	1,100
Development of Approach for Eradication	500	-	500
Report Documentation	700	200	900
Subtotal	**$ 2,500**	**$ 300**	**$ 2,800**
Wood and Gravel Augmentation Plan			
Field Inspection/Survey	1,000	100	1,100
Data Analysis	500	-	500
Development of Approach for Wood and Gravel Augmentation	500	-	500
Report Documentation	700	200	900
Subtotal	**$ 2,700**	**$ 300**	**$ 3,000**
Riparian Habitat Replacement Plan (for Class I and II streams only)			
Field Inspection/Survey	1,500	100	1,600
Development of Approach for Riparian Replacement	1,000	100	1,100
Report Documentation	1,000	100	1,100
Subtotal	**$ 3,500**	**$ 300**	**$ 3,800**

3.2.2 Implementation Costs

3.2.2.1 Implementation of Fish Passage

The Policy requires fish passage at all diversions on Class I streams. Because direct diversion facilities (e.g., offset wells) do not create barriers, fish passage may not be necessary at direct diversions. However, diversions with onstream regulatory dams or storage dams do create barriers to fish passage and, accordingly, fish passage facilities are necessary.

The additional cost for fish passage features would vary widely depending on site circumstances. An example of a fish passage facility on a diversion with onstream regulatory dam would be a fish ladder or fish passage ramp on the downstream side of the dam. This would afford upstream passage over the regulatory dam. For an onstream storage dam, a bypass channel could be used for upstream fish passage in addition to a fish passage structure on the downstream side of the MBF diversion weir.

The estimated cost for implementing fish passage was developed for the case study dam with passive bypass on a Class I stream and is detailed in Appendix A. The estimated cost derived from this case study provided an additional basis for the development of the estimated range of costs, which brackets the estimated case study cost. These estimated costs are summarized in Table 3-7.

3.2.2.2 Implementation of Mitigation Plans for Existing Unauthorized and New Onstream Dams

3.2.2.2.1 Non-native species eradication plan

The estimated cost to implement the non-native species eradication plan is based on the following assumptions:

- The plan is implemented or supervised by a biologist with experience in performing non-native species eradication.
- Plan implementation involves: (1) field work consisting of supervising passive extermination activities focusing on bullfrog eradication, such as annual reservoir draining/drying; and (2) monitoring and preparation of an annual report on the effectiveness of the plan.

The cost to implement a non-native species eradication plan will vary from application to application depending on several factors, including the following:

- Biologist's working efficiency and hourly rate;
- Number of non-native species present and abundance; and
- Size of the onstream dam and storage area.

The cost to implement a typical non-native species eradication plan is based on R2 staff's experience in performing similar work under field condition representative of the Policy area. The breakdown of the estimated cost is detailed in Table 3-6 and summarized in Table 3-7.

3.2.2.2.2 Gravel and Wood Augmentation Plan

The estimated cost to implement the gravel and wood augmentation plan is based on the following assumptions:

- The plan is implemented by a contractor experienced in riparian restoration work and supervised by an engineer, biologist, or fluvial geomorphologist with experience in implementing gravel and wood augmentation.
- Plan implementation involves: (1) use of heavy equipment to place gravel and wood into the stream channel below the dam; and (2) monitoring and preparation of an annual report on the effectiveness of the plan.

The cost to implement a gravel and wood augmentation plan will vary from application to application depending on several factors, including the following:

- Contractor's working efficiency;
- Amount of gravel and wood to be placed; and
- Ease of availability of a clean source of gravel and wood for placement.

The cost to implement a typical gravel and wood augmentation plan is based on R2 staffs' experience in performing similar work under field condition representative of the Policy area. The breakdown of the estimated cost is detailed in Table 3-6 and summarized in Table 3-7.

3.2.2.2.3 Riparian Habitat Replacement Plan

The estimated cost to implement the riparian habitat replacement plan is based on the following assumptions:

- The plan is implemented by a contractor experienced in riparian restoration work and supervised by a biologist or restoration ecologist with experience in implementing riparian habitat replacements.
- Plan implementation involves: (1) use of heavy equipment for site preparation and use of hand-operated equipment and manual labor for riparian planting; and (2) monitoring and preparation of an annual report on the effectiveness of the plan.

The cost to implement a riparian habitat replacement plan will vary from application to application depending on several factors, including the following:

- Contractor's working efficiency;
- Size and condition of the area to be restored;
- Type(s), variability, and abundance of the riparian habitat to be replaced; and
- Extent of infestation by invasive plants, if any.

The cost to implement a typical riparian habitat replacement plan is based on R2 staff's experience in performing similar work under field condition representative of the Policy area. The estimated cost assumes 2 acres of riparian habitat replacement, a unit replacement cost of $27,000 per acre, and the need to reinstate about one-half of the work due to non-survival of the initially planted vegetation. The breakdown of the estimated cost is detailed in Table 3-6 and summarized in Table 3-7.

Table 3-6. Summary of Estimated Costs to Implement Mitigation Plans

Task	Fisheries Scientist/ Biologist Labor @ $100/hr	Restoration Contractor	Total
Non-Native Species Eradication Plan Implementation			
Annual Eradication (passive)	1,000/yr	-	1,000/yr
Annual Monitoring/Reporting	1,000/yr	-	1,000/yr
Subtotal Annual (perpetuity)	**$ 2,000/yr**	**-**	**$ 2,000/yr**
Wood and Gravel Augmentation Plan Implementation			
Annual Furnish/Placement of Wood and Gravel	1,000/yr	2,000/yr	3,000/yr
Annual Monitoring/Reporting	1,000/yr	-	1,000/yr
Subtotal Annual (perpetuity)	**$ 2,000/yr**	**$ 2,000/yr**	**$ 4,000/yr**
Riparian Habitat Replacement Plan (for Class I and II streams only)			
Riparian Restoration (2 acres @ $27,000/acre x 1.5 times)	8,000 (one time)	81,000 (one time)	89,000
Annual Monitoring/Reporting (annual cost x 5 years)	10,000	-	10,000
Subtotal	**$ 18,000**	**$ 81,000**	**$ 99,000**

3.3 SUMMARY OF COSTS FOR NEW PERMITS FOR ALL DIVERSIONS – IMPLEMENTATION COSTS

Table 3-7 summarizes the estimated ranges of representative typical costs that applicants would incur to implement conditions of new water right permits in compliance with the Policy. Estimated ranges of costs are provided for implementing fish screening and passage (Class I streams only), passive or automated bypass, and non-native, gravel/wood, and riparian mitigation plans. Required monitoring and reporting costs are also included. Estimated ranges of costs are provided for all types of newly permitted diversions and for all stream classifications.

Table 3-7. Summary of Application and Implementation Costs for New Permits for Onstream Dams (dollars)[e]

Dam Status	Diversion Type	Stream Class	Applicable Additional Costs Category																									
			Fish				Bypass				Flow Monitoring				Mitigation													
			Passage[a]		Screen		Passive Bypass[f]		Auto Bypass		Monitoring Equipment[b]		Monitoring/ Reporting[b]		Non-Native				Gravel/Wood				Riparian				Mitigation Monitoring/ Reporting[b]	
															Plan		Implementation[b]		Plans		Implementation[b]		Plan		Implementation			
			High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
Exist. Unauth.	Onstream Dam/ Storage[c]	I	250,000	10,000	250,000	2,000	175,000	50,000			10,000	5,000	3,000	1,000	4,000	1,000	2,000	1,000	4,000	1,000	4,000	1,000	5,000	1,000	100,000	20,000	5,000	2,000
		II					150,000	40,000	350,000	100,000	10,000	5,000	3,000	1,000	4,000	1,000	2,000	1,000	4,000	1,000	4,000	1,000	5,000	1,000	100,000	20,000	5,000	2,000
		III					150,000	25,000	300,000	75,000	10,000	5,000	3,000	1,000	4,000	1,000	2,000	1,000	4,000	1,000	4,000	1,000					4,000	1,000
Exist. Unauth.	Onstream Dam/ Regulatory[c]	I	200,000	10,000	250,000	2,000	30,000	10,000			10,000	5,000	3,000	1,000	2,000	500	1,000	500	2,000	500	2,000	500	2,500	500	20,000	2,000	3,000	1,000
		II					25,000	5,000			10,000	5,000	3,000	1,000	2,000	500	1,000	500	2,000	500	2,000	500	2,500	500	20,000	2,000	3,000	1,000
		III					20,000	3,000			10,000	5,000	3,000	1,000	2,000	500	1,000	500	2,000	500	2,000	500					3,000	1,000
Exist. Unauth.	Onstream Direct Diversion[c]	I			250,000	2,000	30,000	10,000			10,000	5,000	3,000	1,000														
		II					25,000	5,000			10,000	5,000	3,000	1,000														
		III					20,000	3,000			10,000	5,000	3,000	1,000														
New	Onstream Dam/ Storage	I (Not permitted)																										
		II (Not permitted)																										
		III					150,000	25,000			10,000	5,000	3,000	1,000	4,000	1,000	1,000	500	4,000	1,000	4,000	1,000	5,000	1,000	100,000	20,000	3,000	1,000
New	Onstream Dam/ Regulatory	I (Not permitted)																										
		II (Not permitted)																										
		III[d]					0	0			10,000	5,000	3,000	1,000	2,000	500	1,000	500	2,000	500	2,000	500	2,500	500	20,000	2,000	3,000	1,000
New	Onstream Direct Diversion	I[d]			250,000	2,000					10,000	5,000	3,000	1,000														
		II[d]									10,000	5,000	3,000	1,000														
		III[d]									10,000	5,000	3,000	1,000														

Footnotes:

a Cost given includes fish passage structure on diversion weir; passive bypass channel provides additional required fish passage.

b Monitoring equipment not required for passive bypass. Cost given under the column heading Monitoring/Reporting is the recurring annual cost.

c Cost given are for modification of existing unauthorized diversion facility, and keeping of the same diversion type.

d Cost given does not include the cost to construct offstream storage.

e Costs given are based on the use of outside contractors to provide labor and materials in connection with compliance activities.

f For an onstream dam, estimated apportionment of passive bypass costs are as follows: 40% bypass channel, 15% MBF intake/weir, and 45% maximum diversion intake/spillway. For a direct diversion, MBF and maximum diversion features are integrated and, costs are inseparable.

3.3.1 Construction of a New Onstream Dam on a Class III Stream

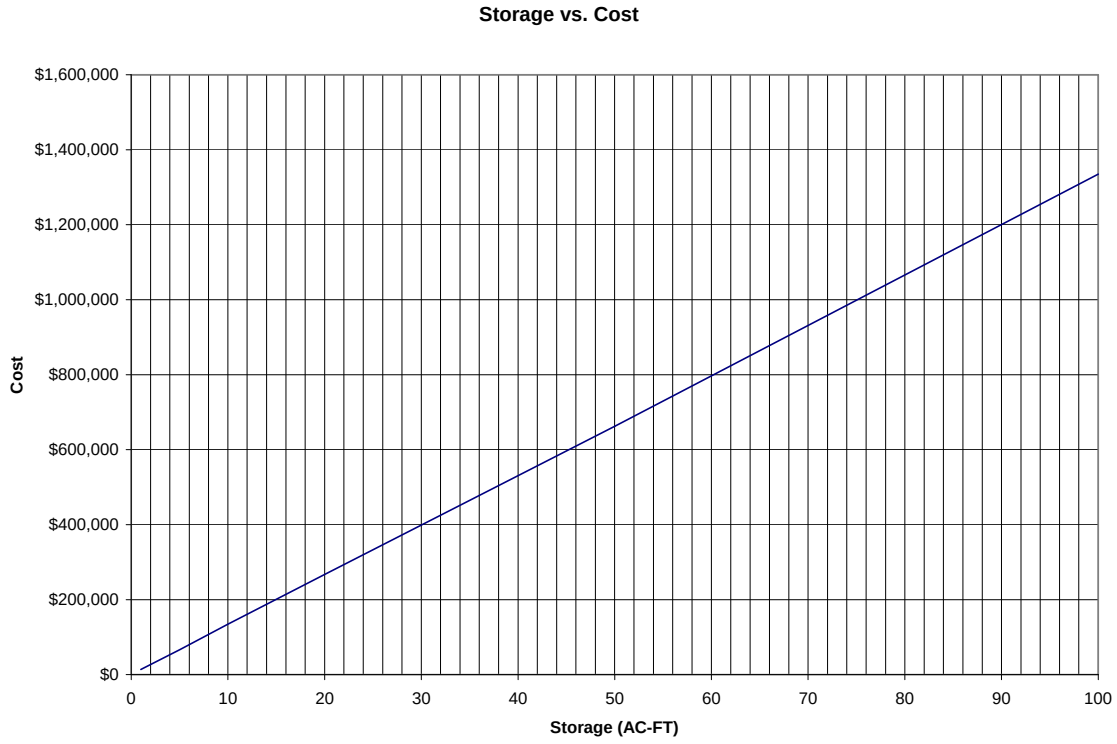
The Division will not issue a water right permit for new onstream dams on Class I or II streams built after July 19, 2006; however, the Division may issue a water right permit for a new onstream dam on a Class III stream if the applicant implements passive bypass and provides mitigation plans for non-native species and gravel/wood augmentation. Table 3-7 does not include the cost of the construction of a new dam on a Class III stream (this is not required by the Policy), but the additional costs that are required for the water right permit for a new dam on a Class III stream, including costs for passive or automated bypass, mitigation plans, and monitoring and reporting, are included. These estimated ranges of costs bracket the costs that were developed from the case study dam with passive bypass on a Class III stream as detailed in Appendix A.

3.3.2 Construction of New Offstream Storage Reservoir

Restrictions in the Policy on permitting of onstream dams could lead some applicants to construct new off-stream storage reservoirs. The cost to construct new off-stream storage reservoirs will vary depending on many factors, particularly reservoir size, in terms of wetted area and storage volume, and distance from the point of diversion on the stream. A general relationship between construction cost and reservoir storage volume over a range of typical volumes is presented in Figure 3-1. This relationship is based on the following key assumptions:

- The reservoir would be dimensionally sized to minimize earthwork needed to achieve the desired storage;
- The reservoir would be located in an upland location, on flat land that is ready for construction;
- Construction cost components consist of earthwork cost and other costs which are assumed at 10% of the earthwork cost;
- Earthwork unit cost is $15 per cubic yard;
- Land cost is not included; and,
- Water supply pipeline cost is not included.

Figure 3-1. Relationship Between Construction Cost and Volume for Offstream Storage Reservoir



CHAPTER 4 - POTENTIAL FUNDING SOURCES

The previous section discusses representative costs that the applicant would incur in order to comply with the Policy. The costs are divided into two categories: application and implementation costs. It is assumed that the applicant would provide his/her own funding for the costs associated with the application process. The applicant would also provide funding for implementation costs of compliance; however, potential sources of funding are available to assist the applicant with implementation costs. This section discusses possible sources of funding for the applicant.

4.1 FEDERAL GRANT PROGRAMS

There are many federal programs that provide funds for habitat restoration and other mitigation requirements of the Policy. The specific parameters vary from program to program. Funding may be available to state and local government agencies, public and private organizations, tribes, and individual landowners. Table 4.1 lists many of the federal agencies that administer grant programs for habitat restoration. Each agency's website should list the currently available funding programs along with specific information on eligibility. Federal grant opportunities can also be researched at *www.grants.gov*.

Table 4-1. Federal Agencies that Administer Grant Programs for Habitat Restoration

Agency	Website
AmeriCorps	*www.americorps.org*
Bureau of Indian Affairs	*www.doi.gov/bureau-indian-affairs.html*
Bureau of Land Management	*www.blm.gov*
Coastal America	*www.coastalamerica.gov*
Economic Development Administration	*www.eda.gov*
National Fish and Wildlife Foundation	*www.nfwf.org*
National Marine Fisheries Service	*www.nmfs.noaa.gov*
National Oceanographic and Atmospheric Administration	*www.noaa.gov*
National Park Service	*www.ncrc.nps.gov*
Natural Resources Conservation Service	*www.nrcs.usda.gov*
US Army Corps of Engineers	*www.usace.army.mil*
US Environmental Protection Agency	*www.epa.gov*
US Farm Service Agency	*www.fsa.usda.gov*
US Fish and Wildlife Service	*www.fws.gov*
USDA Forest Service	*www.fs.fed.us*

4.2 STATE AND LOCAL GRANT AGENCIES

Table 4.2 lists many of the state and local agencies that administer grant programs for habitat restoration and similar mitigation plans in northern California. Each agency's website should list the currently available funding programs along with specific information on eligibility. State grant opportunities can also be researched at *http://getgrants.ca.gov*. Funding may also be available through local county or city programs.

Table 4-2. State and Local Agencies that Administer Grant Programs for Habitat Restoration

Agency	Website
California Bay-Delta Authority	*http://calwater.ca.gov*
California Coastal Coalition	*www.calcoast.org*
California Department of Conservation	*www.consrv.ca.gov*
California Department of Fish and Game	*www.dfg.ca.gov*
California Department of Parks and Recreation	*www.parks.ca.gov*
California Department of Water Resources	*www.dwr.water.ca.gov*
California Resources Agency	*http://resources.ca.gov*
California State Coastal Conservancy	*www.scc.ca.gov*
California State Water Resources Control Board	*www.waterboards.ca.gov*
California Wildlife Conservation Board	*www.wcb.ca.gov*
San Francisco Bay Joint Venture	*www.sfbayjv.org*

4.3 NON PROFIT GROUPS AND PRIVATE FOUNDATIONS

Table 4.3 lists a few of the non-profit organizations and private foundations that may have current funding programs for habitat restoration in California. There are many potential grant sources available that can be researched through a subscription grant database such as the Foundation Directory at *www.foundationcenter.org*.

Table 4-3. Examples of Non-Profit Organizations and Private Foundations that May Fund Programs for Habitat Restoration in California

Organization	Website
David and Lucile Packard Foundation	*www.packard.org*
FishAmerica Foundation	*www.fishamerica.org*
Fishery Foundation of California	*www.fisheryfoundation.org*
Singing for Change	*www.singingforchange.com*

CHAPTER 5 - REFERENCES

State Water Control Board. 2007. *Instream Flow Policy for Northern California Coast Streams Peer Review Draft.*

Stetson Engineers Inc. 2007. *North Coast Instream Flow Policy Potential Indirect Environmental Impacts of Modification or Removal of Existing Unauthorized Dams.*

Rantz, S.E., and T.H. Thompson. 1967. *Surface water hydrology of California coastal basins between San Francisco Bay and Eel River.* U.S. Geological Survey Water-Supply Paper 1851. Washington D.C.

Waananen, A.O., and Crippen, J.R. 1977. *Magnitude of Frequency of Floods in California.* Water Resources Investigations 77-21, U.S. Geological Survey, Washington, DC.

APPENDIX A: CASE STUDY COSTS TO MODIFY EXISTING UNAUTHORIZED DAMS TO COMPLY WITH THE POLICY

Appendix A describes estimated potential costs of compliance for selected case studies.

The Policy restricts the permitting of onstream dams or applies certain conditions to the permitting of onstream dams depending on the classification of the stream where the dam is proposed and whether it is an existing unauthorized (i.e., built before 7/19/06) or new dam. The Policy provides that a water right permit may be issued for an existing unauthorized onstream dam on a Class I, II, or III stream or for a new dam on a Class III stream under the following conditions: (1) fish passage and screening is provided (Class I stream only); (2) a passive bypass system is provided, or if not possible due to physical site constraints, an automated bypass system may be used as provided in the Policy; (3) a non-native species eradication plan is implemented; (4) a gravel and wood augmentation plan is implemented; and (5) a riparian habitat replacement plan is implemented (Class I and II streams only).

To estimate the cost that applicants applying for a water right permit for an existing unauthorized onstream dam may incur to comply with the Policy, three existing authorized onstream dams were selected from the State Water Board's Water Resources Information Management System (WRIMS) database as case studies for the purpose of aiding estimation of representative typical costs. These three dams cover a range of sizes and stream classifications and, collectively, are considered representative of onstream dams that would be affected by the Policy. Conceptual designs and estimated costs were prepared for the three case study onstream dams, and are illustrated in the following nine figures/tables:

- Passive Bypass Option Class I Stream (Figure/Table A-1)
- Dam Removal and Direct Diversion to Off-Stream Storage Class I Stream (Figure/Table A-2)
- Automated Bypass Class I Stream (Figure/Table A-3)
- Passive Bypass Option Class II Stream (Figure/Table A-4)
- Dam Removal and Direct Diversion to Off-Stream Storage Class II Stream (Figure Table A-5)
- Automated Bypass Class II Stream (Figure/Table A-6)
- Passive Bypass Option Class III Stream (Figure/Table A-7)
- Dam Removal and Direct Diversion to Off-Stream Storage Class III Stream (Figure/Table A-8)
- Automated Bypass Class III Stream (Figure/Table A-9)

For all the case study onstream dams, conceptual layouts were prepared for three options: "passive bypass," "dam removal and direct diversion to offstream storage," and "automated bypass." The conceptual layouts at each of the onstream dams have been designed using the following criteria:

- The MBF was estimated for each case study dam based on the drainage area at the dam using the unimpaired mean annual runoff given in Rantz (1967);
- The maximum diversion rate was estimated at 5% of the 1.5 year peak flow;
- The 1.5 year peak was estimated for each case study dam based on the drainage area at the dam and using the unimpaired peak flow regression equation given in Waanenen and Crippen (1977); and

- The bypass capacity was assumed to be equal to the capacity of the inflowing stream channel, which was assumed to be the 5-year peak flow estimated based on the drainage area at the dam and using the unimpaired peak flow regression equation given in Waanenen and Crippen (1977).

Passive Bypass Option – A passive bypass system is required for permitting of onstream dams on Class I, II, and III streams. A passive bypass system is defined in the Policy. The passive bypass systems designed for the case studies have three main components: an MBF diversion-bypass and a maximum diversion-bypass, both located on the stream just above the storage reservoir, and a bypass channel that conveys the bypass flows to a discharge point below the dam. The MBF diversion-bypass consists of a small diversion weir and an inlet designed to divert all flows at or below the MBF rate to a bypass channel. The incremental flow exceeding the MBF capacity of the MBF diversion passes over the small diversion weir and continues downstream. The maximum diversion-bypass consists of a lateral spillway along one bank of the stream channel. The crest of the spillway is set at the height of maximum diversion rate under normal flow conditions in the channel and has sufficient crest length such that incremental flows exceeding the maximum diversion rate are "cropped off" as they spill over the lateral spillway and are conveyed to the bypass channel. The maximum diversion-bypass lateral spillway and bypass channel capacities were assumed equal to the capacity of the inflowing stream channel (i.e., 5-year peak flow).

For the onstream dam on the Class I stream, the required fish passage is integrated into the design of the passive bypass system. The bypass channel itself and the MBF diversion-bypass weir with fish ladder would both need to meet fish passage criteria set forth by CDFG.

Dam Removal and Direct Diversion to Offstream Storage Option -- Rather than modify the existing dam, the applicant may elect to remove the onstream dam, stabilize and restore the site, and install a direct diversion structure (i.e., diversion without onstream storage) and an offstream storage facility. The direct diversion consists of stage/flow sensor and a pump with a computerized controlled discharge that enables controlled diversions and bypass releases based on measured streamflow.

Dam removal and direct diversion to offstream storage systems for the case studies have been designed based on the following assumptions:

- Most of the material comprising the dam and accumulated sediment would be removed and the site would be regraded, stabilized, and revegetated sufficiently to prevent erosion.
- The pump and pipeline would have the capacity to convey the maximum diversion rate.
- A pipeline would be constructed from the direct diversion to a new offstream storage reservoir.
- The capacity of the new offstream storage reservoir would be equal to the capacity of the existing reservoir that is removed.

Automated Bypass Option – The "automated bypass" option includes a streamflow gage to measure inflow and a high capacity, low level, controlled gated outlet with a computerized gate controller that regulates controlled bypass releases based on measured inflow. The outlet capacity was assumed equal to the capacity of the inflowing stream channel (i.e., 5-year peak flow).

Insert Figure A-1. Passive Bypass Class I Stream

Table A-1. Passive Bypass - Class I Stream

	Cost Item	Quantity	Capital Cost
Fish Passage			
	Furnish and Install Fish Passage Structure	1 LS	$227,000
	Subtotal Fish Passage		**$227,000**
Fish Screening			
	Furnish and Install Fish Screen	1 LS	$5,000
	Subtotal Fish Screening		**$5,000**
Passive Bypass			
	Bypass Channel	1,540 LF	$25,000
	Bypass Channel Spoils Stabilization	0.8 AC	$8,000
	MBF Intake Structure	1 LS	$4,000
	MBF Weir	1 LS	5,000
	Maximum Diversion Bypass Intake/ Lateral Spillway	1 LS	$29,000
	Subtotal Passive Bypass		**$71,000**
	Design, Environmental Permitting, Construction Management @20%		$61,000
	Subtotal		**$364,000**
	Unlisted Items and Contingencies @30%		$109,000
	Total Passive Bypass Class I Stream		**$473,000**

Insert Figure A-2. Dam Removal and Direct Diversion to Off-Stream Storage Class I Stream

Table A-2. Dam Removal and Direct Diversion to Off-Stream Storage - Class I Stream

	Cost Item	Quantity	Capital Cost
Dam Removal and Site Restoration			
	Earthwork	33,093 CY	$827,000
	Site stabilization and revegetation	4.7 AC	$127,000
	Subtotal Earthwork and Sitework		**$954,000**
	Design, Environmental Permitting, Construction Management @ 20%		$191,000
	Subtotal		**$1,145,000**
	Unlisted Items and Contingencies @30%		$344,000
	Subtotal Dam Removal and Site Restoration		**$1,489,000**
Replacement Diversion to Offstream Storage (Passive Bypass with Low and High Flow Combined)			
	Furnish and install pipe to offstream storage	1,000 LF	$49,000
	Furnish and install pump	1 LS	$8,000
	Furnish and install motor-operated valve on discharge pipe	1 LS	$11,000
	Furnish and install diversion flow sensor, stream stage / flow sensor, and data recorder	1 LS	$5,000
	Furnish and install automatic PLC controller, electrical	1 LS	$69,000
	Earthwork (offstream storage)	56,377 CY	$846,000
	Subtotal		**$988,000**
Fish Screening			
	Furnish and install fish screen		$5,000
	Subtotal Fish Screening		**$5,000**
	Design, Environmental Permitting, Construction Management @ 20%		$199,000
	Subtotal		**$1,187,000**
	Unlisted Items and Contingencies @ 30%		$356,000
	Subtotal Replacement Diversion to Offstream Storage		**$1,543,000**
	Total Dam Removal and Direct Diversion to Offstream Storage		**$ 3,032,000**

Insert Figure A-3. Automated Bypass Class I Stream

Table A-3. Automated Bypass - Class I Stream

	Cost Item	Quantity	Capital Cost
Fish Passage			
	Furnish and Install Fish Passage Structure	1 LS	$227,000
	Subtotal Fish Passage		**$227,000**
Fish Screening			
	Furnish and Install Fish Screen	1 LS	$5,000
	Subtotal Fish Screening		**$5,000**
Automated Bypass			
	Bypass Channel	1,540 LF	$25,000
	Bypass Channel Spoils Stabilization	0.8 AC	$8,000
	MBF Intake Structure	1 LS	$4,000
	MBF Weir	1 LS	$5,000
	Furnish and install outlet pipe	100 LF	$36,000
	Furnish and install motor operated gate on outlet pipe	1 LS	$40,000
	Furnish and install automatic PLC controller, electrical	1 LS	69,000
	Subtotal Active Bypass		**$187,000**
Monitoring Equipment			
	Furnish and install stream stage / flow sensors, data recorders, and telemetry	1 LS	$10,000
	Subtotal Monitoring Equip.		**$10,000**
	Design, Environmental Permitting, Construction Management @20%		$86,000
	Subtotal		**$515,000**
	Unlisted Items and Contingencies @30%		$155,000
	Total Automated Bypass Class I Stream		**$670,000**

Figure A-4. Passive Bypass Class II Stream

Table A-4. Passive Bypass - Class II Stream

	Cost Item	Quantity	Capital Cost
Passive Bypass			
	Bypass channel	1,180 LF	$24,000
	Bypass channel spoils stabilization	0.8 AC	$8,000
	MBF intake structure	1 LS	$4,000
	MBF weir	1 LS	$5,000
	Maximum diversion bypass intake / lateral spillway	1 LS	$27,000
	Subtotal		**$68,000**
	Design, Environmental Permitting, Construction Management @ 20%		$14,000
	Subtotal		**$82,000**
	Unlisted Items and Contingencies @ 30%		$25,000
	Total Passive Bypass Class II Stream		**$107,000**

Insert Figure A-5. Dam Removal and Direct Diversion to Off-Stream Storage Class II Stream

Table A-5. Dam Removal and Direct Diversion to Off-Stream Storage - Class II Stream

	Cost Item	Quantity	Capital Cost
Dam Removal and Site Restoration			
	Earthwork	10,485 CY	$262,000
	Site stabilization and revegetation	3.1 AC	$84,000
	Subtotal Earthwork and Sitework		**$346,000**
	Design, Environmental Permitting, Construction Management @ 20%		$69,000
	Subtotal		**$415,000**
	Unlisted Items and Contingencies @30%		$125,000
	Subtotal Dam Removal and Site Restoration		**$540,000**
Replacement Diversion to Offstream Storage (Passive Bypass with Low and High Flow Combined)			
	Furnish and Install pump	1LS	$8,000
	Furnish and install pipe to offstream storage	1,000 LF	$49,000
	Furnish and install motor-operated valve on discharge pipe	1 LS	$11,000
	Furnish and install diversion flow sensor, stream stage / flow sensor, and data recorder	1 LS	$5,000
	Furnish and install automatic PLC controller, electrical	1 LS	$69,000
	Furnish and install concrete weir	1 LS	$5,000
	Earthwork (offstream storage)	17,485 CY	$262,000
	Subtotal		**$409,000**
	Design, Environmental Permitting, Construction Management @ 20%		$82,000
	Subtotal		**$491,000**
	Unlisted Items and Contingencies @ 30%		$147,000
	Subtotal Replacement Diversion to Offstream Storage		**$638,000**
	Total Dam Removal and Direct Diversion to Offstream Storage		**$1,178,000**

Insert Figure A-6. Automated Bypass Class II Stream

Table A-6. Automated Bypass - Class II Stream

	Cost Item	Quantity	Capital Cost
Automated Bypass (With High and Low Flow Bypass System Combined)			
Automated Bypass			
	Furnish and install outlet pipe	120 LF	$44,000
	Furnish and install motor-operated gate on outlet pipe	1 LS	$40,000
	Furnish and install automatic PLC controller, electrical	1 LS	$69,000
	Subtotal Automated Bypass		**$153,000**
Flow Monitoring Equipment	Furnish and install reservoir water level and stream stage / flow sensors, data recorders and telemetry	1 LS	$10,000
	Subtotal Flow Monitoring Equipment		**$10,000**
	Design, Environmental Permitting, Construction Management @ 20%		$33,000
	Subtotal		**$196,000**
	Unlisted Items and Contingencies @ 30%		$59,000
	Total Automated Bypass		**$255,000**

Insert Figure A-7. Passive Bypass Class III Stream

Table A-7. Passive Bypass - Class III Stream

	Cost Item	Quantity	Capital Cost
Passive Bypass			
	Bypass channel	940 LF	$17,000
	Bypass channel spoils stabilization	0.5 AC	$5,000
	MBF intake structure	1 LS	$4,000
	MBF weir	1 LS	$5,000
	Maximum diversion bypass intake / lateral spillway	1 LS	$45,000
	Subtotal		**$76,000**
	Design, Environmental Permitting, Construction Management @ 20%		$15,000
	Subtotal		**$91,000**
	Unlisted Items and Contingencies @ 30%		$27,000
	Total Passive Bypass Class III Stream		**$118,000**

Insert Figure A-8. Dam Removal and Direct Diversion to Off-Stream Storage Class III Stream

Table A-8. Dam Removal and Direct Diversion to Off-Stream Storage - Class III Stream

	Cost Item	Quantity	Capital Cost
Dam Removal and Site Restoration			
	Earthwork	5,175 CY	$78,000
	Site stabilization and revegetation	1 AC	$27,000
	Subtotal Earthwork and Sitework		**$105,000**
	Design, Environmental Permitting, Construction Management @ 20%		$21,000
	Subtotal		**$126,000**
	Unlisted Items and Contingencies @30%		$38,000
	Subtotal Dam Removal and Site Restoration		**$164,000**
Replacement Diversion to Offstream Storage (Passive Bypass with Low and High Flow Combined)			
	Furnish and install pump	1 LS	$8,000
	Furnish and install pipe to offstream storage	1,000 LF	$49,000
	Furnish and install motor-operated valve on discharge pipe	1 LS	$11,000
	Furnish and install diversion flow sensor, stream stage / flow sensor, and data recorder	1 LS	$5,000
	Furnish and install automatic PLC controller, electrical	1 LS	$69,000
	Earthwork (offstream storage)	8,956 CY	$134,000
	Subtotal		**$276,000**
	Design, Environmental Permitting, Construction Management @ 20%		$55,000
	Subtotal		**$331,000**
	Unlisted Items and Contingencies @ 30%		$99,000
	Subtotal Replacement Diversion to Offstream Storage (Passive Bypass)		**$430,000**
	Total Dam Removal and Direct Diversion to Offstream Storage		**$594,000**

Insert Figure A-9. Automated Bypass Class III Stream

Table A-9. Automated Bypass - Class III Stream

	Cost Item	Quantity	Capital Cost
Automated Bypass (With High and Low Flow Bypass System Combined)			
	Furnish and install outlet pipe	80 LF	$29,000
	Furnish and install motor-operated gate on outlet pipe	1 LS	$40,000
	Furnish and install automatic PLC controller, electrical	1 LS	$69,000
	Subtotal		**$138,000**
Flow Monitoring Equipment	Furnish and install reservoir water level and stream flow sensors, data recorders and telemetry	1 LS	$10,000
	Subtotal Flow Monitoring Equipment		**$10,000**
	Design, Environmental Permitting, Construction Management @ 20%		$30,000
	Subtotal		**$178,000**
	Unlisted Items and Contingencies @ 30%		$53,000
	Total Automated Bypass		**$231,000**

APPENDIX B: CASE STUDY COSTS TO MODIFY EXISTING UNAUTHORIZED DAMS USING ACTIVE BYPASS

Appendix B describes case study conceptual layouts and estimated potential costs to modify existing unauthorized dams using active bypass. The Policy does not allow active bypass. These layouts and costs are presented for comparative purposes only.

Conceptual designs and estimated costs were prepared for the three case study onstream dams, and are illustrated in the following three figures/tables:

- Active Bypass Class I Stream (Figure/Table B-1)
- Active Bypass Class II Stream (Figure/Table B-2)
- Active Bypass Class III Stream (Figure/Table B-3)

The conceptual layouts for active bypass of the case study onstream dams are based on the same design criteria as those prepared for the bypass options described in Appendix A.

Active Bypass – An "active bypass" system requires manual control by an operator to divert flows in compliance with the Policy. The "active bypass" system includes flow sensors/recorders on the inflow and outflow and a high capacity, low level, manually-controlled gated outlet. The operator reads the inflow flow sensor and adjusts the gate setting to release the required outflow (i.e., bypass flow). The operator reads the outflow flow sensor to confirm that the release is adequate.

For the onstream dam on the Class I stream, a bypass channel and MBF diversion-bypass weir with fish ladder were integrated into the design of the active bypass system to meet the Policy requirements for fish passage. Both the bypass channel and ladder would need to meet fish passage criteria set forth by CDFG.

Insert Figure B-1. Active Bypass Class I Stream

Table B-!. Active Bypass - Class I Stream

	Cost Item	Quantity	Capital Cost
Fish Passage			
	Furnish and Install Fish Passage Structure	1 LS	$227,000
	Subtotal Fish Passage		**$227,000**
Fish Screening			
	Furnish and Install Fish Screen	1 LS	$5,000
	Subtotal Fish Screening		**$5,000**
Active Bypass			
	Bypass Channel	1,540 LF	$25,000
	Bypass Channel Spoils Stabilization	0.8 AC	$8,000
	MBF Intake Structure	1 LS	$4,000
	MBF Weir	1 LS	5,000
	Furnish and install outlet pipe	100 LF	$36,000
	Furnish and install manual gate on outlet pipe	1 LS	$25,000
	Subtotal Active Bypass		**$103,000**
Monitoring Equipment			
	Furnish and install stream stage / flow sensors and data recorders	1 LS	$10,000
	Subtotal Monitoring Equip.		**$10,000**
	Design, Environmental Permitting, Construction Management @20%		$69,000
	Subtotal		**$414,000**
	Unlisted Items and Contingencies @30%		$124,000
	Total Active Bypass Class I Stream		**$538,000**

Insert Figure B-2. Active Bypass Class II Stream

Table B-2. Active Bypass - Class II Stream

	Cost Item	Quantity	Capital Cost
Active Bypass			
	Furnish and install outlet pipe	120 LF	$44,000
	Furnish and install manual gate on outlet pipe	1 LS	$25,000
	Subtotal Active Bypass		**$69,000**
Monitoring Equipment			
	Furnish and install reservoir water level staff gage, stream flow sensors and data recorders	1 LS	$10,000
	Subtotal Monitoring Equipment		**$10,000**
	Design, Environmental Permitting, Construction Management @ 20%		$16,000
	Subtotal		**$95,000**
	Unlisted Items and Contingencies @ 30%		$29,000
	Total Active Bypass Class II Stream		**$124,000**

Insert Figure B-3. Active Bypass Class III Stream

Table B-3. Active Bypass - Class III Stream

	Cost Item	Quantity	Capital Cost
Active Bypass			
	Furnish and install outlet pipe	80 LF	$29,000
	Furnish and install manual gate on outlet pipe	1 LS	$25,000
	Subtotal Active Bypass		**$54,000**
Monitoring Equipment			
	Furnish and install reservoir water level staff gage, stream flow sensors and data recorders	1 LS	$10,000
	Subtotal Monitoring Equipment		**$10,000**
	Design, Environmental Permitting, Construction Management @ 20%		$13,000
	Subtotal		**$77,000**
	Unlisted Items and Contingencies @ 30%		$23,000
	Total Active Bypass Class III Stream		**$100,000**