TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 Introduction

The Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) is the first of four regional plans intended to implement the CALFED Ecosystem Restoration Program (ERP) element. The DRERIP will refine the planning approach specific to the Delta, enhance existing Delta specific restoration actions, and provide Delta specific implementation guidance, program tracking, performance evaluation and adaptive management feedback.

With guidance from the Ecosystem Restoration Program Science Board (ERPSB), a Working Group of ERP implementing agency staff[1] have developed an outline for the DRERIP and defined a process for obtaining scientific input. The process was developed specifically for use in preparing the DRERIP and other regional implementation plans to be prepared by the California Bay-Delta Authority (CBDA), and is intended largely as a planning tool for scheduling, tracking, and communicating the science input component of the DRERIP process.

The scientific input process for DRERIP consists of four discrete phases:

1. process design;
2. the development of conceptual models depicting species life history and ecosystem elements;
3. the evaluation, or scientific evaluation, of proposed ERP actions; and
4. an analysis of the feasibility and prioritization of the actions.

The process outlined above and the various teams formed to conduct the process are described in more detail in a document entitled "Delta Regional Ecosystem Restoration Implementation Plan, Scientific Input Process Map" (http://www.delta.dfg.ca.gov/erpdeltaplan/science_process.asp).

The following provides guidance for phase 3 of the process (herein referred to as the Scientific Evaluation Process) which focuses on scientifically evaluating previously identified ERP actions in light of current scientific knowledge and understanding. The process for scientific evaluation ERP actions was developed by an Adaptive Management Planning Team (AMPT) formed to oversee the scientific input process for DRERIP. The process represents a work in progress subject to further refinement and revision as other elements of the scientific input process are developed (particularly the species and ecosystem conceptual models).

[1] ERPIAMs = Ecosystem Restoration Plan Implementation Agency Managers

2.0 Scientific Evaluation of ERP Actions

Potential ecosystem restoration actions for the Delta are identified in multiple ERP planning documents. These documents include the Ecosystem Restoration Program Plan (ERPP) Volumes I and II, ERP Strategic Plan, Phase 2 Report, Water Quality Program Plan, Draft Stage 1 Implementation Plan and Record of Decision (ROD; ERP-Multi Species Conservation Strategy Milestones). The DRERIP science input process envisions a scientific evaluation of all previously identified Delta actions, including programmatic actions (defined activities intended to achieve ecosystem restoration targets) and targets (qualitative or quantitative statement of a strategic objective).

The purpose of scientific evaluation is to clarify and categorize previously identified ERP actions in light of current scientific knowledge and understanding. Evaluation will involve a close examination of proposed actions and targets so that they are not pursued on a *de facto* basis and so that the scientific rationale for each action is well understood and documented.

The process of evaluating ERP actions, as described herein is intended to focus on questions of science and involve an objective process that is fully transparent. Once actions have been vetted from a scientific, adaptive management perspective, a process for prioritizing the actions can occur. Scientific evaluation should inform prioritization and project selection but does not in and of itself constitute prioritization.

Scientific evaluation starts with a listing of previously identified Delta ERP actions which are sorted and evaluated through a three-step process as noted below and shown graphically in Figure 1.

Step 1: **Preliminary Sorting** - separates out actions that have been completed in whole or in part and identifies remaining actions as either research or implementation actions;

Step 2: **Initial Evaluation** - looks at the overall clarity of the action (as written), including whether there is a clear cause and effect relationship (either explicit or implicit) and whether the action is clearly written (ERP actions in need of clarification will be rewritten using a prescribed rewriting process presented below); and

Step 3: **Adaptive Management (AM) Routing** - provides a procedure for categorizing the actions into specific implementation categories.

Step 1 of the scientific evaluation process will be conducted by staff. Steps 2 and 3 will be performed by an Action Team consisting of scientific experts convened specifically to develop ecosystem conceptual models for the Delta and to vet ERP actions using those models. A database of ERP actions (ERP Actions-Targets Database) will be used to assist in the organization of actions, including the identification of similar or closely-related ERP actions. Each of these three steps is described in more detail in Sections 3, 4, and 5 of this document.

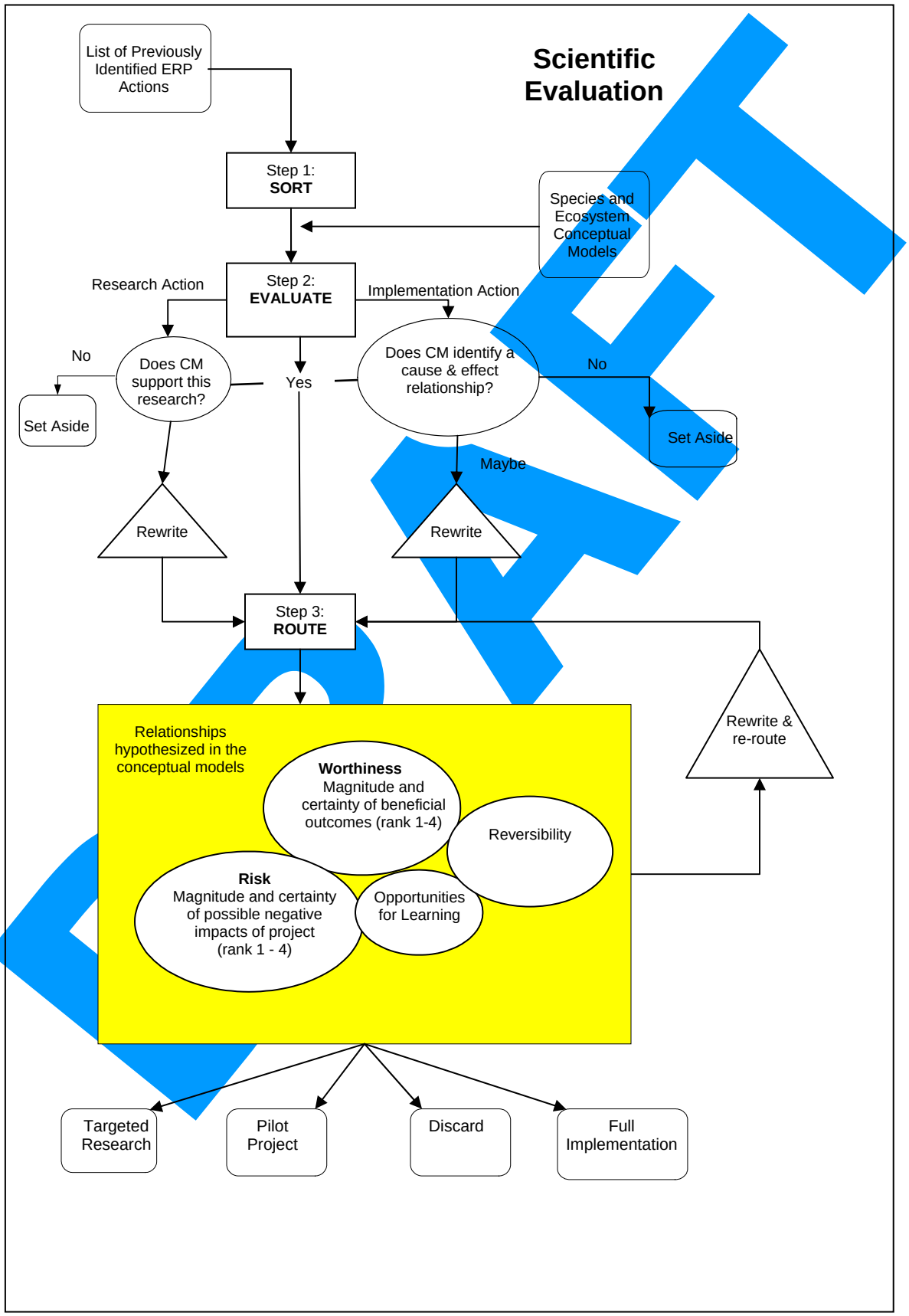
Using Conceptual Models in the Scientific Evaluation Process

Phase 2 of the DRERIP scientific input process involves the development of a suite of species life history and ecosystem conceptual models. These conceptual models will describe our current understanding of species life histories and how various systems work including hypotheses about cause and effect relationships, or linkages, between drivers (ecosystem elements that affect other components of the system) and outcomes (a result, effect, or consequence).

The DRERIP conceptual models will be used in Step 2 (Initial Evaluation) and Step 3 (Adaptive Management Routing) of the scientific evaluation process. In the Initial Evaluation, conceptual models will be used to determine if there is a known or hypothesized cause and effect relationship that suggests that the action is reasonable to consider from a scientific perspective (see Section 4). In the Adaptive Management Routing, the conceptual models will form the basis for identifying expected outcomes (or consequences) and the anticipated magnitude and Understanding of those outcomes (see Section 5). Essentially the conceptual models represent the information base for evaluating if the action will have its intended effect, and what the potential unintended effects might be (i.e. is it worthy, and what are the risks?).

Figure 1 below illustrates the Scientific Evaluation Process in a flow diagram. The process follows the three major steps with actions evaluated and routed according to certain criteria. Steps 2 and 3 allow for the action to be rewritten and then routed in its new form. Step 3 – Adaptive Management Routing - examines the actions through according to four key criteria (yellow box), which then directs to one of four final categories.

Figure 1: Scientific Evaluation Process



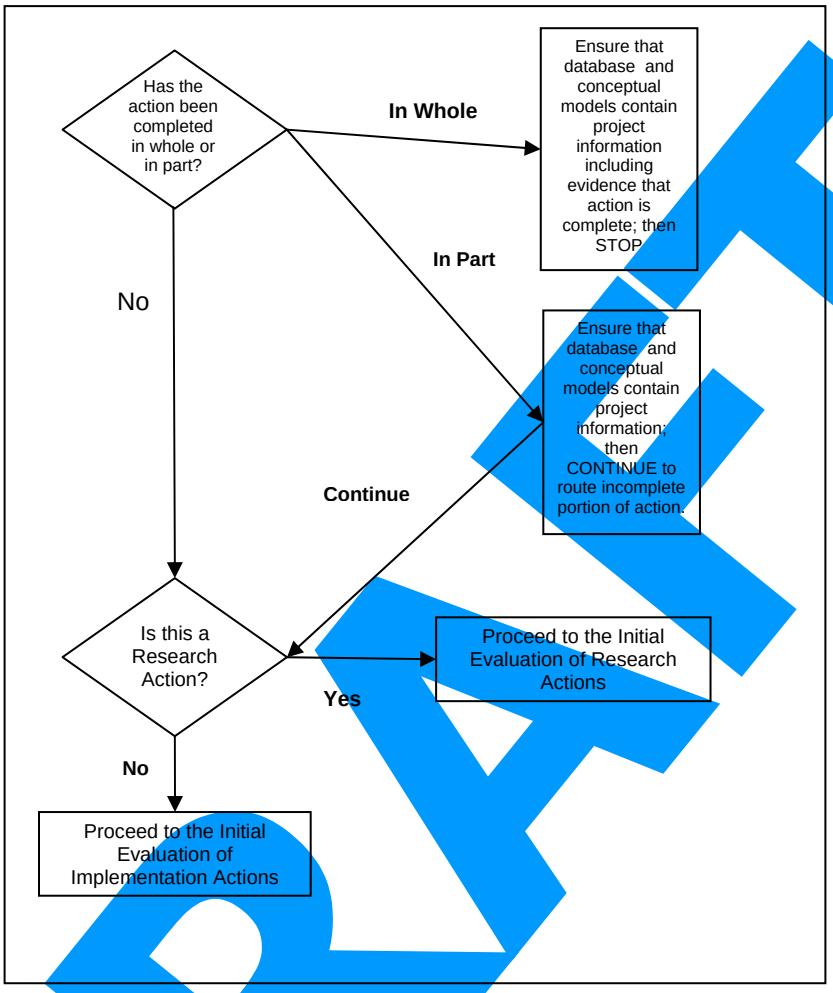
3.0 Preliminary Sorting

The Preliminary Sorting step of scientific evaluation involves identifying actions that have already been completed (either in whole or in part) and identifying actions which are clearly intended as research as opposed to implementation. Figure 2 displays a decision tree developed for use in Preliminary Sorting.

For ERP actions that have been wholly completed, the scientific evaluation process ends. For actions that have not been completed, they are sorted into *research* and *implementation* actions for further consideration in the Initial Evaluation step of the scientific evaluation process. Information on actions that have been wholly or partially completed must be cross-referenced to the ERP Actions-Targets Database for verification. Assessing whether or not an action has been completed and what constitutes "complete" will depend some on the action itself. For actions that contain specific habitat acreage targets such as "restore 2500 acres of tidal wetlands", whether or not the action has been completed or not will be relatively simple to assess. Actions that involve changes in flow regimes involve ongoing annual or monthly activity which is never fully "completed". The estimate of "completeness" should be left up to staff based on their knowledge of program activity. If it is unclear how to classify an action, it should be presumed to not have been completed and subjected to the rest of the scientific evaluation process. If there are research actions that have been completed, staff should check to see if the results of the research have been incorporated into relevant conceptual models.

The Preliminary Sorting step also involves grouping, or "bundling" related actions as appropriate to improve the efficiency of the Initial Evaluation and Adaptive Management Routing steps of the Scientific Evaluation Process. The ERPP has already established a hierarchy of activities including general types of actions that are supported by more specific actions. This context is important to maintain throughout the evaluation and may allow the Action Team to address a suite of very similar actions at the same time, or in sequence, which will save time and effort. Beyond the existing hierarchy established in the ERPP, there are many cases where similar actions are repeated in multiple sections of the ERPP. Grouping these similar actions at the Preliminary Sorting step will help the overall efficiency of the process. Grouping actions will be a staff function done using the ERP Action Database.

Figure 2: Preliminary Sorting



4.0 Initial Evaluation

Once actions have been sorted, as described in Section 3.0 above, the actions should be evaluated with regard to the following three questions:

1. Is there a common level of understanding of the action proposed and the expected outcome, as portrayed in applicable conceptual models, that allow for an evaluation of the action without further clarification?
2. Are there similar or related actions, or other program documents that provide information or approaches that enlighten the common level of understanding without re-writing the action?
3. If necessary (based on questions 1 and 2 above), can the action be re-written to achieve question 1, considering other similar or related actions in the Actions-Targets Database?

Addressing question 1 above will involve evaluating the clarity of the stated action and identifying if and how the action fits with existing conceptual models. Specifically, as described in more detail in Section 4.3 below, the action should not be written so as to lead to multiple interpretations of its intent. The action should be written as an "action" not as a desired outcome or goal. The action should also relate to a cause and effect relationship represented in one or more conceptual models. This step provides context for the proposed action and indicates how it might be expected to impact the system (including what the potential positive and negative outcomes of the action might be).

The following sections describe the Initial Evaluation process for implementation and research actions. If the action is a monitoring action, then it should be identified as such and set aside. Monitoring actions should not be vetted using the process outlined herein.

4.1 Implementation Actions

Figure 3 illustrates the initial evaluation process for implementation actions. It begins with the question regarding the current level of understanding for the action and how it might be related to other actions in the actions database. Depending on the level of understanding, the action can be routed, rewritten and routed, or set aside as noted below.

1. **Proceed to Routing Matrix –** relevant cause and effect relationships are documented in an applicable conceptual model or a similar action is identified in the database which provides information which can be used to sufficiently evaluate the action without re-writing the action, or;

2. **Rewrite Action** – relevant cause and effect relationship(s) and/or implementation strategies need clarification (See Section 4.3 - Guidelines for Re-Writing ERP Actions) or;

3. **Set Action Aside** – if the action cannot be re-written (see above) or the current conceptual models do not identify a need for the action it should be set aside for further consideration under Gap Analysis. The Gap Analysis is intended to identify areas where additional actions may be needed. The Gap Analysis will occur at the end of Phase 3

(after all existing actions have been vetted). The Gap Analysis not part of the scientific evaluation process itself.

4.2 Research Actions

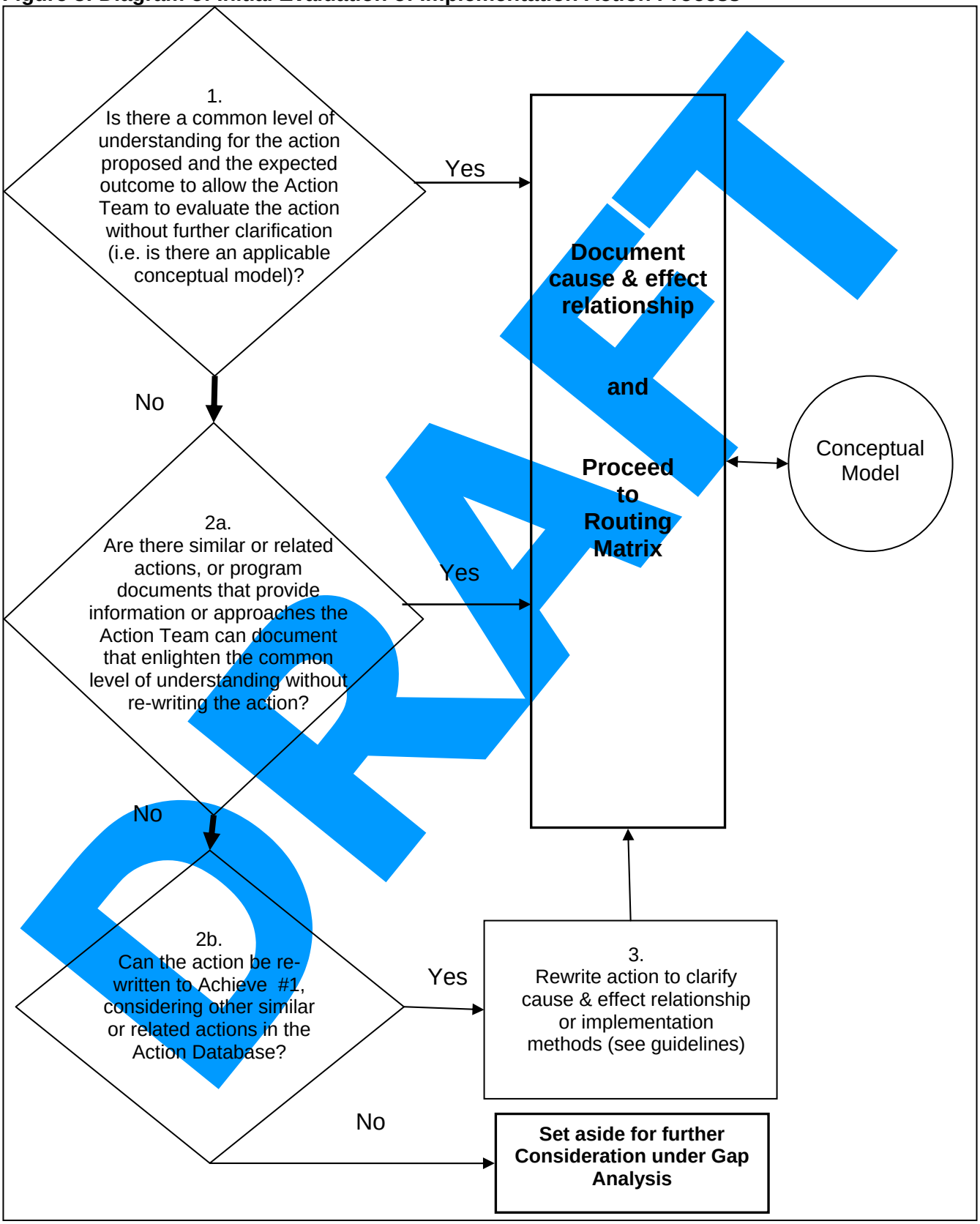
Figure 4 illustrates the initial evaluation process for research actions. This process evaluates if the research action is developed enough to pursue or, if the research action needs further thought and development. Research actions will be divided into one of the following categories based on the current level of understanding and how the action might be related to other actions in the actions database:

1. **Place in Targeted Research –** an applicable conceptual model exists or, there are related actions in the database that identify a need for the Research Action, or;

2. **Rewrite Action** - relevant cause and effect relationship(s) and/or implementation strategies need clarification (See Guidelines for Re-Writing ERP Actions document) or;

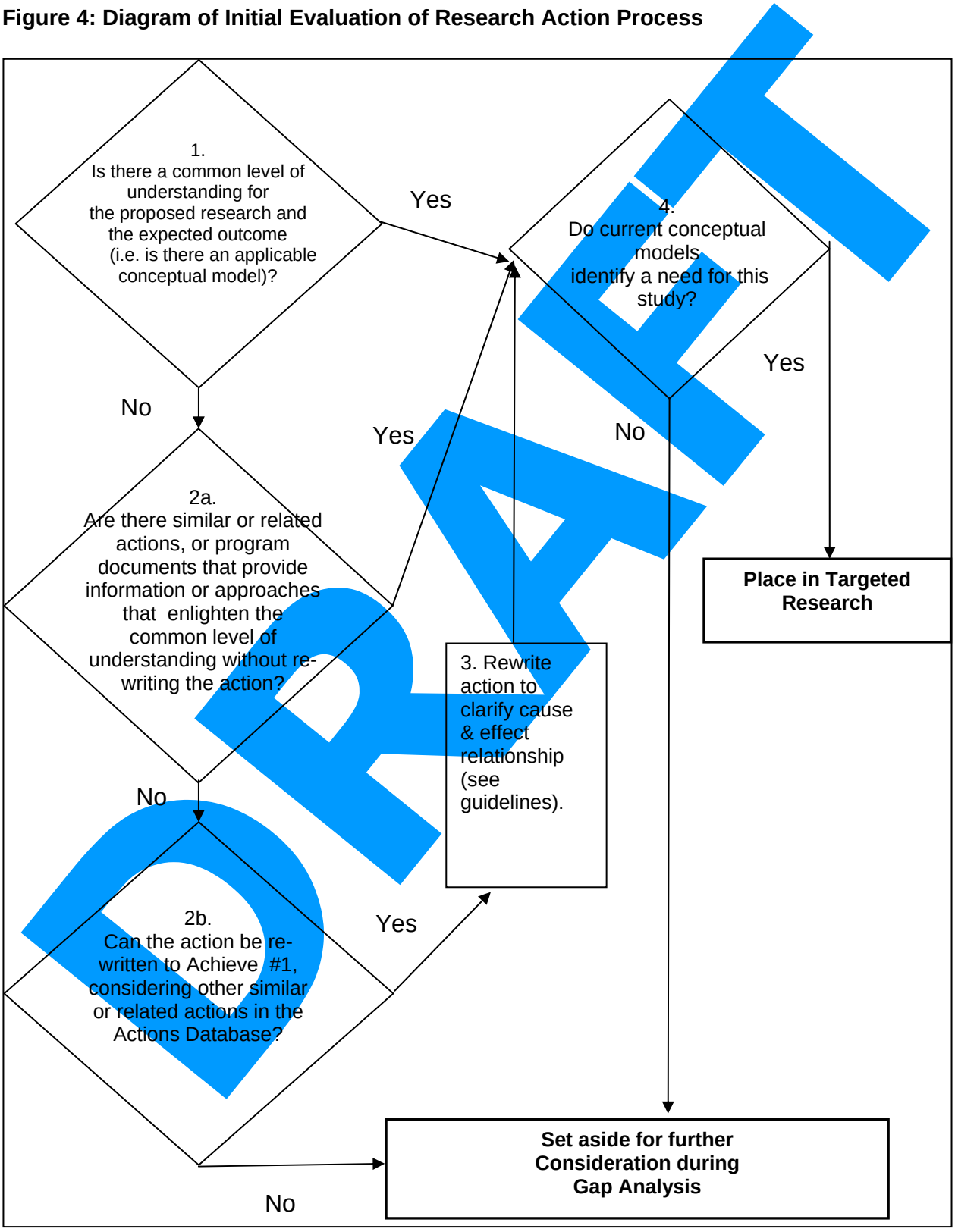
3. **Set Action Aside** – if the action cannot be re-written (see above) or the current conceptual models do not identify a need for the study it should be set aside for further consideration under Gap Analysis. The Gap Analysis occurs after all actions have been vetted and is intended to identify areas where additional actions may be needed.

Figure 3: Diagram of Initial Evaluation of Implementation Action Process



Based on V2. 4-19-04 ZPH Updated V5. 7-06-04 BD

Figure 4: Diagram of Initial Evaluation of Research Action Process



4.3 Guidelines for Re-writing ERP Actions

Many of the proposed restoration actions identified in the Ecosystem Restoration Program Plan (ERPP) and other CALFED documents are vague, either in terms of the intent of the action or the underlying mechanisms that support the suggested need for the action. In other cases, the actions may be clear, but the justification for the action is not supported by current knowledge.

The following provides guidelines intended to clarify the circumstances under which re-writing an action would be justified and to promote consistency in how actions are re-written. The guidelines were developed to help guide the Action Team (who will be responsible for conducting Step 2 of the scientific evaluation process) without being overly prescriptive.

Re-writing an action may occur (1) during the Initial Evaluation step of the Scientific Evaluation Process, or (2) as a consequence of routing (as described below). In either case, the purpose for re-writing an action is to clarify the action so that it can be routed (if possible). The underlying intent and focus of the action should be retained during rewriting. Rewriting should not create new actions for the purpose of filling an identified gap. Development of additional actions to fill gaps will occur after the Scientific evaluation process has been completed, and the gaps identified.

Justification for Re-writing an Action

<u>During Initial Evaluation</u>:

1. The wording of the action is unclear leading to multiple interpretations of its intent.

2. The "action" is really more of a goal (desired outcome) than an action.

3. There is no clear cause and effect relationship identified (i.e. linkage is unclear). The action should either directly influence an identified linkage or influence a driver that affects a given linkage or mechanism.

<u>During Routing</u>:

4. The action may be rewritten if the Action Team identifies several **substantially different** implementation approaches that would lead to **major** variations in understanding and consequences (thereby making routing difficult). Potential for implementation approaches to produce minor differences in understanding and/or consequences should not lead to re-writing an action.

<u>During Initial Evaluation or Routing</u>:

5. The Action Team determines and documents that the cause and effect relationship implied in the action is no longer valid and the action cannot be rewritten to clarify the cause and effect relationship based on current conceptual models. The action should be set aside for further consideration under Gap Analysis.

4.3.2 Guidance for Re-Writing Actions

1. It is important to consider the original motivation and/or look at the action relative to other related actions and targets prior to re-writing an action to ensure nothing has been missed.

2. It may be necessary to parse the action to clarify its meaning and intent. This may result in several actions arising from one. All rewritten actions should be tracked relative to their origin. (The Actions-Targets Database has been designed to facilitate this tracking.)

3. If it is determined that the assumed cause and effect relationship is not consistent with the conceptual models, then the action should be re-written to reflect the currently understood nature of the relationship. This determination should be thoroughly documented and teams should be wary of dismissing the potential value of the action too early. If an action can not be effectively re-written (as described in number 4 below), then the action should be set aside.

4. The Action Team should attempt to re-write actions (as needed) to make them consistent with current conceptual models without substantially deviating from the initial intent of the proposed action. If the cause and effect relationship implied in the action is no longer valid and the action cannot be rewritten to clarify the cause and effect relationship based on current conceptual models, then the action should be set aside for further consideration during the Gap Analysis (to be conducted after the scientific evaluation process has been completed).

4.3.3 Format for Re-Writing Actions

1. Action statements should be written in a consistent format identifying specific cause and effect relationships (i.e. it should be clear what the action is attempting to accomplish and how the action intends to achieve its outcome - what the linkages are). The suggested cause and effect relationship should be supported by one or more conceptual models which clearly demonstrate the linkage between the action and outcome, including identifying and articulating underlying hypotheses.

2. Suggested consistent format is "Do 'x' action to meet 'y' outcome using 'z' implementation approach." Implementation approach does not need to be detailed, rather it only needs to be clear enough to route the action.

4.3.4 Examples of Re-writing ERP Actions

For illustrative purposes the following presents a couple of ERPP actions and demonstrates how the guidelines outlined would apply.

Example 1:

REDUCING OR ELIMINATING STRESSORS - WATER DIVERSIONS
(ERPP Volume II, pg. 115)

<u>TARGET 1</u>: Reduce loss of important fish species at diversions.

<u>PROGRAMMATIC ACTION 1A:</u> Consolidate and screen agricultural diversions in the Delta.

<u>RATIONALE</u>: Loss of juvenile fish in diversions is detrimental to fish species of special concern (Larkin 1979; Erkkila et al. 1950).

The above Programmatic Action itself contains no cause and effect relationship and the intent (or expected outcome) is also unclear. When viewed in concert with the Target and the Rationale, it is clear that the expected outcome is to reduce the loss of juvenile fish, but the terms "important fish species" and "species of special concern" are vague and would not support linking the action to a specific species model.

A possible re-write of the action might read as follows:

<u>PROGRAMMATIC ACTION 1A</u>: Reduce the entrainment and loss of juvenile winter run Chinook salmon by consolidating and screening agricultural diversions in the Delta.

Note the action could re rewritten to produce actions for several species deemed to be impacted by diversions.

<u>Example 2</u>:

NATURAL FLOODPLAIN AND FLOOD PROCESSES
(ERPP Volume II, pg 100)

TARGET 1: Expand the floodplain area in the North, East, South, and Central and West Delta Ecological Management Units by putting approximately 10% of leveed lands into the active floodplain of the Delta.

PROGRAMMATIC ACTION 1C: Remove levees that hinder tidal and flood flows in the headwater basins of east Delta dead-end sloughs (Beaver, Hog, and Sycamore) and allow these lands to be subject to flood overflow and tidal action.

RATIONALE: Subjecting approximately 10% of existing Delta leveed lands to tidal action and flood flows will greatly enhance the floodwater and sediment retention capacity of the Delta. The tracts at the south end of the Yolo Bypass, along the South Mokelumne River, and along the San Joaquin River channel are logical choices for this because they have limited levee systems and are already at high flood risk. These lands have had limited subsidence and offer good opportunities for restoring tidal wetland/slough complexes.

The above Programmatic Action presents a clear action with a well defined cause and effect relationship (remove levees to introduce flood and tidal processes). Read in

concert with the Target and Rationale the intent of the action and the rationale for the proposed location is further clarified.

Reviewing this action in light of the guidelines suggests there is no need to re-write the action, unless the Action Team determines that it is not consistent with current scientific knowledge.

5.0 Adaptive Management Routing

The process of adaptive management (AM) routing involves categorizing ERP actions that survive the Preliminary Sorting and Initial Evaluation steps into one of five implementation categories:

1. **Targeted Research** – Pursue targeted research.
2. **Pilot -** Pursue a pilot or demonstration project to test the action.
3. **Full-Scale** - Pursue full-scale implementation of the action.
4. **Rewrite and Re-route Action** – Re-write action to reflect an alternative approach.
5. **Discard** – Remove from consideration based on analysis of outcomes.

The first step in routing is to identify and describe the outcome(s) that might be expected to result from a given ERP action. This includes both potential positive and negative outcomes. Outcomes are then evaluated with regard to six routing criteria (see Table 1). Positive and negative outcomes are scored with regard to the magnitude and understanding of the outcome on a scale of 1 to 4 using the definitions shown in Tables 2 and 3. These scores are then combined to estimate the worth of the proposed action and the risk associated with the proposed action (on a scale of high, medium, and low) - as described in Section 5.2. Tables 4 and 5 show how various combinations of magnitude and understanding translate into measured degrees of worth and risk for the purpose of routing.

After the worth and risk of a given action are evaluated, the reversibility of the action and the opportunity for learning associated with the action are scored using a binary score of yes/no and high/low respectively. Definitions for reversibility and opportunity for learning are shown in Tables 6 and 7.

Action Team should rely on the conceptual models (species and ecosystem) as well as other sources of information in identifying outcomes (positive and negative) and the magnitude and understanding of each. The team may explore modifications to the conceptual models during this process.

The Action Team should focus on the one best outcome for the target (species or habitat) and the one greatest potential negative impact. Other potential positive and negative ecological outcomes that are identified should be documented but not vetted. The list of additional outcomes can be referred to during the gap analysis and prioritization. Non-ecological outcomes (positive and negative) such as impacts on navigation or other resource considerations should be noted during the scientific evaluation process if they come up.

If an action is not reflected in the conceptual models, then the action should be re-written based on other information and/or the conceptual model should be modified. If the action contradicts the conceptual model, then the action should be set aside.

5.1 Assessing the Magnitude and Understanding of Ecological Outcomes

Action Teams use the species and ecosystem element conceptual models, as well as their individual expertise, to evaluate the *magnitude* of the likely positive and negative ecological outcomes from the implementation of a given ERP action for the Delta. The content of these evaluations are documented so that the rationale behind all identified positive and negative outcomes can be tracked throughout the routing process. Outcomes are scored for magnitude according to the definitions shown in Table 2.

The level of understanding regarding the outcomes of a particular action will greatly depend on the input of species experts, Action Team experience, and the ecosystem conceptual models. Levels of understanding are based on the scientific information supporting the linkage between the action and expected outcome. Outcomes are scored for understanding according to the definitions outlined in Table 3.

If there are legitimate differences of scientific opinion regarding some aspects of how the system works that have resulted in competing conceptual models, then the action should be given multiple scores based on each of the models which are converted to values of worth and risk and routed through the decision tree as described below. If the different scores based on the different conceptual models result in different recommended implementation strategies, then the more conservative of the strategies should be selected. For example, if the differences in the conceptual model result in two routing outcomes, "pilot" and "targeted research", then "targeted research" as the more conservative implementation strategy should be selected.

5.2 Estimating Degrees of Worth and Risk

After an action is scored for magnitude and understanding, these evaluations are converted to measures of worth and risk so they can be routed through a decision tree (see Figure 5). A conversion table is used to convert the scores of magnitude and understanding to measures (high, medium, and low) of ‘worth’ for positive effects, and ‘risk’ for negative effects.

The worth of an action is represented as a function of the predicted magnitude and understanding of its positive outcome. For example, if it is well understood that an action will have a large positive ecological effect, then that action is considered to have a high degree of worth. Similarly, the risk associated with an action is represented a function of the predicted magnitude and understanding of its negative outcome. For example, if it is well understood that an action will have a large negative ecological effect, then that action is considered to have a high degree of risk. Degrees of worth and risk are used to route actions through a decision tree which selects an appropriate implementation strategy (full-scale, pilot, targeted research, or discard).

Table 4 shows how scores for a given outcome are converted to a measure of the degree of the action's worth or risk. Understanding and magnitude of the outcome are considered in order to provide a grade of high, medium, or low for the action. The resulting degrees of worth and risk are used to route the action through the decision tree with the other criteria.

5.3 Reversibility

The reversibility criterion attempts to capture the degree to which any particular action or group of actions, when implemented, can be undone or reversed. The score takes into account a subjective assessment of ease and costs associated with reversing the action as defined in Table 5.

5.4 Opportunity for Learning

This criterion asks the questions:

1. "How much can we learn if we perform this action?" and
2. "Will this action help improve other actions or the overall ERP?"

A score is assigned to these criteria for each action to attempt to capture how it will contribute to the overall state of knowledge in the area as defined in Table 6.

If the opportunity for learning is low, then the decision tree provides a second opportunity to ask about in the level of understanding regarding the identified outcomes (positive and negative) as defined in Table 3. If the Action Team confirms that there is a high degree of understanding regarding the positive and negative outcomes (e.g., ranking of 3 or 4), then the action is discarded. If the team determines that the outcomes are not well understood (e.g., ranking of 1 or 2), then the decision tree asks if there is an alternative implementation approach that might be pursued. If there is an alternative approach, this approach is defined; the action is re-written and re-routed. If there is not an alternative implementation approach, then the decision tree asks if there is a research action that would increase the level of understanding regarding the likely outcome of the action. If such a research action can be identified, then the action is routed to "targeted research" as shown in the decision tree (see Figure 5).

Table 1 – Definitions of Adaptive Management Routing Criteria

Magnitude of Positive Outcome –The magnitude of anticipated positive ecological effect. Understanding of Positive Outcome - The estimated level of understanding, based on the state of the science and experts' knowledge and experience, that the action will result in expected positive ecological effect to a species, process, stressor reduction and/or habitat enhancements. Magnitude of Negative Outcome – The magnitude of anticipated negative ecological effect. Understanding of Negative Outcome – The estimated level of understanding, based on the state of the science and experts' knowledge and experience, that the action will result in potential negative ecological effect. Reversibility – The ease and certainty with which an action or a group of actions could be undone and/or reversed, e.g. a change to a flow regime is relatively easy to reverse, successful introduction of a new species is relatively difficult to reverse. Opportunity for Learning – The likelihood that an action or a group of actions will increase the level of understanding with regard to the species, process, condition, region or system that is in question or of concern.

Table 2 - Magnitude of Ecological Outcomes (positive and negative)

4 = High magnitude: expected sustained major population level effect (e.g., addresses key limiting factor) or landscape scale habitat effect
3 = Medium magnitude: expected sustained minor population effect or effect on large area of habitat
2 = Low magnitude: expected sustained effect limited to small fraction of population or limited spatial or temporal effects
1 = Conceptual model indicates little or no effect

Table 3 -Understanding of Ecological Outcomes (positive and negative)

4 = Understanding is based on peer-reviewed studies from within system and scientific reasoning supported by most experts within system.
3 = Understanding based on peer-reviewed studies from outside the system and corroborated by non peer-reviewed studies within the system.
2 = Understanding based on non peer-reviewed research within system or elsewhere.
1 = Scientific basis unknown or not widely accepted

Table 4 – Conversion Table for the Degree of Worth and Risk of an Action

Outcome		Understanding			
		1	2	3	4
Magnitude	1	***Low***	***Low***	***Low***	***Med***
	2	***Low***	***Low***	***Med***	***High***
	3	***Low***	***Med***	***High***	***High***
	4	***Med***	***High***	***High***	***High***

Table 5 - Reversibility Scores

Yes/Easy = Action could likely be reversed as or more quickly and cheaply than original action

No/Hard = Reversing action would require more time or more money than implementing action; action may not be completely reversible

Table 6 - Opportunity for Learning Scores

High = Expect to advance our understanding of critical uncertainties as identified in CMs in a quantifiable manner.

Low = Impractical or excessive time or resources likely required to achieve such understanding.

Figure 5: Decision Tree for the Adaptive Management Routing Process