FINAL

DEPARTMENT OF WATER RESOURCES DIVISION OF FLOOD TRACKING SYSTEM

Summary Report

Prepared for

California Department of Water Resources

October 2019

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Prepared for:

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SECTION 1
Introduction

Background

The Central Valley Flood Protection Plan (CVFPP) recommends that the California Department of Water Resources (DWR) develop a system for tracking performance of the flood system, including the following actions:

- Track the outcomes from flood investments to demonstrate value.
- Monitor and track outcomes of multi-benefit projects over time.
- Create a tracking system of operations and maintenance investments and outcomes to demonstrate the value that Local Maintaining Agencies attain for their investments.
- Track and report changes in the hydrologic and sea level rise conditions and subsidence over time through updates to the Flood System Status Report (FSSR)

These recommendations stem from progressive work during the development of the 2012 CVFPP and subsequent 2017 CVFPP update.

This report documents work completed through Environmental Science Associates' (ESA's) Task Order 33 to develop the DWR Division of Flood Management (DFM) Tracking System. The DWR DFM Tracking System tracks the 2017 CVFPP outcomes related to: (1) improving flood risk management and (2) enhancing ecosystem vitality. To that end, Task Order 33 developed a performance tracking system to track the status, trends, and changes over time of the ecosystem (including the Conservation Strategy's Measurable Objectives [CSMOs] as of 2016) and the state's flood control infrastructure (including levees, channels, and hydraulic structures as documented in the FSSR as of 2017).

Performance tracking offers a number of benefits to DWR, including the ability to demonstrate value and return on investment (which facilitates public support for future funding requests) and the ability to adaptively manage the flood system. In addition, performance tracking promotes accountability and transparency among taxpayers, DWR, the California State Legislature, and Local Maintaining Agencies. The DWR DFM Tracking System also allows for course-corrections as needed to improve the effectiveness and efficiency of program implementation.

Users will find that this tracking system demonstrates progress toward achieving the CVFPP's primary and supporting goals, as well as return on investments. In addition, it supports pursuits of future funding for state flood management programs.

Scope and Purpose

ESA supported DWR in developing a tracking information system covering the area within the Systemwide Planning Area (SPA) to support implementation of the CVFPP and continued improvement of DFM programs. The primary purpose of the system is to document the status and trends of natural resources in the flood system and enable reporting relative to the CVFPP CSMOs and other management and regulatory drivers. DWR collaborated with ESA to define the specific needs and objectives of the system as related to the CSMOs. Through that process, a separate need to document the status, trends, and changes over time of the conditions of the state's flood control infrastructure emerged.

ESA then developed a conceptual model (Figure 1) for how the DWR DFM Tracking System could be used to monitor near- and long-term changes in flood system status.

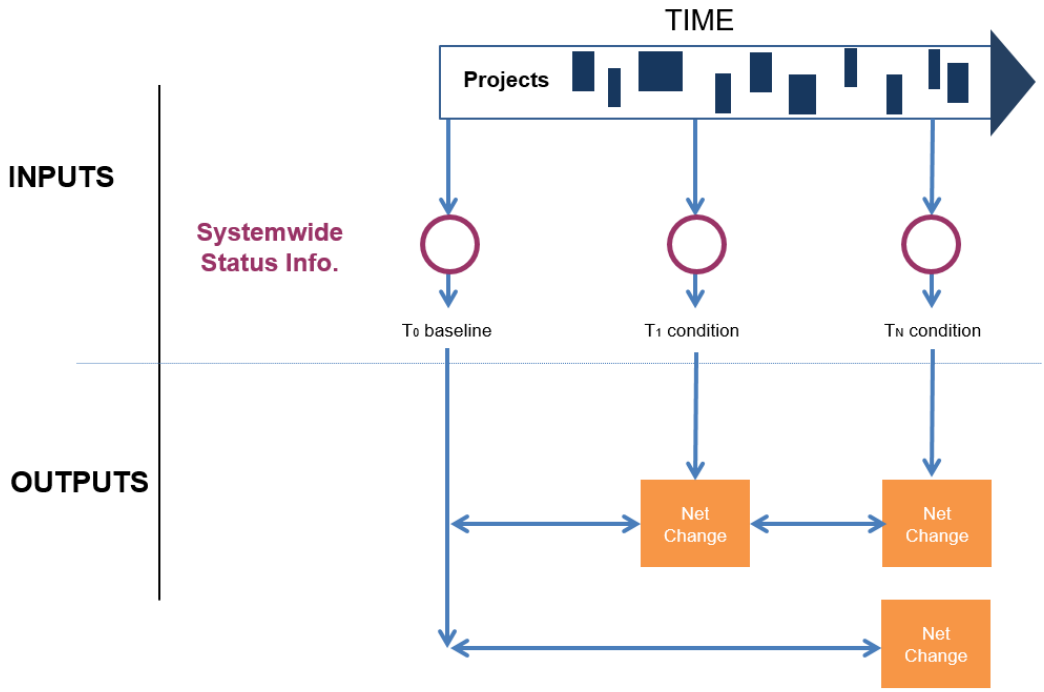

Figure 1. Conceptual Model of DWR DFM Tracking System

Projects and management actions could be input (as shown across the top of Figure 1) into the tracking system. Broad-scale system status information (purple circles in Figure 1) could be input after large flood events or after a sufficient amount of time has passed for a parameter being tracked to evolve (vegetation is a good example; not much change is detectable with just 1 year between data points, but after 10 years new communities may have evolved). A user would be able to query the application to evaluate the change in a particular metric over time (net change analysis), and the system can evaluate project-specific changes related to system-wide trends (interim conditions estimate).

Building off of the conceptual model and understanding of the information stored and captured in the system, ESA worked with DFM staff to create a data schema that included SPA ecosystem- and flood infrastructure-related information. ESA then coordinated with DFM staff to create a front-end application that includes several key components, such as data entry, search, reporting, and QA/QC review. These collective back-end and front-end components constitute the DWR DFM Tracking System, and will allow DWR staff to manage, retrieve, query, map, and store geo-referenced information such as: existing and updated system-wide habitat conditions; management action (project) data, including data on both anticipated impacts and beneficial outcomes; significant replacement and repair activities; and data from the FSSR. ESA conducted user interviews to identify the information needs, design the repository structure, develop draft reporting formats, and collect and compile data from various sources. ESA worked as directed to consolidate, associate, and upload and/or geo-reference this information into the repository. That work also included the definition and development of maintenance and update tasks for the system, as documented in this Summary Report.

Through Task Order 33, as amended, ESA provided DWR with the following deliverables (those deliverables related to project planning and management are omitted):

- Application and assets deployed to the California Data Exchange Center (CDEC) server (Task 3 deliverable)
- Index of electronic files and appropriate documentation (Task 4 deliverable)
- This Summary Report detailing work completed and maintenance and update tasks for the system (Task 4 deliverable)
- User Guide (Task 4 deliverable, under separate cover)

This Summary Report includes the following components:

Section 1 Introduction (this section)

Section 2 Development Steps

Section 3 DWR DFM Tracking System

Section 4 Maintenance and Updates

Section 5 Recommendations

Appendix A – Status of User Stories and Backlog

Appendix B – Developer System Documentation

Appendix C – Outstanding Questions and Recommendations

Appendix D – Workflows

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SECTION 2
Development Steps

ESA followed the Agile Software Development Process, as described in the Workplan (Task 2 deliverable; provided to DWR in 2017, finalized in 2018). The following sections outline the Agile work steps completed to develop the system.

Requirements and documentation

Before developing the DWR DFM Tracking System or any data, ESA conducted a series of "focus meetings" to identify system user needs, collect user stories, and discuss the potential features and functions of the tracking system. ESA worked with DWR staff to prioritize the user needs. The details on user stories and data needs are included in **Error! Reference source not found.**.

Data capture, collection, and processing

ESA worked closely with DWR staff to identify the geospatial and tabular data needed and to develop the workflows to implement the user stories. We also conducted a gap analysis to identify which data were not readily available. Those that were not available were developed by DWR and ESA in order to implement the tracking system functions and features. ESA then collected geospatial data from DWR sources and pre-processed the data to align to a standard data format for use in the system.

The data supporting the 2017 FSSR were readily available but required some pre-processing. Some of the CSMO data, however, required additional manipulation, adaptation, and formatting from broader regional datasets. In addition, no sample "project data" were readily available to test the DWR DFM Tracking System via input as sample projects; ESA had to develop synthetic project datasets representative of the range of metrics and geographies within the Central Valley accordingly.

The primary spatial data layers used to implement the tracking system are included in the following list in Table 1. Table 1 shows the data layer name, the source of the data, the planned update frequency of this layer, and notes on coverage of that layer within the SPA.

TABLE 1
SPATIAL DATA AVAILABILITY, UNITS, COVERAGE, SOURCE, AND UPDATE FREQUENCY

Metric	GIS Layer	Type	Units Field	Coverage/Limitation of Baseline Data	Source	Update Frequency
Ecosystem:						
Floodplain inundation	Ecosystem_Floodway	polygon	Acres	Major River Reaches only	DWR	unplanned
Natural bank	Ecosystem_NaturalBank	linear	Miles	Major River Reaches only	DWR	~ 5 years or as available
River meander potential	Ecosystem_RiverMeander	polygon	Acres	Middle/Upper Sacramento River only	DWR	unplanned
SRA Cover	Ecosystem_SRA	linear	Miles	Major River Reaches only	DWR	unknown
SRA Cover - Natural bank	Ecosystem_SRA	linear	Miles	Major River Reaches only	DWR	unknown
Habitat - Riparian	Ecosystem_Habitat_Riparian	polygon	Acres	Entire systemwide planning area	CDFW	5 years
Habitat - Marsh and wetlands	Ecosystem_Habitat_Wetlands	polygon	Acres	Entire systemwide planning area	CDFW	5 years
Stressors - Revetment	Ecosystem_Revetment	linear	Miles	Major River Reaches only	DWR	~ 5 years or as available
Stressors - Levees	Ecosystem_Stressors_LeveeLength	linear	Miles	systemwide planning area	DWR	unknown
Stressors - Fish passage barriers	Ecosystem_FishPassageBarriers	point	N/A	systemwide planning area	DWR	unknown
Stressors - Invasive plants	Ecosystem_Stressors_Invasives	polygon	Acres	systemwide planning area	CDFW	5 years
Flood System Status:						
Levees						
Overall Hazard Classification	FSS_Levees_OverallHazard	linear	Miles	systemwide planning area	DWR	No planned updates
Geometry	FSS_Levees_Geometry	linear	Miles	systemwide planning area	DWR	unknown
Underseepage	FSS_Levees_Underseepage	linear	Miles	systemwide planning area	DWR	unknown
Through Seepage	FSS_Levees_ThroughSeepage	linear	Miles	systemwide planning area	DWR	unknown
Structural instability	FSS_Levees_StructuralInstability	linear	Miles	systemwide planning area	DWR	unknown
Erosion	FSS_Levees_Erosion	linear	Miles	systemwide planning area	DWR	unknown
Settlement	FSS_Levees_Settlement	point	N/A	systemwide planning area	DWR	unknown
Penetrations	FSS_Levees_Penetration	point	N/A	systemwide planning area	DWR	unknown
Levee vegetation	FSS_Levees_LeveeVegetation	point	N/A	systemwide planning area	DWR	unknown
Burrowing animals	FSS_Levees_BurrowingAnimals	linear	Miles	systemwide planning area	DWR	unknown

TABLE 1
SPATIAL DATA AVAILABILITY, UNITS, COVERAGE, SOURCE, AND UPDATE FREQUENCY

Metric	GIS Layer	Type	Units Field	Coverage/Limitation of Baseline Data	Source	Update Frequency
Encroachments	FSS_Levees_Erosion	point	N/A	systemwide planning area	DWR	unknown
Channels						
Conveyance capacity (rating)	FSS_Channels_ConveyanceCapacity	polygon	Acres	systemwide planning area	DWR	unknown
Channel vegetation	FSS_Channels_ChannelVegetation	point	N/A	Smaller/upstream tributaries only	DWR	unknown
Channel sedimentation	FSS_Channels_ChannelSediment	point	N/A	Smaller/upstream tributaries only	DWR	unknown
Structures						
Hydraulic - Structural inspection rating	FSS_Hydraulic_StructuralInspection	point	N/A	systemwide planning area	DWR	unknown
Hydraulic - Vegetation and obstruction rating	FSS_Hydraulic_VegetationObstruction	point	N/A	systemwide planning area	DWR	unknown
Hydraulic - encroachment inspection rating	FSS_Hydraulic_Encroachment	point	N/A	systemwide planning area	DWR	unknown
Pumping plant inspection rating	FSS_PumpingPlants_InspectionRating	point	N/A	systemwide planning area	DWR	unknown
Bridge condition	FSS_Bridges_Conditions	point	N/A	Sutter Bypass area only	DWR	unknown

NOTES:
Update frequency – unplanned: there is no current plan to update this layer; unknown: it is unknown at the time of preparing this report what the update frequency is for this layer.
"Stressors - Targeted Species" remains a metric data gap.
* Where Field Name = N/A, the layer itself serves as the metric.
CDFW = California Department of Fish and Wildlife
DWR = California Department of Water Resources
SRA = Shaded Riparian Aquatic habitat

ESA worked with DWR staff and the project team to develop workflows for integrating project geospatial data with the system-wide GIS spatial data (also called base data or existing conditions data). For example, what logic would the tracking system use behind the scenes to "add" new floodplain or riparian projects to the current floodplain and riparian areas in the SPA? Figure 2 shows existing conditions system-wide GIS data in the first box, with levees that do not meet criteria in red, levees that meet criteria in green, riparian habitat in light green, and revetment in black. In Box 2, new projects are added. Project 1 improves the poor section of levees (represented by the full green line segment), Project 2 removes revetment (represented by the black dashed line), and Project 3 sets back the poor section of levee (green line) and, in doing so, removes the poor section of levee (red dashed line) and adds riparian habitat (represented in green polygons). Box 3 shows the addition of all of these in the landscape, and Box 4 shows the "final" new existing conditions after the projects have been implemented.

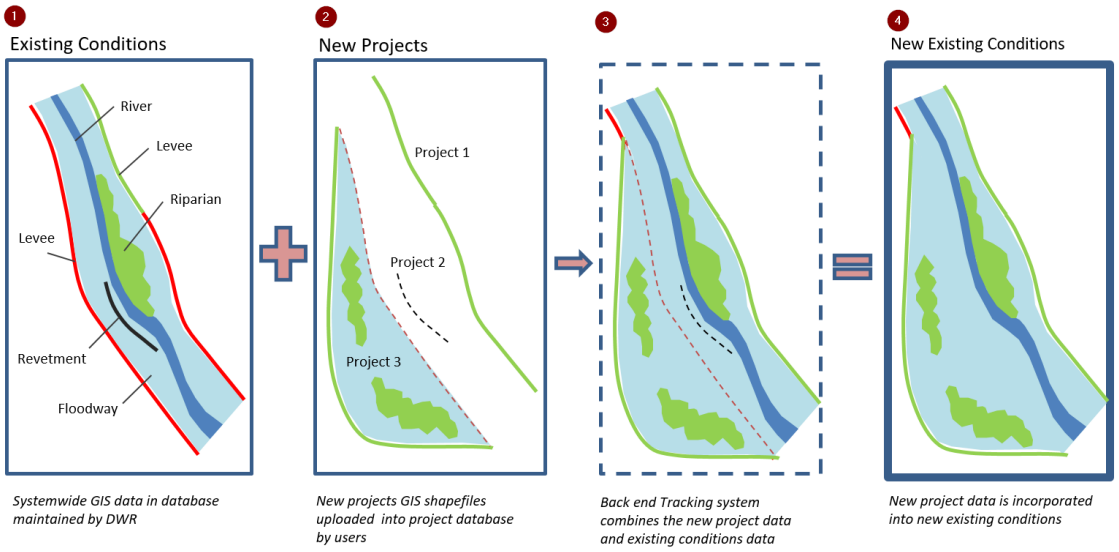

Figure 2. Workflow shows how new projects are added to update existing conditions

This process was developed for each of the metrics so that as a user uploads a project, the "system" performs the appropriate "math equation" to get to a new Existing Conditions. In this phase of the tracking system, steps 1 and 2 are performed by a DWR user who uploads project data. Step 3 above is performed through a quality assurance (QA)/quality control (QC) process whereby a data steward or tool manager reviews the uploaded projects, combines them, and re-uploads them back to the system to get to Step 4. It is anticipated that, in future phases of the project, it will be possible for these steps to be more automated, requiring less work of the data steward.

Appendix D., includes PowerPoint sketches of some of the workflows ESA developed for various metrics.

Design

ESA design staff developed initial wireframe concepts to provide a static visual representation of the user interface for the DWR DFM Tracking System (

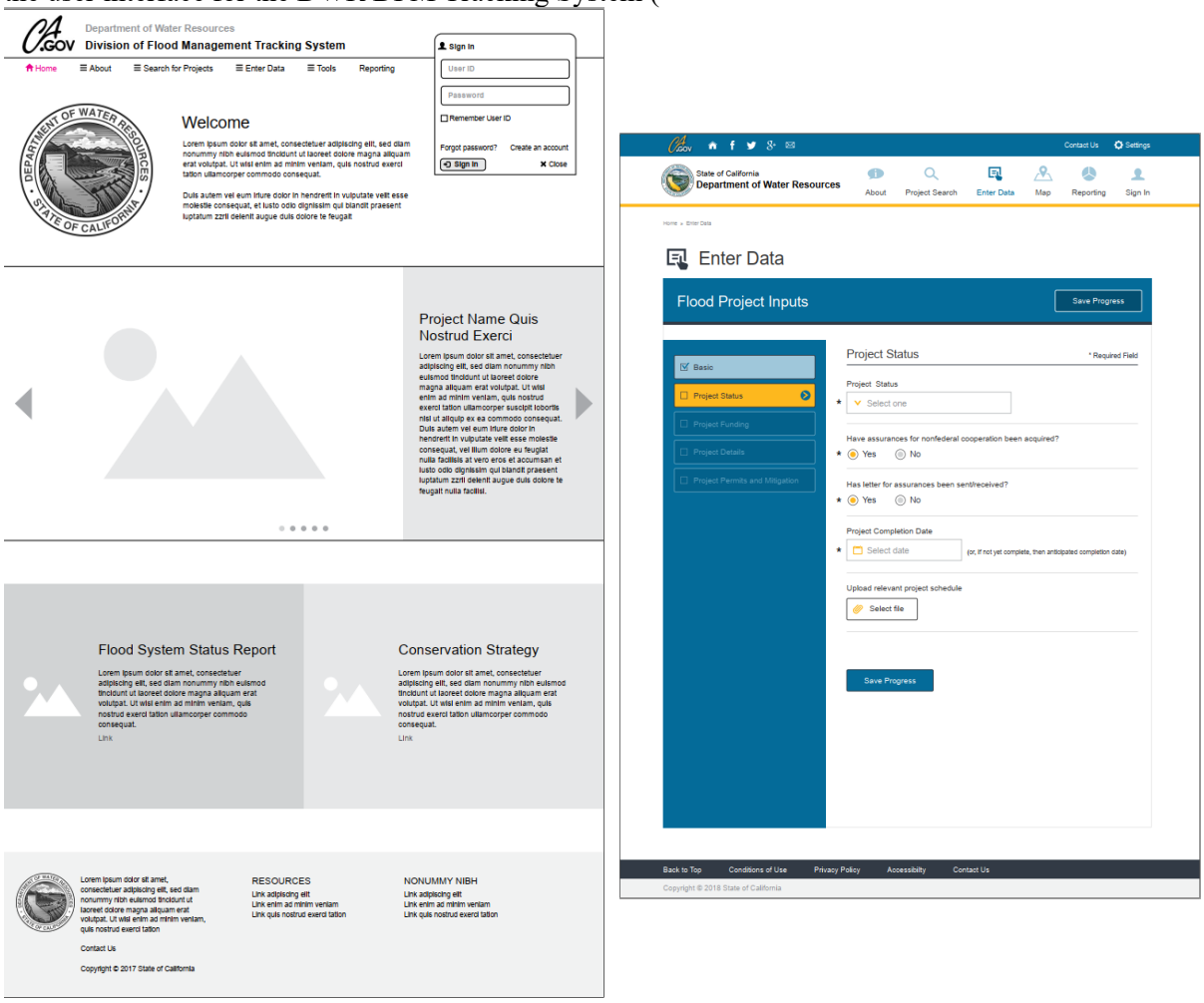

Figure 3). DWR staff were provided several rounds of review to give input and recommend revisions that were incorporated into design elements. This included the data entry and review pages, the search and mapping pages, as well as the design of preliminary reports. ESA then developed a series of design compositions incorporating DWR's branding guidelines and color to system features. The final implemented design compositions align and are compatible with DWR's master website guidelines.

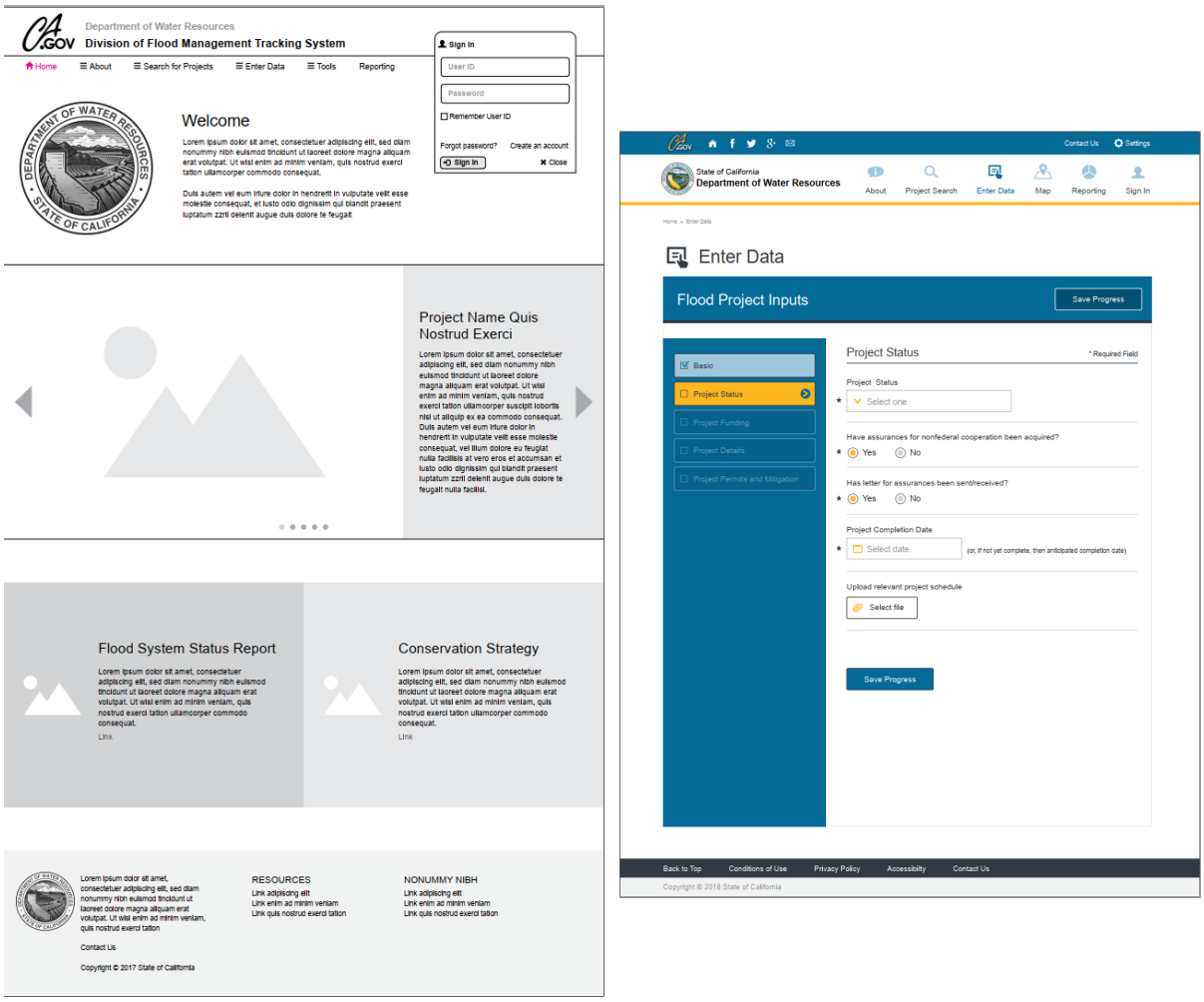

Figure 3. Early wireframe and design composition examples showing the application landing page (left) and an enter data page (right)

Code testing, quality control, and deployment

After design, data, and user requirements were defined, ESA implemented the design to build the system. As functions were being built, the tracking system development schedule included a series of releases. Each release entailed internal testing, feedback, and revisions. ESA used Trello (Figure 4) to track the status of features and functions and issue tracking for each Sprint.

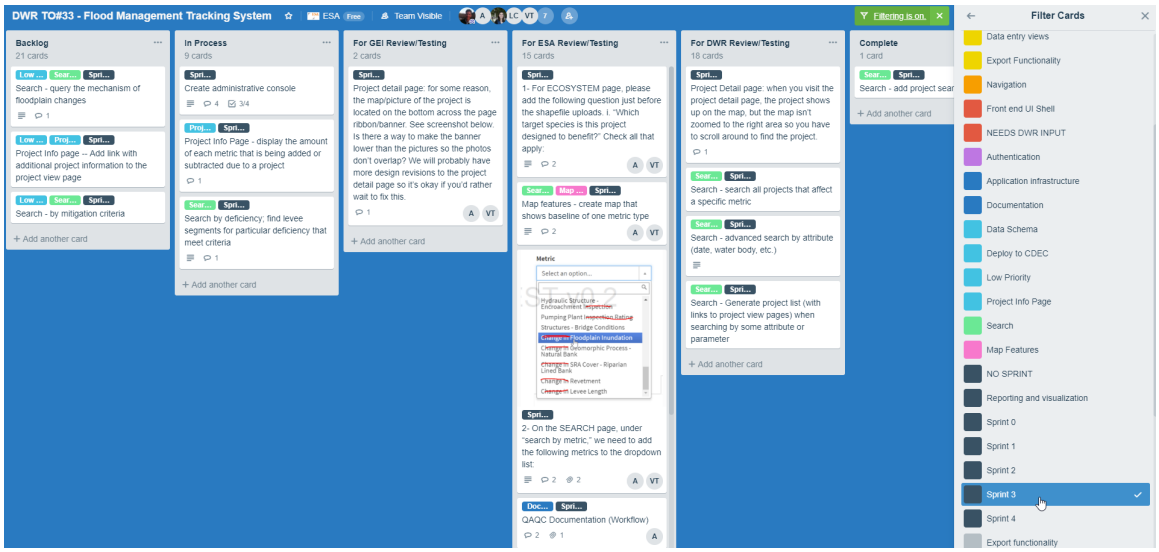

Figure 4. Software development project features, functions, and issue tracking in Trello

Feedback was incorporated and a newer version was released to DWR for further testing. DWR feedback was subsequently incorporated into the next release of the tracking system. This process entailed fixing any issues, including bugs, and then deploying revised versions. The final version will be deployed to the production (CDEC) server.

SECTION 3
DWR DFM Tracking System

System needs

System needs and requirements were determined based on 112 user stories that came out of the initial focus group meetings and additional Task Order 33 project meetings as the designs progressed (**Error! Reference source not found.**). There was a lot of overlap between user stories; as such, the user stories were distilled into 14 primary features and functions identified below, most of which were built into phase one of the project; outstanding features and functions were placed into a feature product backlog. The primary needs identified by DWR included: data collection, data entry, upload and download, search and query, web mapping, summing, and reporting. More needs can be built into the system in future phases. There are still outstanding features and functions in the product backlog. In Appendix A, the outstanding features are indicated by the status which is either "partially implemented" or "not yet implemented."

Description

The DWR DFM Tracking System is an online tool that enables DWR to track the performance of the flood system using metrics established in the Conservation Strategy and FSSR. Users upload information about projects that are implemented on the landscape and the system is able to calculate changes in the metrics to observe both how the system is performing at any point in time, as well as how the system is changing over time. The initial version of the tracking system delivered through Task Order 33 was developed based on user needs and enables users to enter data, search, query, view projects and results on a map, and produce reports useful in their daily work or to policy and decision-makers.

Features

The tracking system performs a range of basic and complex functions, each of which are identified below, and are organized by the corresponding web page within the application where that function is performed. The companion document to this section is the *DWR DFM Tracking System User Guide* (User Guide), which explains in detail how a user would perform each of these features and functions.

Home page

- Login page with password reset ability
- About page with links to parent CVFPP, FSSR, and CSMOs
- Scrolling banner with links to tool pages or to more information

Enter Data Page

- Ability to add project information, including geospatial information (shapefiles), project type, status, funding, ecosystem benefits, and changes to FSSR or ecosystem metrics (see User Guide for details)
- Ability to view a list and details of projects that are in the process of being submitted

QA/QC Page

- Ability to review, download, and validate project information as a QA/QC data steward
- Ability to update and approve revised base dataset following the addition of project data

Search Page

- Ability to search for projects and metrics, and to filter by various parameters, including date range, project type, metric affected, funding source, and location
- Ability to view search results in both map and in list-based views
- Detailed project view page includes project descriptions, changes to metrics, and map
- Interactive map allows user to turn on and off layers and to view projects and base data (existing conditions)

Reporting page

- Option to select from Status, Progress, and Targets reports, Financial and Funding reports, or Other reports
- Dashboard report displays metrics organized by ecosystem, levees, or channels and structures
  - Ability to customize reports by metric, project completion date, project type, project status or development stage, and location
  - Report provides snapshot of existing conditions in the SPA, as well as changes to existing conditions over time, and compares progress from projects against targets set in the 2016 Conservation Strategy
  - Ability to generate a report specifically focused on one metric
  - Ability to view all projects accounted for in a particular query
- Financial and Funding report displays funding project totals organized by project type, date range, conservation planning area, and the funding source or agency that funded a project

SECTION 4
Maintenance and Updates

The utility of this application depends completely on the presence and accuracy of the data captured therein. Specifically, in order to assess the existing conditions of the SPA at any given point in time, and to track how the system is changing over time and making progress toward targets due to projects, it must be kept up to date and maintained in a timely manner. Queries and reports rely solely on the information captured in the tracking system, and therefore accurate reporting requires that the latest information is in the tool.

The DWR DFM Tracking System contains three primary categories of data: system-wide data, project data, and static data—examples of which are shown in Table 2.

TABLE 2
DATA TYPES AND UPDATE FREQUENCY FOR DWR DFM TRACKING SYSTEM

System-wide	Project	Static

• Geospatial
• Existing conditions or "base data"
• **Low** update frequency
	• Geospatial & attribute
	• Project impacts & benefits
	• Project details
	  • Funding & costs
	  • Completion date and project status,
	  • Mitigation information
	  • Target spp.
	• **High** update frequency
		• Geospatial
		• Planning & jurisdictional boundaries
		• Water bodies
		• **Low** update frequency

Existing conditions or system-wide data (often called "base data layers") represent the amount and status of levees, channels, and structures in the SPA presently (time step 0). Examples of the ecosystem existing conditions include the vegetation data layer from which the ecosystem metrics were developed. Project data is the geospatial and attribute information about individual projects that will be uploaded by users as projects are developed or completed. Finally, static data includes data that will not change, and it is often used as an organizing principle or parameter; for example, boundaries, conservation planning areas, or water bodies.

Updating the project inventory

As projects are completed or approved, they must be uploaded into the tracking system in order for DWR to continue to track the benefits and changes to the flood system, the progress toward metrics, and the costs of these investments. To ensure that the tracking system provides the most accurate reporting functions possible at any given point in time, it is recommended that all new projects are uploaded into the tracking system on a quarterly or more frequent basis. Because it is possible to modify project information over time, there is an opportunity to upload a project when it is in planning stages and then modify it if construction or completion differs from the original plan. Without adding in these regular updates, reports will not be able to capture the changes to the CSMOs and other metrics over time.

Updating base/existing conditions data and static data

Over time, the DWR DFM Tracking System will capture changes to the ecosystem and State Plan of Flood Control (SPFC) facilities and will "automatically" update the system-wide data over time. However, some base information may change; for example, if a major flood, fire, or other major disruption occurs that would affect habitat and/or flood infrastructure conditions. Therefore, some base data layers like vegetation may need to be updated beyond the changes occurring from projects. Static data such as outlines of congressional districts or the boundaries of Regional Flood Management Plans are less likely to change than other types of data—it is therefore not anticipated that these data will be updated. However, if they do change, it would be appropriate to update them.

Data Steward or Data Stewardship Team

A data steward, or person(s) whose job it is to manage the DWR DFM Tracking System, will play a key role in ensuring the functionality of the tool. This role likely requires a number of individuals that comprise a Data Stewardship Team. Among other actions, the team will ensure timely updates to project data, system-wide data, and static data if needed. They also play a key role during the project data entry process whereby they will review and validate all project data that are entered in the project system. They will then use this information to update the base data. Each of these steps is critically important in order to assess the existing conditions of the SPA as well as how those conditions are changing from projects or other management actions.

SECTION 5
Recommendations

The initial version of the DWR DFM Tracking system delivered through Task Order 33 implemented the core functionality of the tracking system, and more work is needed to maximize its benefit for DWR. Use of the application will likely generate suggestions for refinements to existing functions as well as development of additional features. In addition, a number of other features and functions that can enhance the tracking system were identified during this initial development phase of the effort. Those features and functions are based on "user stories" that were collected and rated by DWR and ESA as high, medium, low, or no priority; the status of these user stories, and a backlog, can be found in Appendix A and may be implemented in future phases of the project.

DWR will need to develop a process for collecting projects to enter in the tracking system. The process could require projects in the SPA funded by State grants or bonds submit project data to the Tracking system, for example, or as a Phase 3 requirement of Regional Flood Management Planning efforts. To date, there is no mechanism that requires projects be entered into the system—however, collecting projects is essential to the tool's utility. DWR should consider collecting project data that reflects all impacts to the metrics (positive and negative) to facilitate accurate Tracking system updates. The process should also identify the roles and responsibilities of members of the Data Stewardship Team.

This initial effort tracks progress for some of the metrics identified in the CVFPP. A number of other metrics may be developed for tracking at DWR. As additional metrics are developed, it will be determined whether they are more appropriately tracked within the existing DWR DFM Tracking System or within a new tracking system that is constructed differently and performs other functions. We recommend close coordination with ESA during this process. Additional recommendations are included in Appendix C: Outstanding, Key Questions and Recommendations.

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Appendix A

Status of User Stories and Backlog

Table A-1 in Appendix A includes a list of the 112 user stories developed as of June 2019 and the status of whether or not each has been implemented. It is likely that by the time of this printing, and as the project evolves in the coming year, more user stories will be implemented as prioritized by DWR and the ESA project team. As described in the Workplan, user stories were identified by DWR staff through a series of focus and project meetings, and they informed the functions and features described within Section 3, Features.

Of the 112 total user stories, 71 of them were implemented, 27 were partially implemented, and 15 were not implemented. The features implemented were identified as priorities by both DWR staff and the consultant team. These features are described in Section 3 of the Summary Report and include the primary and basic functions on the tracking system. The project team and DWR staff may wish to implement some of the remaining user stories in the future (or new ones yet to be identified). The primary reasons for not yet implementing 42 of the user stories are described below, organized by theme.

Limitations of existing reporting capabilities. In some cases, a user story requests to query by certain information; while the data entry currently *captures* that information, the reporting and querying abilities do not yet have the ability to query *for* that information. For example, the data entry includes identifying whether projects are flood safety only, or restoration. It also enables identifying the target species that should benefit from any project with identified ecosystem benefit, and whether projects use or create mitigation credits. However, the query options and reporting do not enable users to query those things. In this case, implementing these user stories would require a minimal amount of effort relative to some other not-yet-implemented features.

Limitations of data collected for the tracking system. The user stories not implemented include primarily (i) advanced queries and (ii) reports, or, queries for information that was not collected in the initial data collection process. For example, the base information and metrics for CSMOs and FSSR information are in the tracking system. But the raw land cover or fine vegetation data layer is not. Therefore, at this moment in time, it is possible to observe changes in CSMOs, but it is not possible to query how specific vegetation types on the landscape have changed.

Attribution challenges. In more than two user stories, the request was to identify how much of a particular metric can be attributed to a particular funding source. Implementing this function became impossible, however, because it was found that project funding is impossible to parse out by metric. For example, if a $15 million project created riparian and floodplain habitat by setting back a levee, there is presently no way to attribute how much of that money went toward the floodplain versus riparian habitat. If this was an important metric to capture, additional fields could be created in the database to capture project funding at this level.

More information or process needed. To date, only some project types and management actions are trackable in this system using the metrics available—for example, levee improvements and habitat restoration. Others, such as risk awareness, flood proofing, and land use planning are not measurable using the existing metrics, and new metrics or processes would be required to track them appropriately. In addition, the system will not track the removal or negative impact on CSMOs, only the addition of them. This can be accommodated through the project entry process

if DWR wishes its project managers to develop shapefiles for the metrics that are negatively impacted and by adding a subtraction function to the application. Therefore, implementing user stories related to seeing the negative changes of CSMOs will have to wait until there is a way to capture this process.

Tracking system design and navigation preferences have evolved. Two user stories are out of date and no longer relevant because DWR preferences evolved over time. For example, one instance requests to view a particular page, but through the evolution of the system and features, that exact page no longer exists. The functions initially intended for it are on other pages.

Additional backlog items for consideration include:

1. Automated or other user registration processes.
2. Reporting out of metrics in some way other than by CPA/Total.
3. Automated QA/QC and data updating process following project data entry.
4. Add query or reporting parameters to enable users to search by more criteria (the data entry step collects a lot of information and search or reporting features could be modified to extract this information).

TABLE A-1
BACKLOG OF USER STORIES AND IMPLEMENTATION STATUS

ID	User Story	Priority Assigned	Status	User	I want	So that
1	Outside requirement	High	implemented	DWR Site Administrator	to create Administrative access privileges	I can add named users and permissions for tiered authentication into the system
2	Outside requirement	High	implemented	User who will enter project data	To create geospatial files of each CSMO that will change due to a project (e.g., a polygon of the new floodplain that will be created and a polygon of new SRA that will be created	I can view projects on a map
3	Website Design/Options	High	implemented	User who will visit the site, review and query information	to access site-level navigation from the landing page	I can perform primary functions in the application: search/query; enter data; view a map; or go to a reporting page
4	Website Design/Options	High	implemented	User who will visit the site, review and query information	The project view page to show where the project is located on a map	I can see where the project is located
5	Website Design/Options	Medium	implemented	User who will visit the site, review and query information	I want an individual project view	To review a project and all pertinent information
6	Website Design/Options	High	implemented	User who will visit the site, review and query information	A project search feature	I can search for a project by entering its name or key word
7	Website Design/Options	Medium	implemented	User who will visit the site, review and query information	An advanced search function on the project search page that enables me to search by: waterbody; project name; project ID; project type; metric; year; funding source; date range; location; keyword; flood board permit	I can search for projects by parameters:
8	Base GIS information	Low	implemented	DWR Program Manager (FSSR or CSMO)	the ability to import updated base data/ existing conditions information into the tracking system	I can track changes over time or due to projects against the base information
9	Base GIS information	High	implemented	User who will enter project data	to import a GIS shapefile of my project in the project data entry page	I can keep a spatial program inventory of flood/ restoration/management actions
10	Export Information	Medium	implemented	User who will visit, review, query and download information	To download/export GIS data	I can work in in Desktop GIS to overlay and analyze data from the tool in combination with other layers
12	Query by parameter	High	implemented	User who will visit the site, review and query information	to query projects by date range	I can produce a report that identifies all projects completed within a specified date range

TABLE A-1
BACKLOG OF USER STORIES AND IMPLEMENTATION STATUS

ID	User Story	Priority Assigned	Status	User	I want	So that
13	Query by parameter	High	implemented	User who will visit the site, review and query information	to query all projects that affect a given metric	I can assess the performance of system-level functions
14	Query by parameter	Medium	implemented	User who will visit the site, review and query information	To query projects that will remove fish barriers	I can track how many fish barriers have been removed
16	Query by parameter	High	implemented	CVFPB Board or Staff Member	Filter project by year and flood board permit	
17	Query by parameter	High	implemented	User who will visit the site, review and query information	to filter/search for projects by some parameter (i.e., conservation planning area, date range, regional flood management plan, metric type, asset type, flood board permit failure mode, location, congressional district)	I can review relevant information that supports reporting
17a	sum by parameter	High	implemented	User who will visit the site, review and query information	sum all floodplain created by projects	I can produce a report
18	Query by parameter	High	implemented	User who will visit the site, review and query information	To query project by funding source	I can sum all of the projects that were funded by a particular source
19	Query by parameter	High	implemented	User who will visit the site, review and query information	To query all 2019 Feather river projects that contribute to a specific ecological metric	I can track progress toward ecological goals and objectives; and so I can observe if progress is being made equally toward all goals and objectives
20	Query by parameter	High	implemented	User who will visit the site, review and query information	I want a list of all projects in a region	
21	Query by parameter	Low	implemented	User who will visit the site, review and query information	To enter the meander potential associated with my project (outside the tracking system)	to know if a project is in a geographically constrained reach
22	Query by parameter	High	implemented	User who will visit the site, review and query information	to query vulnerabilities/"issues" by deficiency (i.e., encroachments, vegetation, rodents, geometry, settlement, seepage, etc.)	I can view overall issues (summary) on a system-wide basis
23	Query by parameter	High	implemented	User who will visit the site, review and query information	To query the amount of any metric at any point in time	I can report on a specific metric of choice
24	Review project information	High	implemented	User who will visit the site, review and query information	To know whether a project will remove any priority invasive species	I can monitor progress towards DWR's system-wide invasive plant management plan objectives

TABLE A-1
BACKLOG OF USER STORIES AND IMPLEMENTATION STATUS

ID	User Story	Priority Assigned	Status	User	I want	So that
25	Review project information	High	implemented	User who will visit the site, review and query information	To measure the land cover change as it applies to metrics from a project within project boundaries	I can understand the specific impact to land cover from a particular project
32	advanced query	High	implemented	User who will visit the site, review and query information	To query the database for changes in a CSMO metric due to recent projects for a specific time range (time step based on date of the system-wide trend data and the date of query)	I can track changes in the CSMO as a result of projects
36	sum by parameter	High	implemented	User who will visit the site, review and query information	Sum all invasive species removal from projects	to know how much invasive species (area) have been removed and where
38	map	High	implemented	User who will visit the site, review and query information	to see a systemwide summary map (or map outputs) of all FSSR vulnerabilities	I can prioritize remediation actions
39	map	High	implemented	User who will visit the site, review and query information	To generate a map that shows existing conditions and quantities (presences of) of all ecosystem metrics (riparian vegetation, floodplain, SRA, natural bank, etc.)	I can have discussions on the current state or status of any area of particular interest
41	map	High	implemented	User who will visit the site, review and query information	To view a map of CV Flood system with all projects identified on it	I can search for a project by its location or look at all projects
43	map	High	implemented	User who will visit the site, review and query information	The location of all relevant projects to show up on a map when I search by some parameter	I can select projects to view in more detail
44	Measure system change	High	implemented	DWR Program Manager (FSSR or CSMO)	To measure the change in levee evaluation status over time against base information	to support analytics and reporting for the next FSSR
45	Measure system change	High	implemented	DWR Program Manager (FSSR or CSMO)	To calculate the difference between present day ecological metrics (or at any time step) and the ecological targets	I can measure status of and progress toward the CSMOs in the SPA at any time.
46	Measure system change	High	implemented	User who will visit the site, review and query information	To calculate the difference between the total present day ecological metrics and base information	I can measure status of and progress toward the CSMOs in the SPA at any time
47	Measure system change	High	implemented	User who will visit the site, review and query information	To query the database for changes in a CSMO between two time steps (time steps based on input of system-wide trend data)	I can track a change in CSMO as a result of system-wide changes over a time step

TABLE A-1
BACKLOG OF USER STORIES AND IMPLEMENTATION STATUS

ID	User Story	Priority Assigned	Status	User	I want	So that
48	Measure system change	High	implemented	DWR Program Manager (FSSR or CSMO)	To measure the sum of all metrics from new projects against the metrics target goals laid out in the Conservation strategy	I can see the level of progress toward the CSMOs
50	Measure project change	Medium	implemented	DWR Program Manager (FSSR or CSMO)	To measure the change in levee evaluation status from a project against base information	I can produce a summary report of levees and their status
51	Measure project change	Medium	implemented	DWR Program Manager (FSSR or CSMO)	To measure the change in channel evaluation status from a project against base information	I can review channels and their status
52	Measure project change	Medium	implemented	DWR Program Manager (FSSR or CSMO)	To measure the change in structure evaluation status from a project against base information	I can produce a summary report of structures and their status
56	Measure project change	Medium	implemented	User who will visit the site, review and query information	To query how much floodplain (or SRA, or revetment etc.) was created by a particular project	I can attribute the contribution of my project toward overall increase in floodplain (or some particular metric)
57	Generate a table	High	implemented	User who will visit the site, review and query information	To generate a table (or chart?) of the status/sum of each metric	I can track changes and progress of metrics over time
59	Generate a table	High	implemented	User who will visit the site, review and query information	To generate a table (and chart) of the change to each metric due to projects	to provide visual aide toward progress on the metrics and objectives over time
60	Generate a table	High	implemented	User who will visit the site, review and query information	A list or table of all relevant projects to show up on the screen when I search by some parameter	I can select a project to view in more detail
61	Generate a table	High	implemented	User who will visit the site, review and query information	I want a summary view of all projects of a certain attribute/metric/etc.	to understand how much work has happened to improve the status of one metrics
62	Site Navigation	High	implemented	User who will visit the site, review and query information	to view an individual project and associated map information	I can view information about that project
63	Site Navigation	High	implemented	User who will visit the site, review and query information	To visit the View Project info page/box	I can review all pertinent information about a project
64	Site Navigation	High	implemented	User who will visit the site, review and query information	To visit the Query and Analysis page	I can perform a query, search, or report

TABLE A-1
BACKLOG OF USER STORIES AND IMPLEMENTATION STATUS

ID	User Story	Priority Assigned	Status	User	I want	So that
65	Site Navigation	High	implemented	User who will visit the site, review and query information	to search for a project	to answer a question I have (e.g., pull up general information, see it on a map)
66	Site Navigation	High	implemented	User who will visit the site, review and query information	to search for projects	I can query a project to review information
67	Site Navigation	High	implemented	User who will visit the site, review and query information	To visit a page with more information on the FSSR or Conservation Strategy	I can gain more background into the systems
69	Site Navigation	High	implemented	User who will visit the site, review and query information	The project view page to contain a link/option to the query and analysis page	I can perform more detailed analyses/queries on this project or others like this project
71	Site Navigation	High	implemented	User who will visit the site, review and query information	The link to a particular project to open up a project view box (within information) or go to a project view page	I can gather more information about a project
73	Site Navigation	High	implemented	User who will visit the site, review and query information	view central valley flood system data	I can track DWR's progress toward its commitments in the conservation strategy
76	enter project data	High	implemented	User who will enter project data	Capture all information related to how a project affects the FSSR	review/monitor/report to the legislature on the conditions/status of the flood system
79	enter project data	High	implemented	User who will enter project data	To select the metrics (flood system or eco) that will be affected by a project	users can query for projects that affect a given metric
80	enter project data	High	implemented	User who will enter project data	To enter the amount of each metric that will be affected by the project (including 0).	Users can measure the change from base information of each metric
81	enter project data	High	implemented	User who will enter project data	To input new information about a project after some time increment; e.g., after 5 years, what is the project doing?	I or other users can monitor the performance, condition, and status of that project over time
82	enter project data	High	implemented	User who will enter project data	to input whether (and how much) a levee reach that didn't previously meet ULOP criteria now meets ULOP criteria	I know the length of levee segments that meet ULOP criteria
85	enter project data	High	implemented	User who will enter project data	To flag projects that affect floodplain, natural bank, and meander potential	To track progress toward goal of improving and enhancing hydrologic flow and geomorphic processes

TABLE A-1
BACKLOG OF USER STORIES AND IMPLEMENTATION STATUS

ID	User Story	Priority Assigned	Status	User	I want	So that
86	enter project data	High	implemented	User who will enter project data	To flag projects that affect SRA cover, riparian, marsh, and other wetlands	to track progress toward ecological goal of "habitats"; increase and improve quantity, diversity, quality, and connectivity of riverine and floodplain habitats
87	enter project data	High	implemented	User who will enter project data	To flag projects that affect revetment, build, remove, or relocate levees, remove fish passage barriers, or remove invasive plants	to track progress toward "reducing stressors": reduce stressors related to the development and operation of the SPA that negatively affect at-risk species
88	enter project data	High	implemented	User who will enter project data	To enter proposed conditions with respect to each metric associated with a project	I can track the change in base information from individual projects
92	enter project data	High	implemented	User who will enter project data	Quantify by how much a project increases or decreases riparian habitat	I can quantify effects of projects on the CSMOs
93	enter project data	High	implemented	User who will enter project data	Capture whether project increases or decreases natural bank (or no change)	I can track effects of projects on the CSMOs
94	enter project data	High	implemented	User who will enter project data	Quantify by how much a project increases or decreases natural bank	I can quantify effects of projects on the CSMOs
95	enter project data	High	implemented	User who will enter project data	project information to capture whether (and how much) a levee reach that didn't previously meet ULOP criteria now meets ULOP criteria	I know the length of levee segments that meet ULOP criteria
98	enter monitoring data	High	implemented	DWR Program Manager (FSSR or CSMO)	To input existing conditions information and status of which levees meet ULOP criteria and which don't.	to compare future changes against base information
99	enter monitoring data	High	implemented	DWR Program Manager (FSSR or CSMO)	To enter the Conservation Strategy Ecological Targets (quantities)as base information into the system for each metric	I can measure status of and progress toward the CSMO's in the SPA at any time.
100	enter monitoring data	High	implemented	DWR Program Manager (FSSR or CSMO)	To enter the location of geologically constrained reaches into the existing conditions database	I can calculate meander potential associated with my project (outside the tracking system)
104	create account and profile	High	implemented	A user who will enter, download, or review data	to register for the tracking system	I can use the tracking system
105	login	High	implemented	A user who will enter, download, or review data	to login to the tracking system as DWR employee,	I can use the tracking system

TABLE A-1
BACKLOG OF USER STORIES AND IMPLEMENTATION STATUS

ID	User Story	Priority Assigned	Status	User	I want	So that
106	recover account	High	implemented	A user who will enter, download, or review data	to recover account information (forgot password).	I can access my account if I forget things
11	Export Information	Medium	partially implemented	User who will visit, review, query and download information	To download/export project information in tabular (.csv or Excel) format	I can use the information at a later date or produce a report
15	Query by parameter	High	partially implemented	User who will visit the site, review and query information	To query all projects that only affect public safety versus those that are only restoration projects versus those that provide multiple benefits	I can track whether multiple benefit projects are in fact providing multiple benefits
28	advanced query	Medium	partially implemented	User who will visit the site, review and query information	To query whether floodplain is inundated due to a levee setback or whether it was due to raising the floodplain elevation (or some other option)	I can attribute outcomes (like increased floodplain inundation) to specific actions
30	advanced query	High	partially implemented	CVFPB Board or Staff Member	to understand how much of the CSMO change (in metrics) between 2011 and 2022 is from mitigation vs other permitted projects (i.e., pure restoration projects, or multi-benefit flood projects)	I can understand what actions are meeting mitigation requirements versus directly contributing to "uplift"
33	reporting	Low	partially implemented	DWR Program Manager (FSSR or CSMO)	Analytics and reporting functions to support the information that I will need to report out annually to the legislature/general public	I can produce reports to constituents and the legislature
34	reporting	Low	partially implemented	DWR Program Manager (FSSR or CSMO)	Analytics and reporting functions to support the information that I will need to report out on for the FSSR every 5 years.	I can produce reports to meet FSSR requirements
35	sum by parameter	High	partially implemented	CVFPB Board or Staff Member	to understand how much Feather river projects in 2019 changed each MO	
37	sum by parameter	High	partially implemented	User who will visit the site, review and query information	To sum all metrics across the valley (i.e., total floodplain, total SRA, total revetment/natural bank, etc.)	I can measure how much of each metric is present in the SPA at any time step, after project implementation, or after a flood
40	map	High	partially implemented	DWR Program Manager (FSSR or CSMO)	To query/view/filter flood-only projects on a base information map of CSMOs	to track how flood-only projects might be affecting the CSMOs; i.e., is a new levee removing floodplain? Is a larger levee expanding toward water so that amount of floodplain is reduced?

TABLE A-1
BACKLOG OF USER STORIES AND IMPLEMENTATION STATUS

ID	User Story	Priority Assigned	Status	User	I want	So that
49	Measure system change	High	partially implemented	CVFPB Board or Staff Member	to understand how much the CS MOs have changed from 2011 to 2022	I can track a change in CSMO as a result of system-wide changes over a time step
53	Measure system change	High	partially implemented	User who will visit the site, review and query information	To query the database for particular *project-generated* changes	I can track changes in the CSMOs in the flood system, caused by flood projects
55	Measure system change	Medium	partially implemented	User who will visit the site, review and query information	To measure the change between existing and proposed conditions for restoration and flood projects	I can track the change in base information from individual projects
58	Generate a table	High	partially implemented	User who will visit the site, review and query information	To generate a table (and chart) of the changes to each metric over time	to use visual aids in understanding progress
68	Site Navigation	High	partially implemented	User who will visit the site, review and query information	The project view page to link to additional information about this project	I can gather more information about a project
74	map design	Medium	partially implemented	User who will visit the site, review and query information	The map on the system-wide page to have options to select/view the following layers: SPFC facilities; Existing conditions; City boundaries	I can make view/query project-level data against base GIS layers
77	enter project data	High	partially implemented	User who will enter project data	Capture all information related to how a project affects the CS measurable objectives	I can review/monitor/report to the legislature on the conditions/status of the flood system
83	enter project data	High	partially implemented	User who will enter project data	To enter data in a way that captures the attribution of floodplain inundation	to query whether floodplain is inundated due to a levee setback or whether it was due to raising the floodplain elevation (or some other option)
84	enter project data	High	partially implemented	User who will enter project data	To enter the calculated meander potential associated with projects that add/remove revetment or setback levees (geospatially? How is this measured?)	I can track the meander potential associated with projects
89	enter project data	High	partially implemented	User who will enter project data	to be able to code projects as public safety vs. restoration vs. multi benefit	I can search/query for single-purpose vs. multi-benefit projects
91	enter project data	High	partially implemented	User who will enter project data	to enter project footprint	I can query and analyze new project footprints or changes in project footprints with respect to metrics or existing conditions ecosystem data

TABLE A-1
BACKLOG OF USER STORIES AND IMPLEMENTATION STATUS

ID	User Story	Priority Assigned	Status	User	I want	So that
102	enter monitoring data	High	partially implemented	DWR Program Manager (FSSR or CSMO)	To update the base/system-wide information after a certain time step	to track of metrics are changing over time on a system-wide basis
107	Query by parameter		partially implemented	DWR Program Manager (FSSR or CSMO)	to know what listed species the project is meant to benefit	I can see how many projects, and where, are benefitting each listed species
108	advanced query		partially implemented	DWR Program Manager (FSSR or CSMO)	to know if a habitat project utilized or created mitigation credits	know what projects are utilizing credits and from what mitigation banks
109	enter project data		partially implemented	User who will enter project data	Project information to capture which listed species are meant to benefit by a specific project	others can later query all projects by species
110	enter project data		partially implemented	User who will enter project data	Project information to capture whether a project created or used mitigation credits	others can later query all projects that created or used mitigation credits
111	enter project data		partially implemented	User who will enter project data	Project information to capture which credits are associated with each mitigation bank	others can later query from which mitigation bank a particular project is drawing from
112	advanced query		partially implemented	DWR Program Manager (FSSR or CSMO)	To report progress by RFMP area or other geographies	To be able to filter projects/metrics by a specific RFMP.
78	enter project data	High	not yet implemented	User who will enter project data	To link the amount of XX [some metric] created through a project to the funding source (based on Permit #)	I can attribute the outcome of projects (e.g., the amount of floodplain created across the SPA) by a funding source
26	advanced query	Low	not yet implemented	DWR Program Manager (FSSR or CSMO)	To query the total amount of metric created that can be attributed to a specific funding source	To assess how funding at the metric level.
27	advanced query	High	not yet implemented	DWR Program Manager (FSSR or CSMO)	To track the total change in a particular metric across the SPA due to all DWR-funded projects (compared to base data)	I understand how our funding/programs contributes CVFPP's outcomes (and enabling legislation) and I can report to the legislature
29	advanced query	Medium	not yet implemented	User who will visit the site, review and query information	To query whether floodplain loss was due to creation of a setback levee or due to some other floodplain disconnection action	I can attribute outcomes (like loss of floodplain) to specific actions

TABLE A-1
BACKLOG OF USER STORIES AND IMPLEMENTATION STATUS

ID	User Story	Priority Assigned	Status	User	I want	So that
31	advanced query	High	not yet implemented	CVFPB Board or Staff Member	understand how much mitigation for Valley Elderberry Longhorn Beetle has been completed as a part of flood projects permitted in 2019 along the Sacramento River.	To track mitigation components and compliance.
42	map	Medium	not yet implemented	User who will visit the site, review and query information	To generate a map of location and quantity of riparian, or wetland, vegetation generated or removed	I can see visually where riparian and wetland veg is being planted or removed
54	Measure project change	Medium	not yet implemented	User who will visit the site, review and query information	To query the amount of a particular vegetation type that is being added or created due to a project	I can track changes in vegetation cover over time and due to projects
70	Site Navigation	High	not yet implemented	User who will visit the site, review and query information	The project view page to contain a link/option to visit the systemwide page	I can see my project in context of the flood system
72	Site Navigation	High	not yet implemented	User who will visit the site, review and query information	to visit the View CV Flood System and Trends page	I can view the CV flood system at a snapshot in time
75	Site Navigation	Low	not yet implemented	User who will visit the site, review and query information	To see new/featured project photo and snapshot with link to project	DWR can have a mechanism to promote certain projects to others in the org and to the public
90	enter project data	High	not yet implemented	User who will enter project data	To enter whether a flood project is affecting land cover, fish passage, invasive species, floodplain inundation and meander potential, etc.	To track how flood-only projects might be affecting the CSMOs will likely require CEQA determinations or the data steward. TBD Based on DWR outcome
96	enter project data	High	not yet implemented	DWR Program Manager (FSSR or CSMO)	To enter management changes in the tracking system	I can track how management changes are affecting projects on the ground
97	enter monitoring data	High	not yet implemented	DWR Program Manager (FSSR or CSMO)	To enter existing conditions for the amount and locations of priority invasive species in the SPA	
101	enter monitoring data	High	not yet implemented	DWR Program Manager (FSSR or CSMO)	To enter base/existing conditions vegetative mapping in the application	I can track the change in vegetation cover over time (and due to projects)
103	create account and profile	High	not yet implemented	A user who will enter, download, or review data	to create an account/profile by entering my information for: name, agency/organization, contact information, user name, and password	I can register/login to the system

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Appendix B

Developer System Documentation

Introduction

The DWR DFM Tracking System is a database-driven web application, developed with security and maintainability in mind. There are three primary components involved in the application: (1) the databases; (2) the application server; and, (3) client-side code. An array of both open-source and closed-source technologies are used throughout the application, which is discussed in the following sections. Mapping functionality and geospatial data are provided using Esri MapServer and Esri ArcGIS JavaScript API. A high-level interaction diagram is provided below.

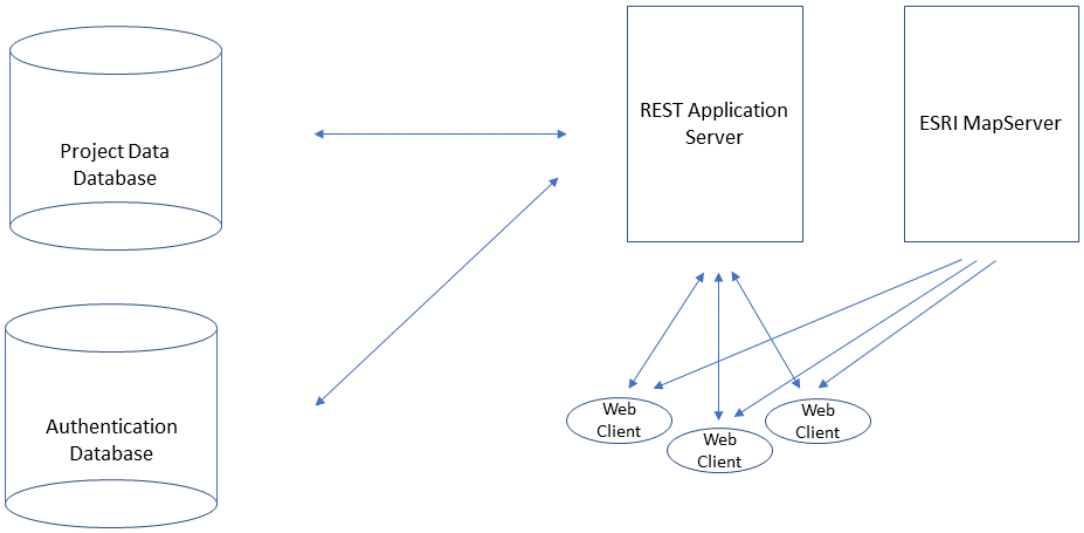


Figure B-1. High-level Interaction Diagram for Tracking System

Database

The database used is Oracle 11g relation structured query language (SQL) database. There are two schemas used to contain the data. First is the project data. Second is the authentication data. Figure B-2, below, shows the data schema for the project data database.[1]

The project data database was designed to store data about flood management and ecosystem restoration projects that are planned, funded, and implemented in the Systemwide Planning Area. Data includes all user-submitted project information as described in the User Guide: binary data, including shapefiles, project images, and other user uploaded content such as the project development status, and the change in metrics from each project.

[1] Due to the size of the ERD/Data Schema diagram, the font is not legible in any configuration of this User Guide. If readers are interested in the diagram, please contact ESA of the DWR TO 33 project manager to request a full PDF. The PDF can be zoomed in so users can understand how all of the data and files within the tracking system relate to one another.

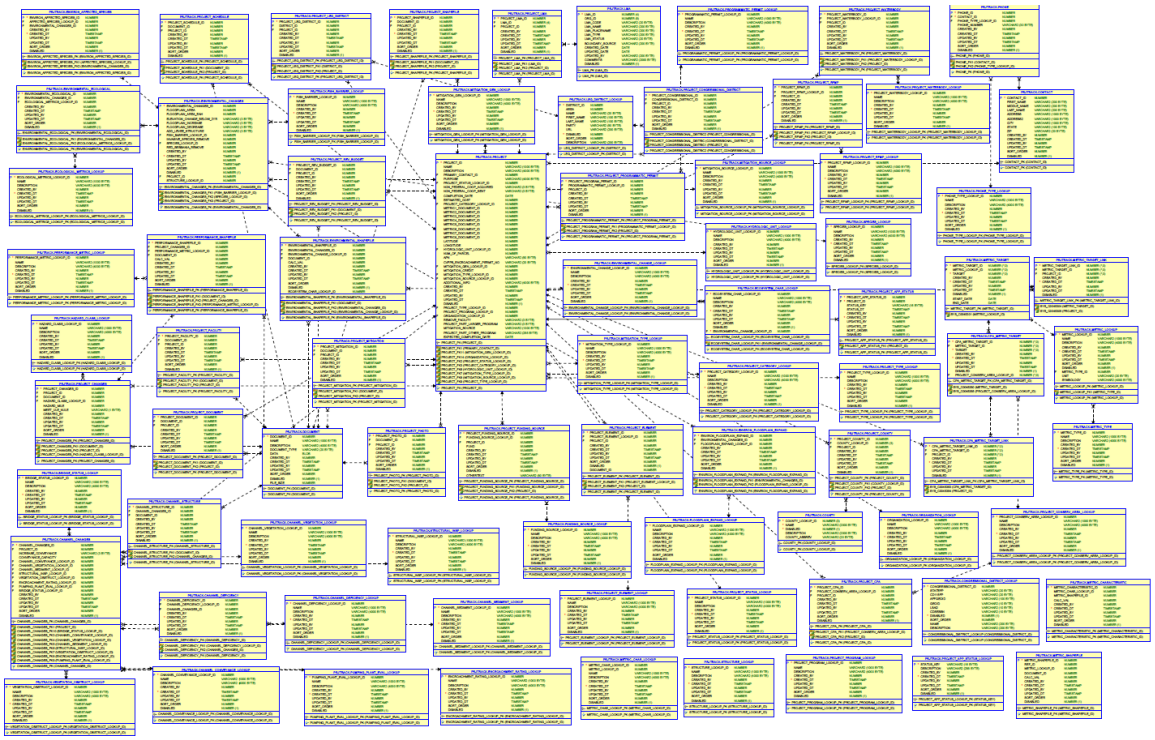


Figure B-2. Data Schema or Entity Relationship Diagram (ERD) Project Data Database of the Tracking System

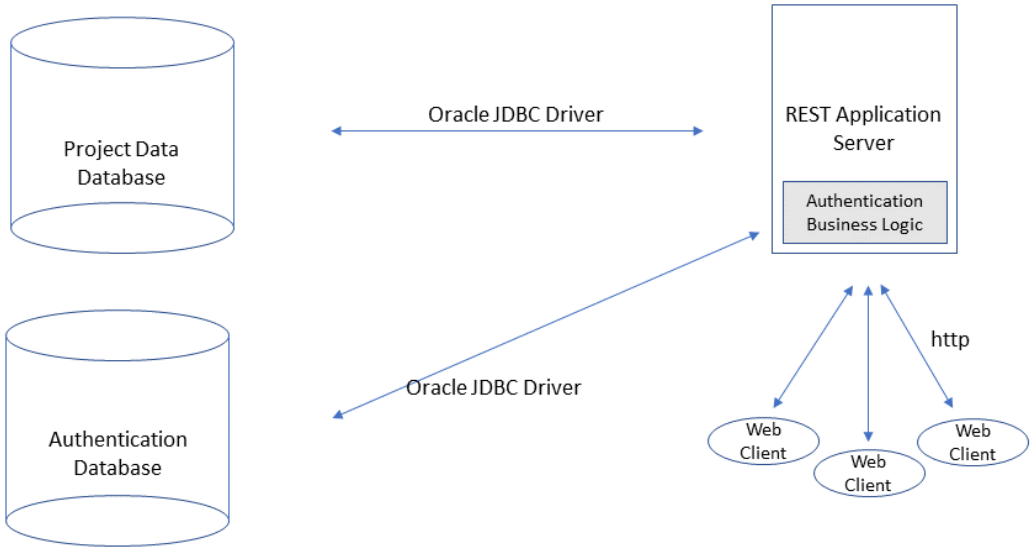
The authentication database was designed to store details about the tracking system users. This includes, name, agency, and authentication information. Authentication information consists of username to login into the system, roles, and permissions. Passwords are stored as salted hashes for maximum security.

Minimum system requirements:

- Memory
  - 16 GB RAM or more
- Processor
  - 3 GHz or faster quad core Xeon CPU
- Disk
  - 1TB Solid State Drive

REST Application Server

The application server is a Java Spring MVC 4.0.1 based Representational State Transfer (REST) server, providing REST end points for interaction with the web client. The authentication business logic and sessions are managed by this layer. Interaction between the databases and the application server are achieved using an Oracle Database JDBC driver. All other communications are passed through using the HTTP protocol.



Primary frameworks and libraries used include:

- JDK 1.7
- Spring Framework 4.0.1
- ojdbc7
- JSTL 1.2.1

Minimum System Requirements

- Memory
  - 16 GB RAM or more
- Processor
  - 3 GHz or faster quad core Xeon CPU
- Disk
  - 256 GB Solid State Drive

Client

The client interface is provided through major up-to-date web browsers. The application is to be served over https for secure data transfer. Views are generated using jsp templates along with client-side ajax for dynamic content. Mapping functionality is enabled using Esri ArcGIS JavaScript API 3.20.

The primary frameworks and libraries use include:

- California State Template v5 – Beta
- ESRI ArcGIS JavaScript API 3.20

- Bootstrap v3.x
- jQuery
- jQuery UI
- dropzone.js
- Plotly.js

Minimum System Requirements

- Modern Web Browser
  - Recommended: Google Chrome, Mozilla Firefox, Microsoft Edge
- Memory
  - 4 GB RAM
- Processor
  - 2 GHz or faster dual-core CPU
- Display Resolution
  - 800x600 or greater

Appendix C

Outstanding Questions and Recommendations

During the development of the DWR DFM Tracking System, a number of questions and items of policy decisions arose. Some are key questions that reside outside the scope of the project, but merit examination (and, optimally, resolution) at this time. Others are simply outstanding questions that will need DWR management input to be resolved. **Questions** and associated **recommendations** are listed below and are broken into two sections: the first related to ongoing work and the second related to forward-looking considerations.

Note: The term "upload" is reserved for the uploading of project data to the system by a project representative. "Posting" is used for when that information has been QA/QC'd by the DWR Data Stewardship Team and is posted to the database/system and can be queried and included in reports.

Current Work on the System

1. **What are the requirements, incentives, and/or triggers for projects being included in the tracking system?**

   – Broken out further:

   - How will DWR ensure that projects built on the landscape by other entities will be included in the system?
   - What actions will trigger someone entering a project into the system?
   - What will the process be for collecting project information?
   - Will there be a deadline for uploading state-funded projects?

Recommendation

- Initially, any applicant seeking grant or local assistance funding from DWR programs may be required to submit GIS data for their project. With projects implemented by other agencies, someone within DWR may be tasked with coordinating with other agencies, and then tracking down GIS files for those projects. Additional incentives or triggers are yet to be decided: initial discussion suggests any project requiring a Central Valley Flood Protection Board permit or filing for a California Department of Fish and Wildlife Lake and Streambed Alteration Agreement could be made into a trigger for mandatory inclusion into the system, and that entering information into the tracking system could be a requirement of the Regional Flood Management Plan (RFMP) process or upon receipt of state grant or bond funds.

2. **Who at DWR will staff the data stewardship (project review and posting) and who will be involved in various aspects of QA/QC?**

Recommendation

Staffing could be resourced entirely internally, include contractor support, or be contracted entirely. QA/QC of incoming projects should be initially completed by the data steward for accuracy and completeness of the incoming information. This should be supported by individuals who are familiar with the system, the FSSR, and CSMOs and have an awareness of the nuances of multi-benefit and other more-complicated projects that contain multiple and have potentially overlapping, project elements.

3. How frequently will system-wide data (existing conditions) be updated?

Recommendation

This will vary being that levee inspections information is collected annually, for example, but other information is not and the efforts are to be determined. See Table 1, in Section 2 of the Summary Report.

4. From what year will the system start capturing projects?

There is a concern that if tracking starts only at the adoption of the 2012 update of the CVFPP (which includes the Conservation Strategy measurable objectives), then DWR "will not get credit" for good work completed prior to that date. In other words, the system will need to begin capturing system changes from all projects and actions completed since some certain year X—so, what is year X?

Recommendations

– At the Flood Management Authority (FMA) presentation, attendees suggested that date be 2004—although it is uncertain as to what (if any) exact funding milestone and/or plan or document release date that this may coincide with.

a. There are practical, data-availability factors that may influence certain "dates."

   i. Past project information was not developed with the same metrics used in the tracking system, which means including any of them in the tracking system (or including existing conditions data from years past) would require development of a GIS dataset compatible with the same metrics used in the tracking system.

   ii. First, our starting date from which we report progress toward Conservation Strategy Targets likely must be the date for which we have CSMO-related system-wide data (2009). This is because the system-wide data for the CSMOs in the system derive from the 2009 fine-scale vegetation layer; any projects completed prior to 2009 *are already accounted for in that vegetation layer*. While it may be possible to input and *view projects* from earlier than 2009 and quantify and view their contribution to the metrics they benefit, we must communicate that these projects provided "progress" toward the 2009 system-wide data layer, but not progress toward the targets, which were set in the 2016 Conservation Strategy and used the 2009 data in setting the targets.

b. At this time, there is no scope to accommodate inclusion of any projects—recent or prior to 2009—in the system. There are implications in the level of effort and steps needed to include any projects and system-wide information earlier than the 2017 FSSR and 2016 Conservation Strategy or underlying datasets (2009), not the least of which is configuring the system to make amply clear the somewhat complicated situation of pre-2009 projects.

5. How will the system capture negative changes (i.e., losses or conversions) to the CSMOs from implementing projects?

Recommendation

In other words, how will the system capture situations where, for instance, projects such as improving a levee with a large stability berm removes 2 acres of riparian habitat?

a. The system is not configured to input "negative progress" toward CSMO targets.

b. The DWR QA/QC data steward will review project polygons and, based on existing conditions prior to the project, will be able to reduce any existing habitat amounts caused by the new project.

c. Negative values will show in project detail page and will reduce the system-wide habitat acreage totals, *but will not apply to (detract from)* the total number of project-created acres summed as progress toward attainment of the targets on reporting dashboard.

6. How will DWR staff data stewardship (project review and posting), and who at DWR will be involved in various aspects of QA/QC?

Recommendations

– Staffing could be resourced entirely internally, include contractor support, or be contracted entirely.

– QA/QC of incoming projects should be initially completed by the data steward for accuracy and completeness of the incoming information. This should be supported by individuals who are familiar with the system, the FSSR, and CSMOs and have an awareness of the nuances of multi-benefit and other more-complicated projects that contain multiple and have potentially overlapping, project elements.

– As a side note: In the future, the process for acquisition of new system-wide information should carefully take into account how this system uses that data and which user stories may be yet to be addressed because of insufficient system-wide data, the acquisition of which could be tailored to address those user stories

7. Will there be users of the tracking system other than DWR, and if so, when will the system be made external?

Recommendations

– This initial version of the system is developed to be internal to DWR.

– The development of this system acknowledges that the intent of the system is external transparency related to making progress toward goals and that there is clearly strong interest in viewing the tracking system by outside users. Thus, means of authentication for different classes of users (providing restriction of access and functionality, as appropriate) is included in this version.

– There is presently no plan for when the system would be made external, and setup and support is not contracted.

8. How/when will Expected Annual Habitat (EAH) be calculated given that only floodplain area polygons are being uploaded?

Recommendations

Calculation of EAH is somewhat complicated—the metric is not yet broadly included as a standard part of restoration planning and the procedure for calculation is mostly in academic publications. The data steward could try to make these conversions but would likely need support, including hydrologic analysis and hydraulic modeling.

How will Meander Potential be included in the system when data isn't available?

Meander Potential information is available for portions of the Upper Sacramento region but not for other locations in the Central Valley.

Looking Forward: Consideration of Key Issues for System Evolution

9. Conservation vs. Mitigation

Recommendations

- The consistent premise has been that the tracking system will capture projects that make contributions toward the CSMOs. Some hold the opinion that this should not include mitigation projects because ostensibly the "new project" simply creates a net cancellation of impacts elsewhere.

- No decision has been made relative to precluding the mitigation-only project type (see item 2, above), but the database is preliminarily configured to identify whether a project is a mitigation project. That stated, the details on the creditable habitat types it may produce are **not** presently included or tracked (primarily because the CSMOs do not align with the various habitats credited for mitigation, which are not metrics being tracked); although, they could be added to significantly increase the functionality of the tracking system, enabling it to become a forecasting and habitat portfolio tracking tool.

- The crediting and conservation paradigm is anticipated to shift with the onset of Mitigation Credit Agreements (MCAs) (through Regional Conservation Investment Strategy (RCISs)) and for this reason, future purposes and functionality of the system should be considered as the prioritized backlog of features/functions for this system are reviewed.

10. How will this application support the update to the next FSSR?

Recommendations

The FSSR will include the CSMOs, and production of the physical FSSR report can be simplified by exporting a series of reports. DWR may want to pre-message on this system and a "more holistic" version of the FSSR well in advance of the 5-year update anniversary. This will be considered alongside the vision and all related communications and engagement for the CVFPP update.

11. How will the tracking system be modified if metrics change or new metrics are added?

Recommendations

- This is probably more of a policy question than a database/tracking question as the database construction will be the same as for the present system.

- Some difficulty may emerge on how to translate tracking progress at the time of the change into the new metric, but, until then, details on that are not well enough understood to address as an issue at this time.

- In terms of policy reasons for why to modify the system with new metrics: Presently, there are no two greater points of tension in the world of Central Valley flood management than the ecosystem and its relationship to public safety, and both are covered by the current system. The ecosystem is well covered with the CSMOs; public safety is addressed by the FSSR metrics. A more-robust flood risk reduction metric (see item 12, below), would be very helpful in effectively and consistently reporting investments to the public and the legislature. Legislatively driven mandates requiring preparation of the FSSR means that tracking and reporting of the items in FSSR will continue; however, an additional new flood risk metric could easily be added.

- Incremental improvements on specific aspects of the CSMOs may be worth entertaining; however, DWR is well positioned with the CSMOs as robust "SMART" objectives, and there is significant power and advantage in sticking with simplicity and "not messing with" metrics in a tool that works and instead focusing on how to use that tool to complete more projects.

12. Potential for a flood risk metric commensurate with the CSMOs to more comprehensively quantify the benefits of multi-benefit projects.

Recommendations

- Developing a single flood *risk* metric would allow DWR to measure progress in the flood system toward the state's overall goal of reducing flood risk, similarly to the way the CSMOs measure progress toward the ecosystem goals.

- A flood risk metric could be expressed as "Expected Annual Damages" (EAD) and/or "Expected Annual Casualties." This metric would provide transparency and would demonstrate whether and by how much overall flood risk is being reduced (or increased) on the landscape. An EAD metric could also demonstrate the cost-effectiveness of the State's investment, show a return on investment, and inform planning decisions around which projects or project types are more cost effective in reducing flood *risk.*

- This metric provides much greater transparency into achievement of the State's goal of reducing flood risk than the FSSR metrics, which tell us about the *condition* of our flood control infrastructure but do not measure the reduction in risk that society receives for our investments. Further, metrics such as the "reduction in the number of expected fatalities from a flood" are much more digestible and compelling for the public and the legislature than something as esoteric as "reduced levee underseepage vulnerability."

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Appendix D
Workflows

The following set of diagrams shows some of the workflows ESA developed to implement the functions in the DWR DFM Tracking System for many of the metrics.

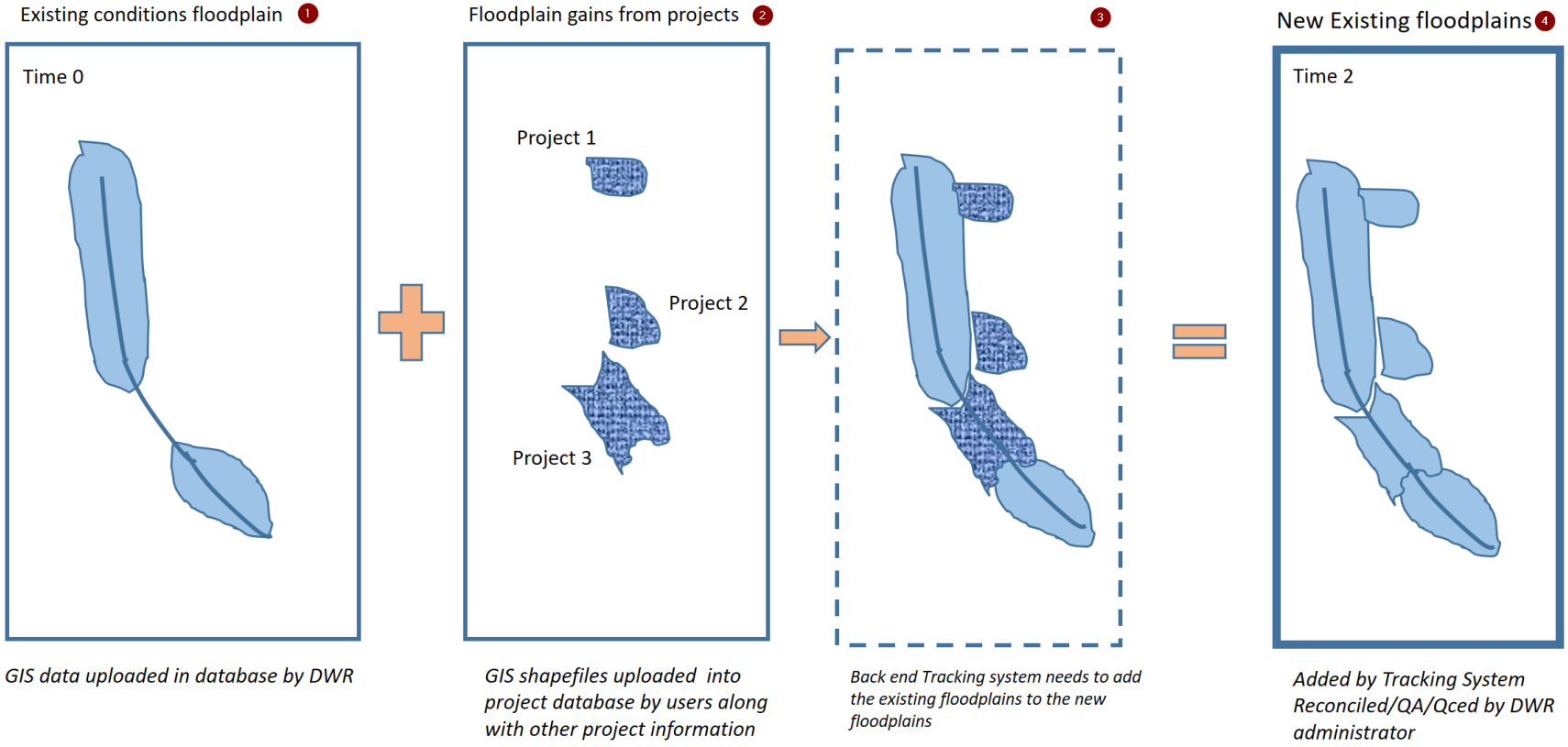

Figure D-1. Workflow for how existing conditions will change due to projects: Floodplain, Habitat-Riparian, and Habitat-Wetland

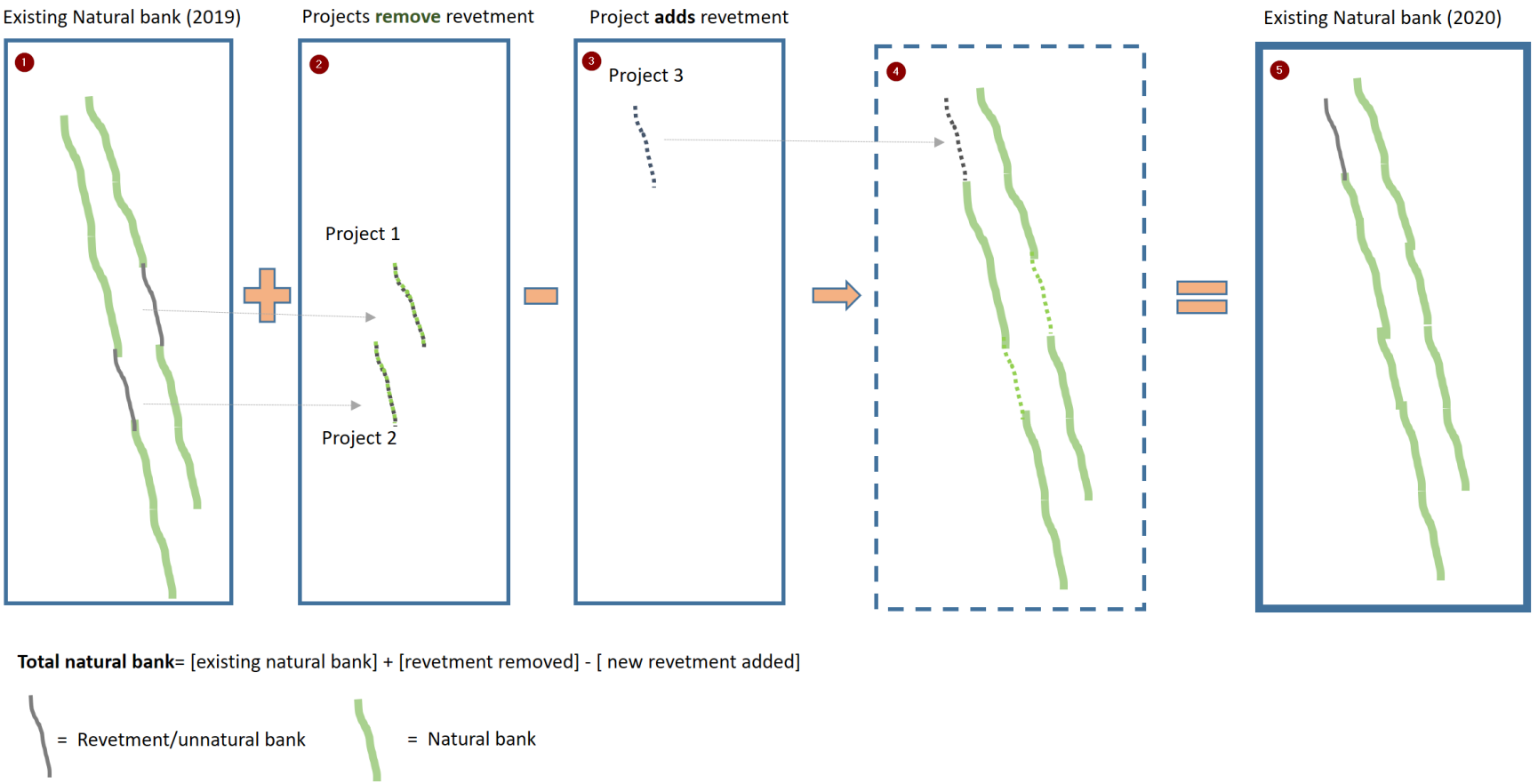

Figure D-2. Workflow for how existing conditions will change due to projects: natural bank and revetment

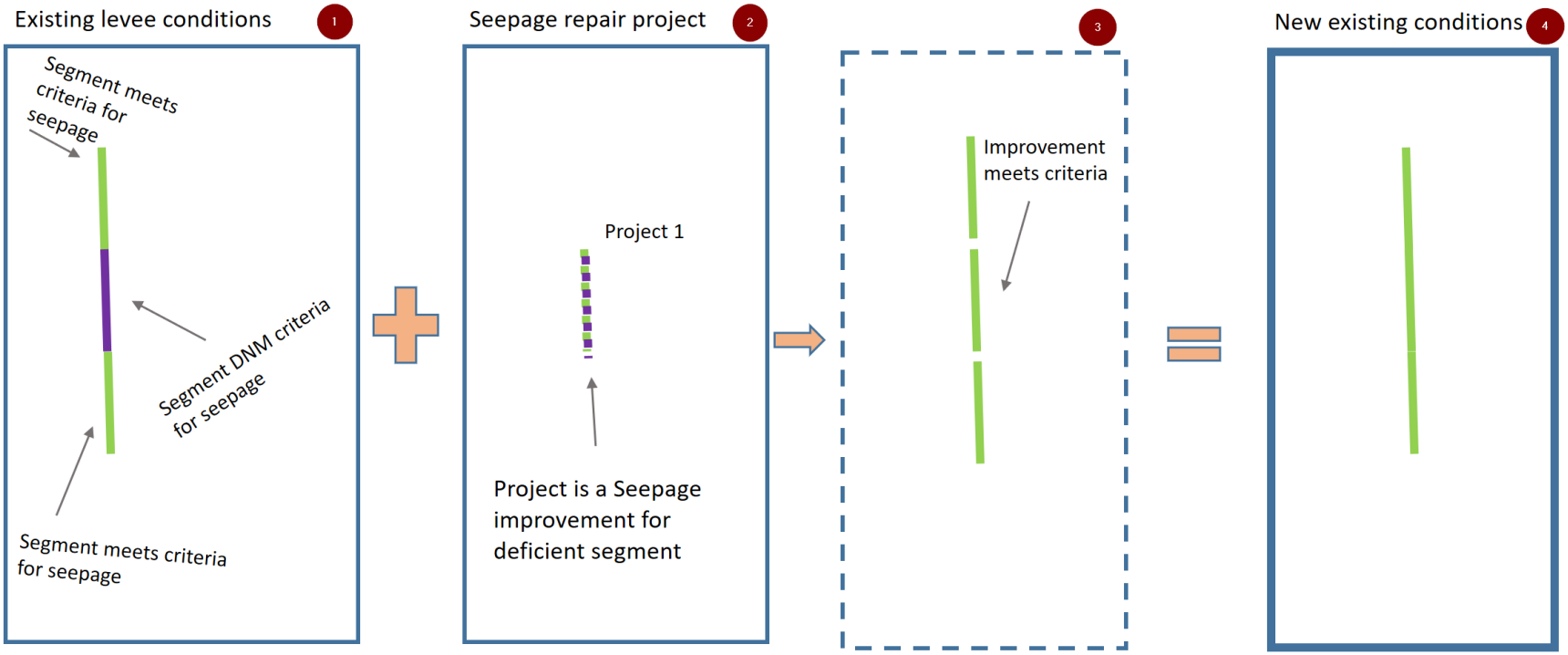

Figure D-3. Workflow for how existing conditions will change due to levee improvement projects

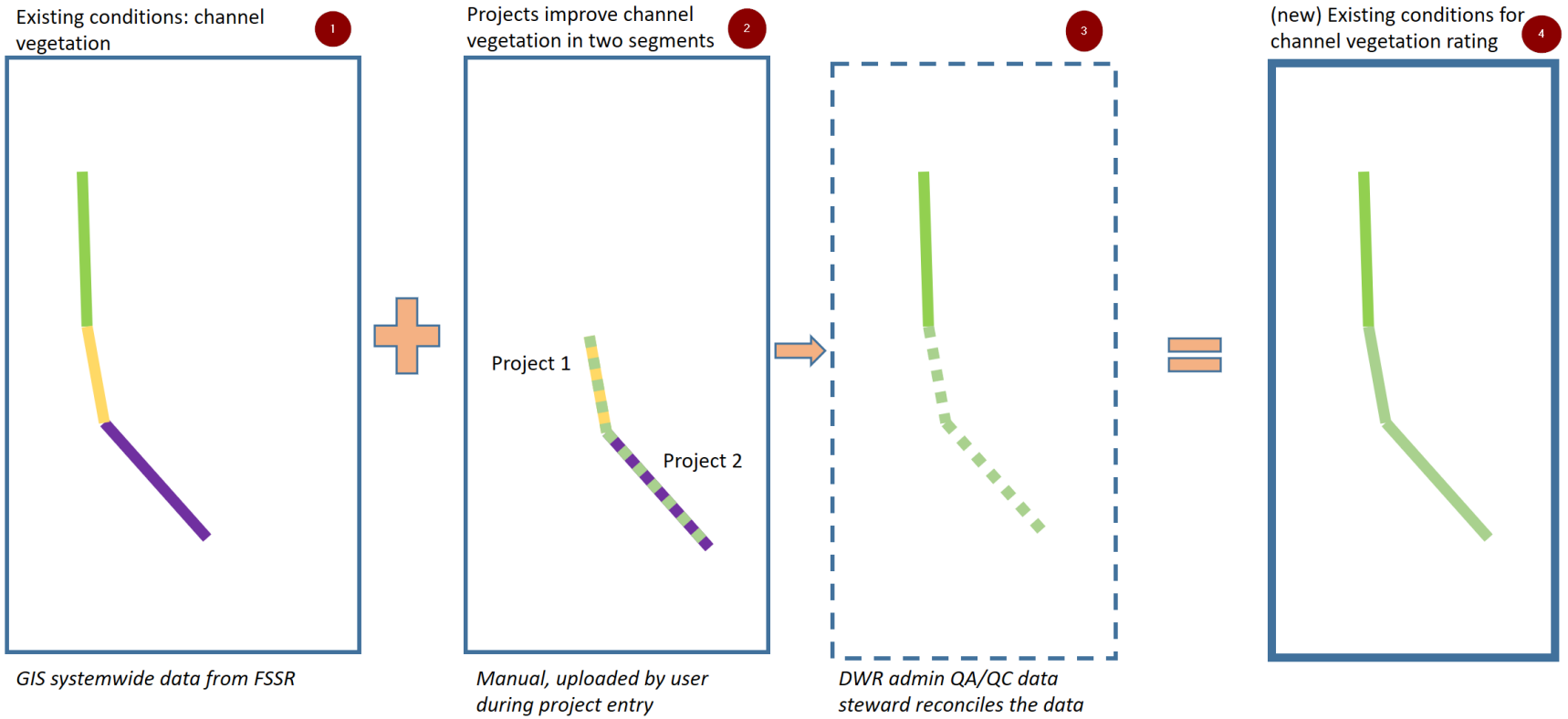

Figure D-4. Workflow for how existing conditions will change due to channel improvement projects