I.   Project Title: Development of a Centralized PIT tag Database for the San Juan and Upper Basin Recovery Programs

II.   Bureau of Reclamation Agreement Number(s): R14AC00084

        Project/Grant Period: Start date (Mo/Day/Yr): 9/18/2014
                                    End date: (Mo/Day/Yr): 6/30/2019
                                    Reporting period end date: 11/30/2018
                                    Is this the final report? Yes _____ No __X__

III.   Principal Investigator(s):

        Amy Greenwell
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IV.   Abstract: The Colorado Natural Heritage Program (CNHP) at Colorado State University has developed an online data system (the Species Tracking, Research and Monitoring System or STReaMS) for the Bureau of Reclamation and the Upper Colorado and San Juan River Recovery Programs. The database is designed to track PIT tags and endangered fish activities in the Upper Colorado River Basin. CNHP is beginning the fifth full year of the project. Throughout Year 4, new features and bug fixes were ongoing, remote antenna data were monitored and imported, and in-depth training for Database Managers was completed. While some features will continue to be refined in Year 5, the database has enhanced functionality and can be accessed at streamsystem.org (registration is required). The current five year agreement ends on June 30 2019.

V.   Study Schedule:
        FY14-FY19

VI.   Relationship to RIPRAP:
        General Recovery Program

        V.A.1. Conduct interagency data management program to compile, manage, and maintain all research and monitoring data collected by the Recovery Program.

VII.   Accomplishment of FY 2018 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

Deliverables thus far include the release of an enhanced version of the website at https://streamsystem.org/. The website is updated periodically, with release notes accessible on the website, https://streamsystem.org/webAdmin/webUpdateLog.php. Accomplishments in Year 4 include 1) Development of an in-depth Database Manager User Guide and Database Manager training sessions; 2) New functionality added to website based on feedback from Data Managers; and 3) Uploads and monitoring of PIA data from various input source files.

During Year 4, schedule adjustments were made due to funding circumstances. We anticipate catching up in Year 5 and will work with the lead Database Manager to develop a revised work plan.

See Appendices 1-5 for status of work accomplished compared to proposed tasks in the original 3 year proposal, general task list completed in Year 4, and general tasks proposed for Year 5.

A detailed list of completed tasks since the last performance report (11/4/2017 – 11/30/2018) is below.

November 2017
- Database Managers Training: focus on flagging records in STReaMS
- Updates to Database Manager User Guide
- Reconfigured Google Analytics to track activity on live site separate from test site
- Added a quality control check to the site effort upload: sample number cannot be null and must be unique in the upload file.
- Fixed bug where user could not save user flags and comments. Now, there is a separate save button for the user flag section. Reconfigured pages to work correctly with revision tracking. This was fixed on encounter, individual and tag pages.
- Fixed reach codes in batch uploads to show reach names.
- Fixed all pop-up box labels to correctly display data type (they were all set to "Agency").
- Pulled fixes to live site and tested live site
- Added new domain item to Shoreline and checked batch upload code for site effort and stocking events.
- STReaMS techinar
- Annual performance report

December 2017
- Database Managers Training: focus on batch uploads in STReaMS
- Updates to Database Manager User Guide
- IT work with Peter MacKinnon to set up FTP configuration on Peter's computer for PIA dat files

January 2018
- Database Managers Training: focus on fixing rejected records
- PIA work: Added two new arrays, SJ below waterfall and McElmo Aneth Bridge. Configured antennas, coordinates, raw data files, set up for PIA batch uploads, and added outages. Renamed McElmo Aneth UT to Aneth Confluence and updated upload information accordingly.
- Reset Loggernet to get latest data (off for two weeks over holidays due to server reboot)
- Updated PIA dat files from Peter MacKinnon for Dolores River Rio Mesa Ctr, Hogback Intake, and Tusher Diversion
- Fixed download bug where Study filter was not getting honored
- Fixed bug where river mile 0.0 was not displaying properly on array page, and not filtering properly on browse encounters.
- Pulled fixes to live site and tested live site
- Discovered issue with null bit fields (T/F). Researched it and identified it is a pervasive issue in the database. Discussed fix with Julie Stahli.
- Sequence ID's for Aneth Confluence PIA were reset by the hardware. Archived old dat file, reset sequence ID and reran upload.

February 2018
- Fixed records with "Tag Conflict (2 individuals)" error through the backend of the database
- Cleaned out duplicates in job queue to reactivate downloads

March 2018
- Sequence ID's for White River PIA were reset by Peter MacKinnon during maintenance. Archived old dat file, reset sequence ID and reran upload.
- Database management set-up to use SQL Server, connections to test site, connections to source file folders
- Fixed permission issues with test site
- Year 4 work plan with Julie Stahli

April 2018
- Updated Stocking uploads to allow duplicates to go through during the analyze phase, but kept the warning when duplicates are found (to give the user the chance to cancel and review his/her file). The duplicates will get caught during reconciliation and fail as stocking duplicates. This way the records are in the system and potentially can be fixed at a later date.
- Changed Data Entry Templates page to Resources and added a river miles section and download file (GIS personal geodatabase and kmz files)
- Fixed bug where tag code list on tag lot page was duplicating first five and last five tags (bug found by Cameron Walford)
- Fixed upload code and edit pages so bit (T/F) fields that are not checked get set to False, instead of being left null.

- Identified fish without encounters to see if they can get deleted
- Investigated two fish that should have had stocking encounters, looked through backup files. Unable to identify why these two fish don't have encounters.

May 2018
- Coordinated with Peter to get PIA data for PIAs on new service (Hogback II, McElmo Creek Aneth Bridge, Green River Tusher Diversion, and Dolores River Rio Mesa), reviewed dat files and uploaded to STReaMS
- Added new antenna for PNM and resubmitted rejected records for upload

July 2018
- Fixed White River PIA data issues: records imported with bad dates (1996) were deleted, PIA was set to nonstandard, and data were reimported using the more accurate date on the left side of the dat file.
- Updated work plan with Julie Stahli
- Created TBL_RiverMile: QC river mile table, compare to hydro areas in STReaMS, add hydro area ID, calculate latitude/longitude in ArcMap, import table to streams. This will be used to calculate latitudes and longitudes for encounters.
- Investigated and wrote up issues regarding river miles and coordinates to send to Julie Stahli
- Reset administrative account to run scheduled tasks
- Tested coding changes from April

August 2018
- Adjusted PIA detail pages, PIA upload page, and upload notices to identify PIAs with real-time Loggernet connections. Added Loggernet check box as read-only to Array details page, added to Help pages
- Reformatted Loggernet bit field for clarity in TBL_Array and adjusted True/False values accordingly.
- Updated download disclaimer on popular downloads page
- Fixed New Encounter page so encounter type does not have to be saved before activating relevant fields (ex. transfer type activates "transferred from river" or detection type activates "PIA location")
- Fixed glitch with Encounter types on Encounter Edit page: Transfers activate the field "Transferred from river" and Detections activate "PIA location". These worked as long as the correct encounter type was selected from the onset. However, if an encounter type was set to Capture and then corrected to Transfer or Detection, the corresponding fields were not activated for editing. Now, the fields are editable each time a different encounter type is selected.
- Fixed glitch with adding a new fish manually on the website where the save order could result in a loss of the tag code. Now, the fish has to be saved (which then saves the tag code), before you can add an Encounter.

- Fixed New Encounter and Encounter Edit pages so new tag codes added manually follow valid tag code rules and convert tag codes to uppercase.
- Wrote release notes
- Tested website for new release

September 2018
- Adjusted new encounter on Browse Encounters to pull up encounter edit instead of new record. This way, the user can see other encounters associated with the fish and there is less of a chance to add a duplicate encounter.
- Release September 4, 2018 version of STReaMS, plus testing of live site
- Linked new Hydro Areas in STReaMS to Hydro Areas in river miles table
- Pulled Google Analytics
- Posted new field collection template
- Flume PIA: updated dat file to work with uploads again and tracked outage

October 2018
- Tested Biologic website. The website provided a sanitized version of the dat file which was not ideal for STReaMS
- Built FTPS secure site to receive PIA data directly from Biomark (for PIAs on the new Biologic service)
- PIA call with recovery program
- Identified steps to update bit fields in SQL server to remove null values and remove these entries from change tracking (since it would add millions of entries)
- Made a STReaMS user to run scheduled tasks, tested and adjusted permissions

November 2018
- Worked with Biomark IT directly to get FTPS site working with Biologic, fixed port issues
- Coordinated with Peter MacKinnon to get PIA data for Hogback II (Intake), McElmo Creek Aneth Bridge, and Green River Tusher Diversion. Reviewed dat files and documented outages. Will follow up with Peter about outages on Hogback II.
- Inactivated Green River Canal "Below Siphon" and "Flume" arrays
- Back-up of MS SQL database file and website for recovery program
- Annual performance report
- Updated work plan with Julie Stahli

VIII. Additional noteworthy observations:

As of November 28, 2018 the database has:
- 1,822,273 PIT Tags
- 1,188,833 Individual Fish
- 2,106,080 Encounters

Between November 2017 and November 2018, Google Analytics show:
- 35,307 page views
- 3,167 sessions
- Average session duration of 11:05 minutes
- Average of 11.15 pages per session
- Bounce Rate of 30.19%

IX.   Recommendations: Server maintenance will continue to be the responsibility of CNHP. Recommendations for new database features in Year 5 are listed below. CNHP will continue to work closely with Database Managers to adapt to emerging needs.

- Revise PIA import tools and tracking
    - Automate connections and uploads to new Biologic service via FTPS
    - Develop import process for PIAs without data loggers
    - Reevaluate outage tracking
    - Streamline process to be more efficient and automated, adjust tables and import code accordingly
- Develop a movement tool to generate a list of Individuals that have moved upstream or downstream from a specific river mile.
    - Adjust for transfers
- Develop QC Tools
    - Change relationships (merge/split records)
    - QC Encounter attributes
    - Identify duplicate records
    - Identify orphaned Individuals
    - Recalculate spatial attributes
- Create calculated fields
    - Known distance travelled (based on Encounter history)
    - Days in river
    - Add calculated fields to Individual downloads and Individual details page
- Complete PIA location attributes and schematics
- Calculate XY coordinates for encounters from PIA coordinates and river mile coordinates
    - Update batch upload process accordingly
- Add an option to download the complete Encounter history for a list of Encounters
- Work with Database Manager to develop any necessary custom queries
- Batch Upload enhancements
- Bug fixes
- Internal testing and stress tests
- Update online help, data dictionary, user manuals, Data Managers user guide, and system documentation
- Train Recovery Program participants on new features and enhancements
- Other priorities identified by Recovery Program Database Managers

X.   Project Status:

        Ongoing

XI.   FY 2018 Budget Status

        A.   Funds Provided: $70,574
        B.   Funds Expended: $35,574
        C.   Difference: $35,000 (not spent due to funding concerns)
        D.   Percent of the FY 2018 work completed, and projected costs to complete: 50%
        E.   Recovery Program funds spent for publication charges: $0

XII.   Status of Data Submission (Where applicable):

        Not Applicable

XIII.   Signed: *Amy Greenwell* /s/   11/30/18
                        Principal Investigator   Date

Appendix 1. Proposed schedule for Year 1 and status of actual work accomplished. Shaded boxes indicate the proposed start of tasks in original proposal.

YEAR 1	Oct-14 - Dec-14	Jan-14 - Mar-15	Apr-15 - Jun15	Jul-15 - Sep-15
Work closely with investigators to assess database needs and design	Ongoing	Ongoing	Ongoing	Ongoing
Purchase and set up server to host database	Complete			
Server security, database backups and server maintenance		Ongoing	Ongoing	Ongoing
Prepare database mockups		Complete		
Develop SQL server database		In Progress	Complete	
QA/QC existing MS Excel and MS Access databases and reformat as needed				Complete
Import existing fishes data into MS SQL Server				Complete
Code web interface for entering and retrieving data				Complete
Code management system for managing users and permissions		In Progress	In Progress	Complete
Develop canned queries for basic downloads				Complete
Create online help, user manual and system documentation			In Progress	In Progress
Internal testing and stress tests		Ongoing	Ongoing	Ongoing
Post basic version of database online				Complete
Train USFWS and BOR personnel to use the database				Ongoing
Prepare quarterly, semi-annual and **annual** reports		Complete		
Project Management and CSU Compliance	Ongoing	Ongoing	Ongoing	Ongoing

Appendix 2. Proposed schedule for Year 2 and status of actual work accomplished through September 2016. Shaded boxes indicate the proposed start of tasks in original proposal.

YEAR 2	Oct-15 - Dec-15	Jan-15 - Mar-16	Apr-16 - Jun-16	Jul-16 - Sep-16
Work closely with investigators to assess database needs and design	Ongoing	Ongoing	Ongoing	Ongoing
Update online help, user manual and system documentation	In Progress	In Progress	In Progress	In Progress
Server security, database backups and server maintenance	Ongoing	Ongoing	Ongoing	Ongoing
Develop online Data Management System for quality control and database administration	Ongoing	Ongoing	Ongoing	Ongoing
Develop online Query Builder for customizing data downloads				
Develop upload capabilities for batch files and data recorded by PIAs			In Progress	In Progress
Develop revision tracking component				
~~Set up GitHub defect tracking~~	-	-	-	-
Set up tracking system using Google Analytics to track public use of the site	Complete			
Internal testing and stress tests	Ongoing	Ongoing	Ongoing	Ongoing
Post advanced version of the database online				Ongoing
Train USFWS and BOR personnel on using and managing the database	Ongoing	Ongoing	Ongoing	Ongoing
Prepare quarterly, semi-annual and annual reports	Complete			
Project Management and CSU Compliance	Ongoing	Ongoing	Ongoing	Ongoing

Appendix 3. Proposed schedule for Year 3 and status of actual work accomplished through November 3, 2017. Shaded boxes indicate the proposed start of tasks in original proposal.

YEAR 3	Oct-16 - Dec-16	Jan-16 - Mar-17	Apr-17 - Jun-17	Jul-17 - Nov-17
Work closely with investigators to assess database needs and design	Ongoing	Ongoing	Ongoing	Ongoing
Server security, database backups and server maintenance	Ongoing	Ongoing	Ongoing	Ongoing
Develop online Data Management System for quality control and database administration	In Progress	In Progress	In Progress	In Progress
Develop online Query Builder for customizing data downloads				Pushed back to Year 4
Develop upload capabilities for batch files and data recorded by PIAs	In Progress	Complete		
Finalize online help, user manual and system documentation	In Progress	In Progress	In Progress	Complete
Enhance features and functionality based on user feedback	In Progress	In Progress	In Progress	Ongoing
Internal testing and stress tests	Ongoing	Ongoing	Ongoing	Ongoing
Develop revision tracking component		In Progress	In Progress	Complete
~~Set up GitHub defect tracking~~	-	-	-	-
Post enhanced version of the database online				Complete
Train USFWS and BOR personnel on using and managing the database	Ongoing	Ongoing	Ongoing	Ongoing
Transfer server and database to BOR or setup maintenance agreement				Complete
Prepare quarterly, semi-annual and final reports	Complete			Complete
Project Management and CSU Compliance	Ongoing	Ongoing	Ongoing	Ongoing

Appendix 4. Task List for Year 4.

Server Maintenance
- Maintain the server, server security, and perform regular database backups
- Maintain the test server and development environment
- Perform necessary software upgrades including Windows Updates, SQL Server updates, and PHP Updates. Ensure all code performs as expected following updates.
- Assess overall performance and optimize resources as needed
- Maintain Database Manager credentials to access SQL Server

Website Maintenance and New Features
- Develop advanced SQL Query Builder and Query Builder User Guide*
- Create a collaborative resources page to share SQL queries and other helpful information*
- Develop QC Tools*
  - Change relationships (merge/split records)
  - QC Encounter attributes
  - Recalculate spatial attributes
- Create calculated fields*
  - Known distance travelled (based on Encounter history)
  - Days in river
- Uploads and monitoring of PIA data from various input source files
- Batch Upload enhancements
- Bug fixes
- Internal testing and stress tests
- Update online help, data dictionary, user manuals, and system documentation
- Train Recovery Program participants on new features and enhancements
- Other priorities identified by Recovery Program Database Managers

Project Management
- Prepare annual reports
- Perform project management and CSU compliance
- Maintain regular communication with Database Managers

*Pushed to Year 5

Appendix 5. Proposed Task List for Year 5.

Server Maintenance
- Maintain the server, server security, and perform regular database backups
- Maintain the test server and development environment
- Perform necessary software upgrades including Windows updates, SQL Server updates, TFS updates, and PHP updates. Ensure all code performs as expected following updates.
- Assess overall performance and optimize resources
- Maintain Database Manager credentials to access SQL Server

Website Maintenance and New Features
- Revise PIA import tools and tracking
  - Automate connections and uploads to new Biologic service via FTPS
  - Develop import process for PIAs without data loggers
  - Reevaluate outage tracking
  - Streamline process to be more efficient and automated, adjust tables and import code accordingly
- Develop a movement tool to generate a list of Individuals that have moved upstream or downstream from a specific river mile.
  - Adjust for transfers
- Develop QC Tools
  - Change relationships (merge/split records)
  - QC Encounter attributes
  - Identify duplicate records
  - Identify orphaned Individuals
  - Recalculate spatial attributes
- Create calculated fields
  - Known distance travelled (based on Encounter history)
  - Days in river
  - Add calculated fields to Individual downloads and Individual details page
- Complete PIA location attributes and schematics
- Calculate XY coordinates for encounters from PIA coordinates and river mile coordinates
  - Update batch upload process accordingly
- Add an option to download the complete Encounter history for a list of Encounters
- Connect Tag deploy attributes to changes made to deploy Encounters and changes from "Undo" uploads
- Work with Database Manager to develop any necessary custom queries
- Batch Upload enhancements
- Bug fixes
- Internal testing and stress tests
- Update online help, data dictionary, user manuals, Data Managers user guide, and system documentation
- Train Recovery Program participants on new features and enhancements
- Other priorities identified by Recovery Program Database Managers

Project Management
- Prepare annual reports
- Perform project management and CSU compliance
- Maintain regular communication with Database Managers