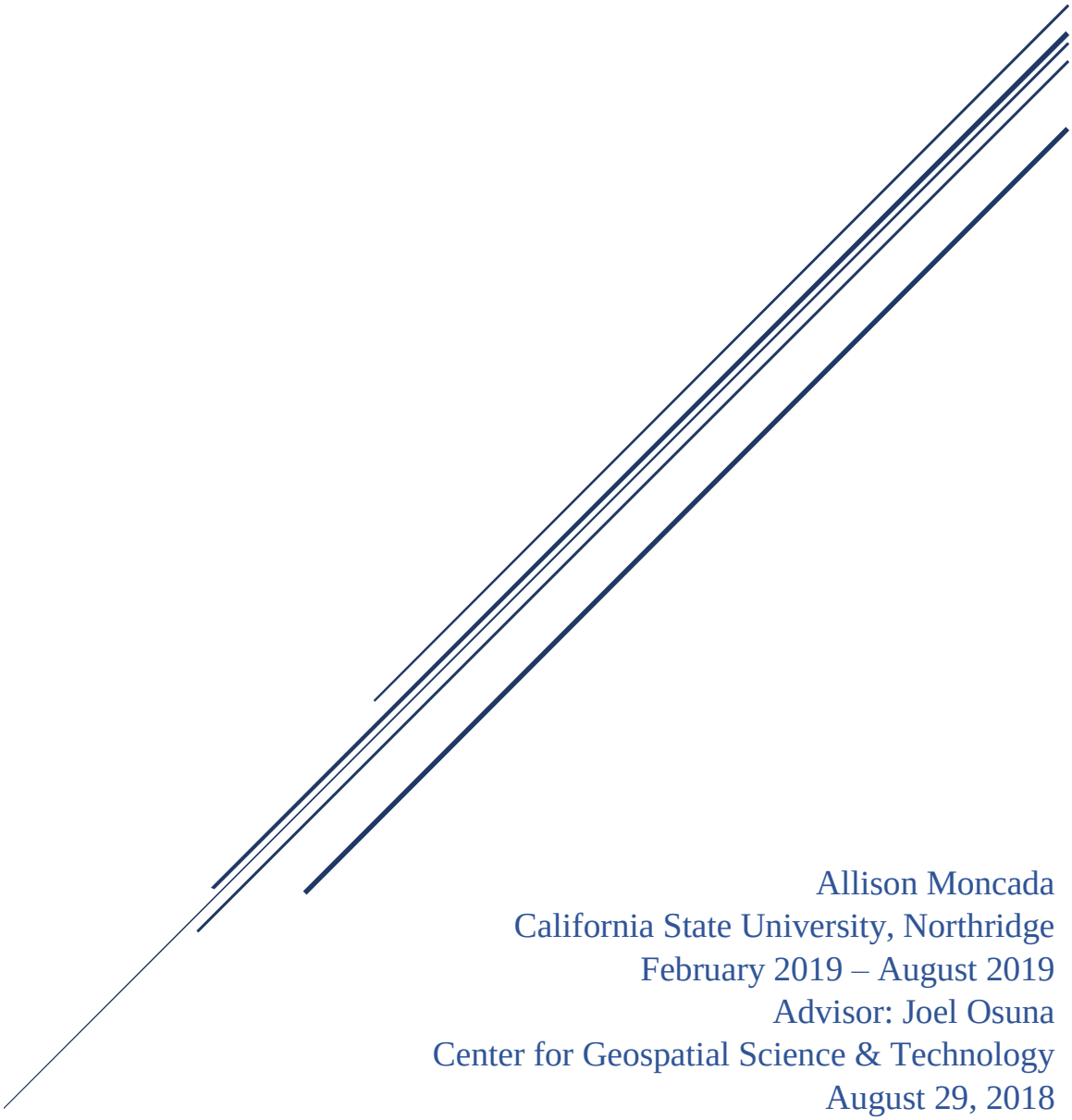
National Hydrography Dataset (NHD) Updates for the Department of Water Resources

WRPI/USDA Experiential Internship 2019

Final Report



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Acknowledgments

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Executive Summary

This project focused on improving the spatial data of the high resolution National Hydrography Dataset (NHD) which included polygonal, linear, and point features and all associated NHD attributes within mutually agreed upon priority areas of California. The Center for Geospatial Science and Technology (CGST) at California State University Northridge (CSUN) provided services to the Division of Statewide Integrated Water Management of the Department of Water Resources (DWR) to update feature attributes and geometry within the NHD, which is a comprehensive spatial dataset of surface water. The edits met the United States Geological Survey (USGS) NHD editing and topology standards at a 1:24,000 scale. CGST worked in collaboration with the Geographical Information Center (GIC) at California State University (CSU), Chico on this work.

The High Resolution NHD is the national authoritative hydrography dataset for California, which is a critical assert for accurate and efficient drought response work. Currently there is no data steward in California and only limited portions of the state have been updated to bring the data up to 1:24,000 data standards. The rest of the state remains at the outdated 1:100,000 data standard. This project focused on getting the NHD updates consistent in resolution, detail, and quality for the State of California.

Project Objectives

The objective of this project was to improve NHD features through realigning geometry, updating seasonality and other attributes, and adding new features. The hydrographic features that were updated in the NHD included points, lines, flowlines, areas, and waterbodies. The NHD features were edited at a scale of 1:12,000 - 1:10,000 in order to be accurate at the high resolution scale of 1:24,000. The stream types (ephemeral, intermittent, and perennial) were used to represent the most accurate seasonality of flowlines. In order to accomplish comprehensive updates, a variety of reference and collateral datasets were utilized, such as the latest National Agriculture Imagery Program (NAIP) California orthoimagery (2014 or newer), Google and Bing maps, Google Earth, US Topographic Maps, and specific mapping business rules.

The editing occurred within selected hydrological unit code (HUC) 8 watersheds which were used as boundaries defining work areas. The HUC 8 watersheds that had not previously received NHD improvements were prioritized, with elevated priority given to the watersheds along the California coast and in the Klamath Basin. Secondary priority watersheds were selected within the California Central Valley. The remaining watersheds were updated in conjunction with other update efforts, to complete the update for California, excluding areas in the Legal Delta and in the United States Forest Service (USFS) lands. All HUC 8 watersheds were selected in collaboration with DWR. The NHD updates were completed by using custom USGS editing tools within the GIS software application, ArcGIS, which allowed spatial data to be captured, manipulated, and analyzed.

I am currently pursuing a Master's degree in Geographical Information Science (GIS) at California State University, Northridge. I chose GIS because it is an environment where I can continuously learn new skills that can be applied to numerous fields outside of GIS. My long term career goal is to work as a GIS Crime Analysist for one of the government branches. This internship has provided me a great opportunity to learn new skills and gain experience.

Project Approach

Data Preparation

The dataset that was checked out from USGS's NHD system needed to be checked for any errors before implementing any NHD edits. A pre-initial quality control (QC) check was preformed to recognize any errors such as small segment check, pseudo-nodes, invalid geometry, and flow directions. Once QC review was complete, the NHD job was ready for NHD editing to begin.

NHD Editing

For this project, I first focused on completing edit updates on two jobs: Mojave and Antelope Freemont Valleys. Both study areas were in arid terrains and had huge HUC's, therefore it was time consuming. The areas were flat lands with very gradual elevation change where ephemeral channels tended to flow for long distances. The Mojave HUC's had areas that included more waterbodies such as playas and lakes than Antelope Freemont Valleys HUCs. The Antelope Freemont Valleys HUC's were challenging at times because some of the arid regions had flowlines that were visibly difficult to edit. Pipelines in HUC's were not edited because they were difficult to determine if the pipelines ran on the surface or undergrown through the aerial imagery. Overall, both jobs had similar features to edit such as flowlines and water bodies.

The NHD editing took place at the HUC12 boundary level, which are the smallest watershed units. A "tracker" layer was created for my NHD jobs, in order for me to keep track of my editing progress within the HUC12 boundaries. The main documents used for guidance on this project were the mapping business rules and workflow documents provided by CGST. The business rules were used to keep the NHD jobs and decision making consistent. The other supporting documents and data that helped in the process of NHD editing were USGS support pages, latest National Agriculture Imagery program (NAIP) California orthoimagery (2014 or newer), Google and Bing maps, Google Earth, US Topographic Maps.

The NHD edits consisted of attribution modification, realignment, and adding new hydrologic features, like streams, lakes, washes, ponds, canals, and ditches. In highly dense areas where flowline densification was the principal editing task, a maximum threshold length of 500 meters was used. Streams less than 500 meters were not added in areas where there was a high flowline density regardless if they were visible at the reference scale. The seasonality of the streams were modified to match the appropriate stream type (ephemeral, intermittent, and perennial) and to have the same consistency throughout the HUC12s.

Job QC Check

Once the NHD edits were completed by the first editor, a second editor would run an internal quality control (QC) check and review the edits previously made. Each NHD job had a second editor review the work previously done to insure accuracy and a feedback loop where the original editor would receive comments on their editing work.

Project Outcomes

The finalization of the Mojave and Antelope Freemont Valleys NHD jobs are currently underway at CGST. The results from this project established that the NHD updates were necessary within mutually agreed upon priority areas of California in order for the hydrography features to be accurate. Many of the improvements included realigning existing streams to match the aerial imagery. New features such as streams were added as long as they were above the 500 meter threshold in specific areas. The outcome of the NHD edits indicated that many of the streams that were added or modified were ephemeral, which meant that the waterway only contained water during or immediately after a rainstorm, flooding event, or heavy snowmelt (Figure 3 and 4). Intermittent streams were defined as channels that contained water in the cool months of the year and contained no water in the dry months of the year. Most of the water bodies were classified as intermittent with high water elevation, which indicated that water was present, but not up to its highest capacity level. A reference map of Mojave and Antelope Freemont Valleys, along with before and after images that demonstrate some of the common features that were updated during NHD editing are provided below (Figure 1- 6).

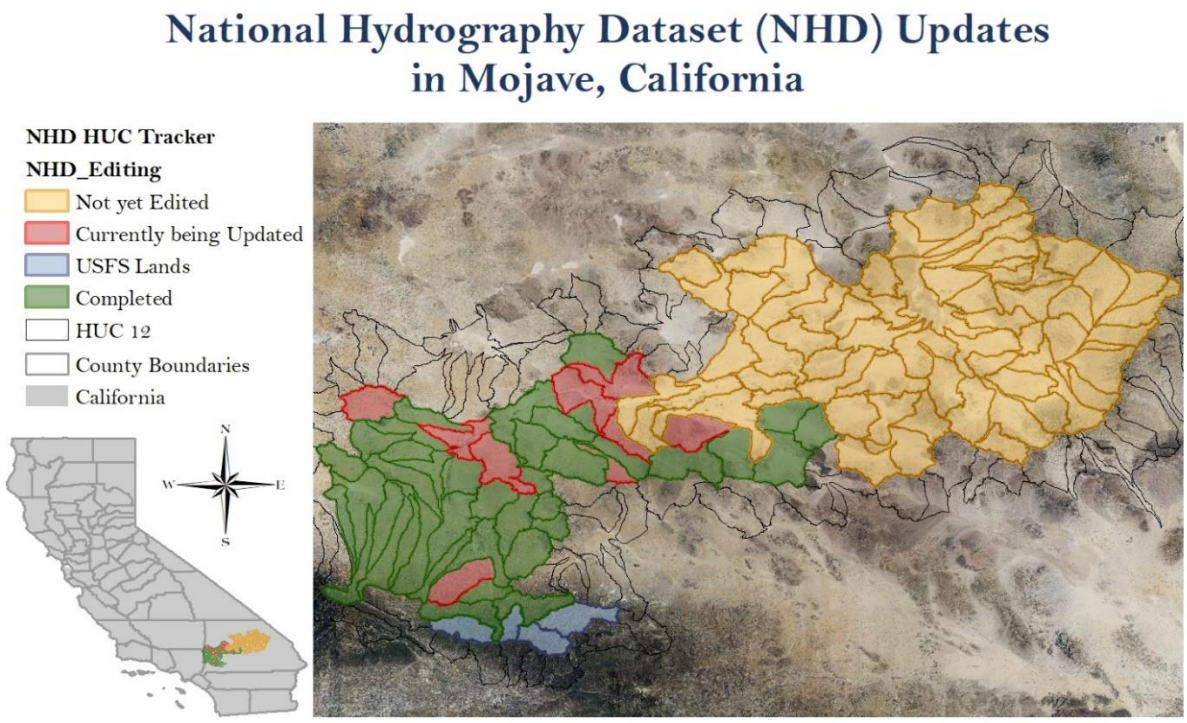

Figure 1: Study area for Mojave, California.

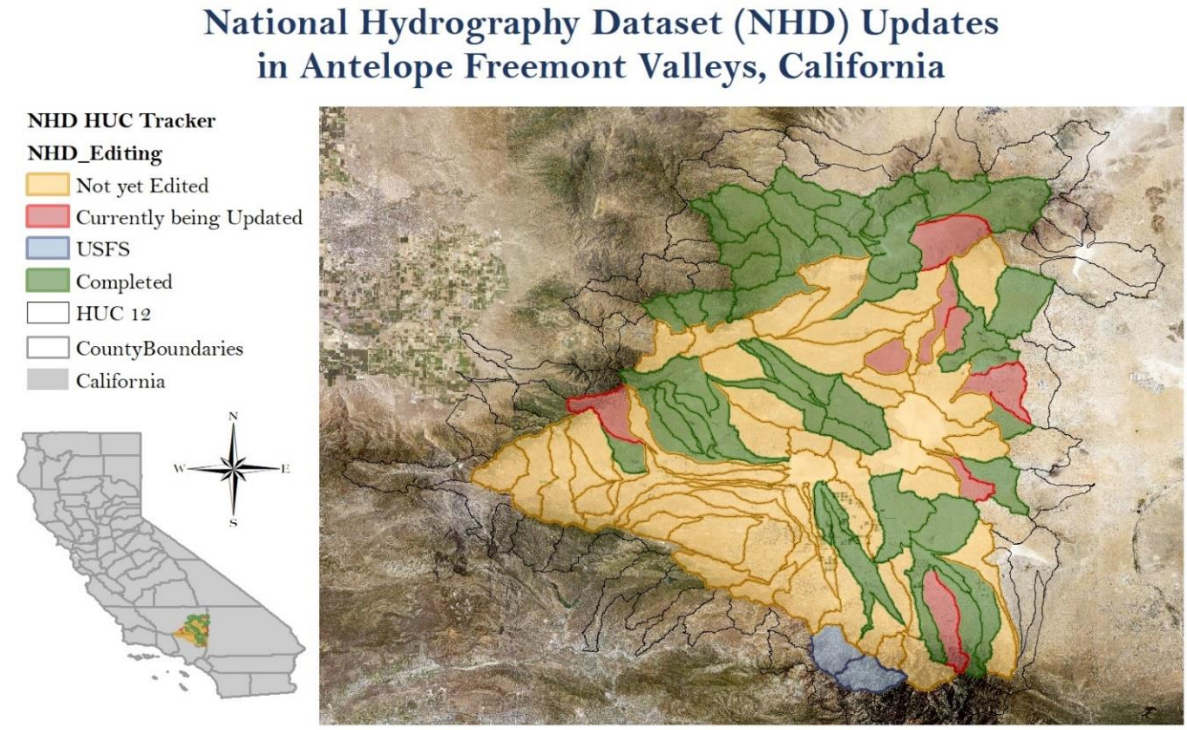

Figure 2: Study area for Antelope Freemont Valleys, California.

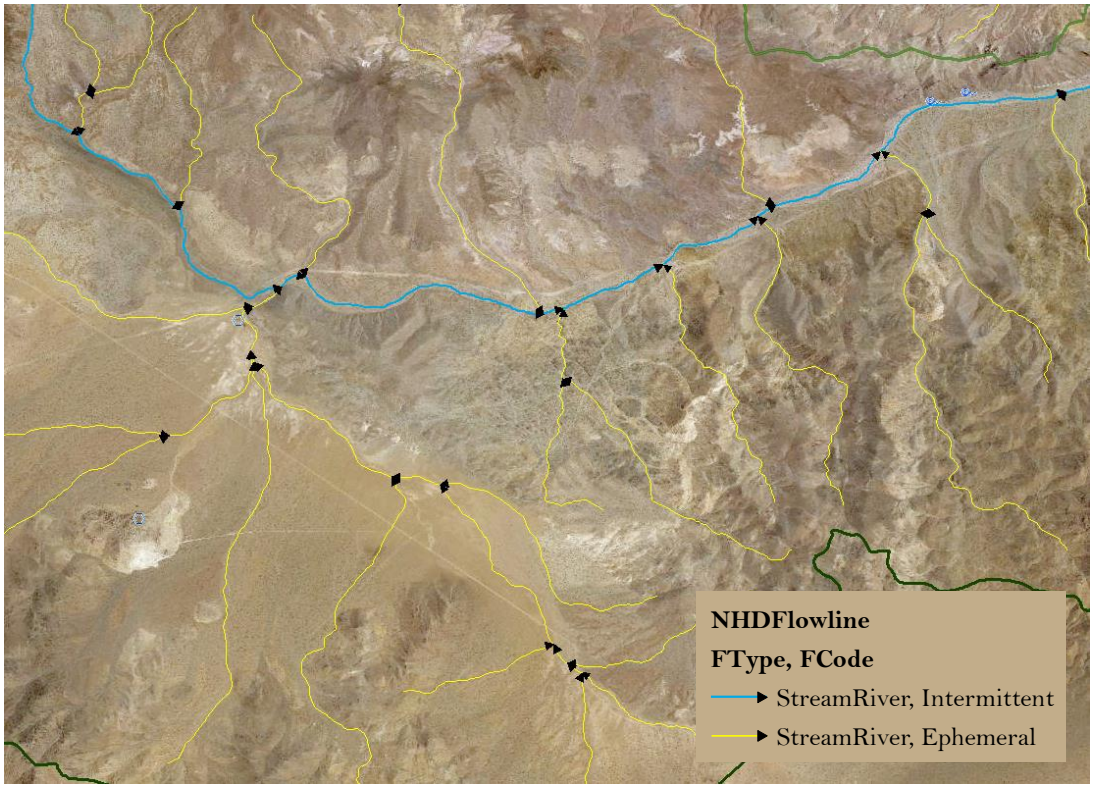

Figure 3: Before NHD Updates in Mojave- Kane Wash.

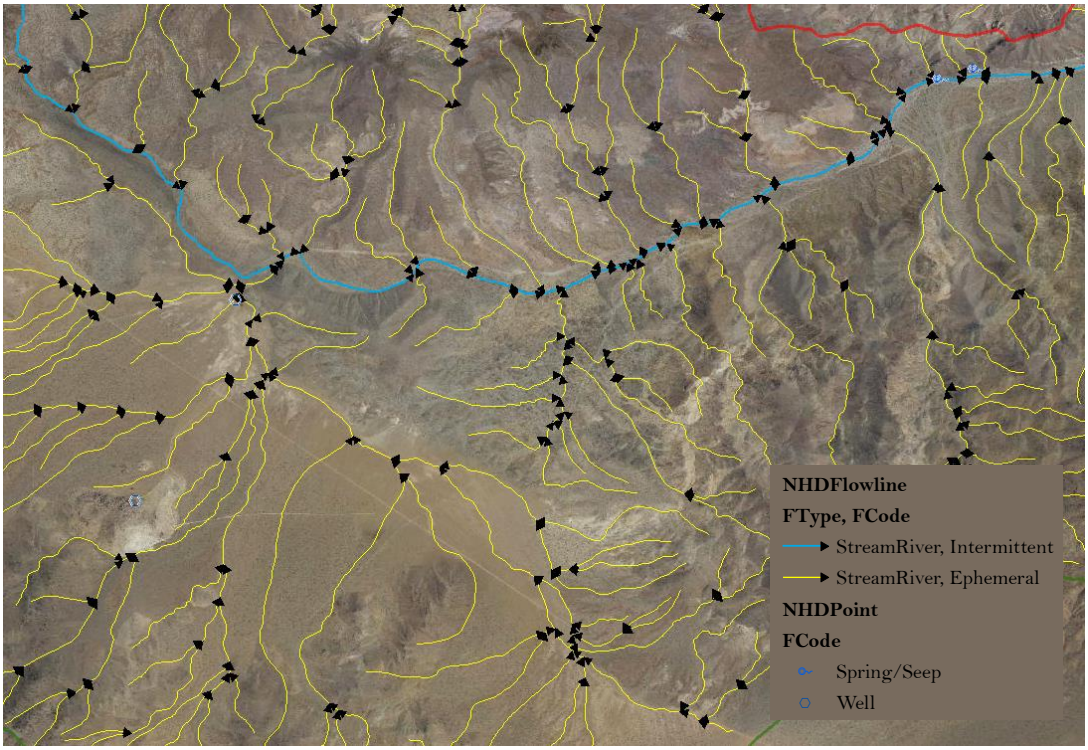

Figure 4: After NHD Updates in Mojave- Kane Wash.

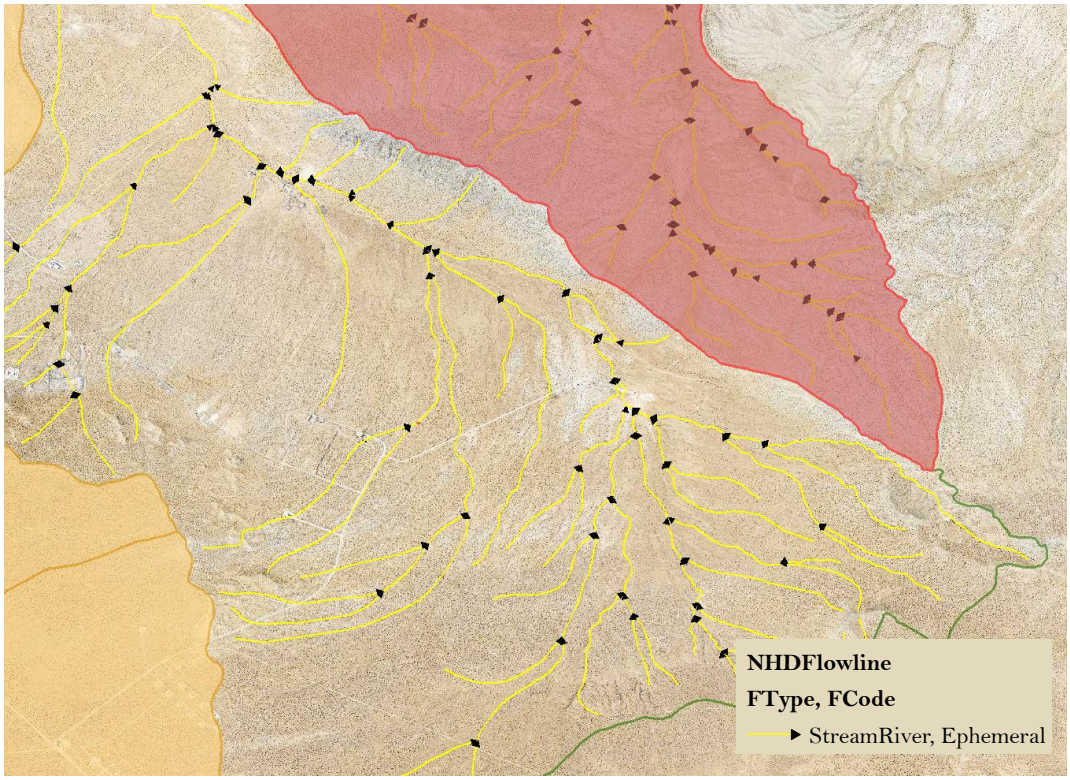

Figure 5: Before NHD Updates in Antelope Freemont Valleys- Reclamation Dam Edwards Air Base.

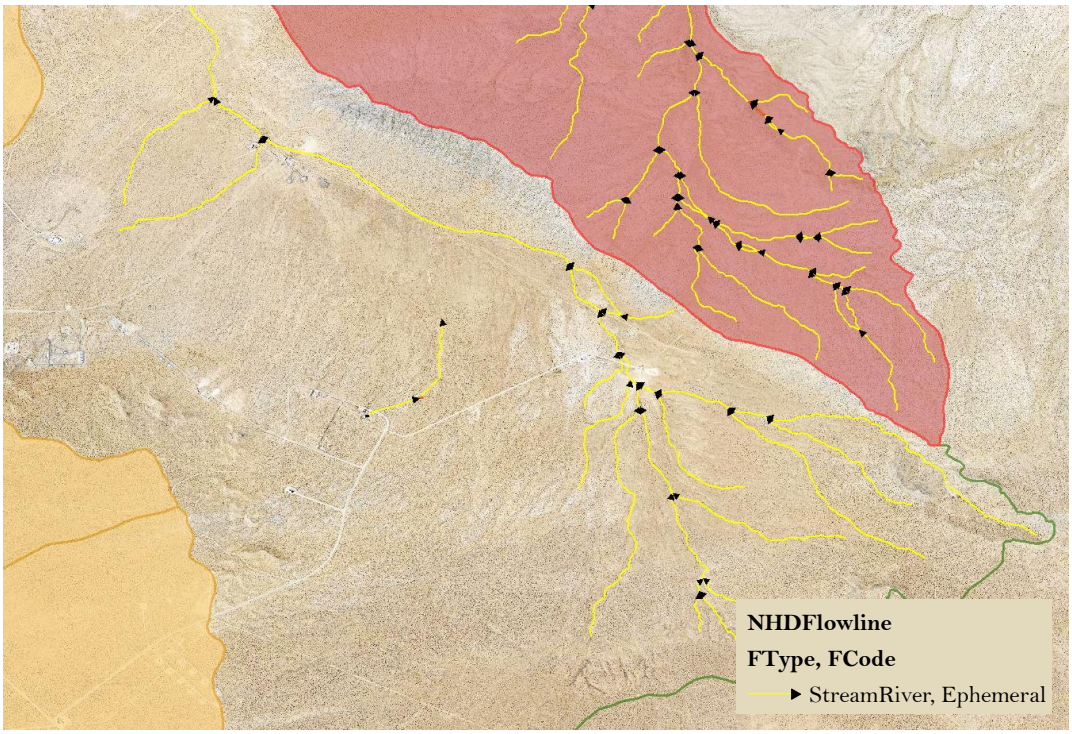

Figure 6: After NHD Updates in Antelope Freemont Valleys- Reclamation Dam Edwards Air Base.

Conclusions

This project provided NHD enhancements that would be a critical asset for accurate and efficient drought response work. Updated NHD is required in order to maximize the quality and utility of high resolution NHDPlus products and derivatives. Therefore, it is imperative for the State of California to achieve an updated NHD before high resolution NHDPlus is generated. Furthermore, this project gave me the chance to build up my geospatial skills, such as hydrography interpretation, GIS editing, quality checks, and following a structured workflow. This WRPI Internship has helped me understand how USGS and DWR work together on important projects to benefit the future utility of natural resources. The internship also allowed me to grow professionally and expand my technical skills in both GIS and project documentation.