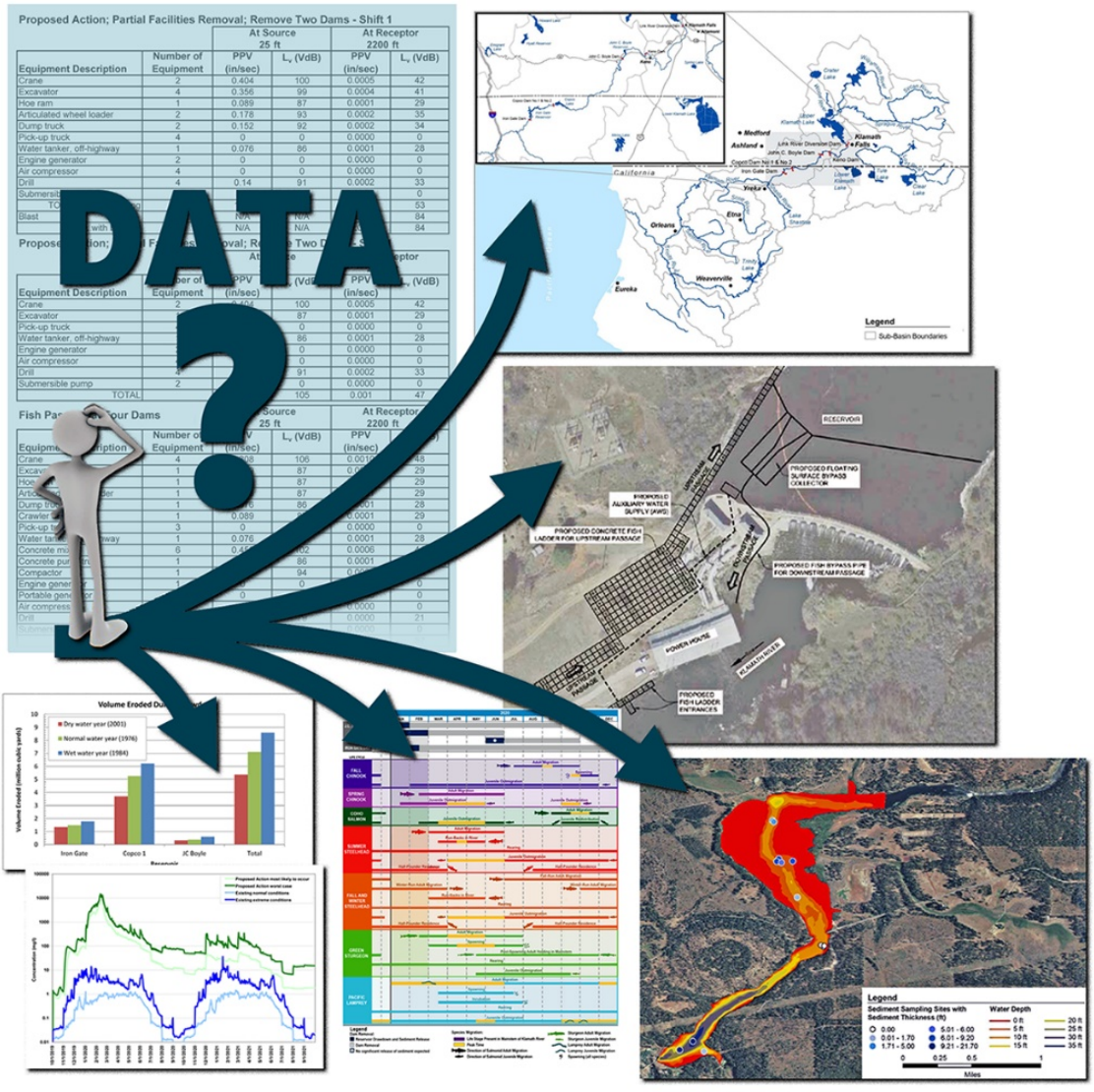
BUREAU OF RECLAMATION

Effective Graphics Guide

Creating Effective Displays for Models and Maps

Technical Service Center Manuals and Standards



U.S. Department of the Interior June 2020

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Cover image: Use your imagination to visualize your audience and find the right display to convey your results (Reclamation/Gray).

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Technical Service Center Manuals and Standards

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Acronyms and Abbreviations

BMP	Bitmap
DOI	Department of the Interior
dpi	dots per inch
GIF	Graphics Interchange Format
GIS	Geographic Information System
JPG or JPEG	Joint Photographic Experts Group
IT	information technology
MB	megabyte
pdf	Portable Document files
PNG	Portable Network Graphics
PRMS	Precipitation Runoff Modeling System
ppi	pixels per inch
Reclamation	Bureau of Reclamation
RISE	Reclamation's Information Sharing Environment
SVG	Scalable Vector Graphics
TIFF	Tag Image File Formats
TSC	Technical Service Center
VI	Visual Identity
VIC	Variable Inflow Capacity
WCAG	Web Content Accessibility Guidelines

Executive Summary

You have collected and analyzed the data and you have the results—the trends, the issues, the spatial locations for data and engineering designs, etc. Now how do you communicate those results to the people who will use them? To ensure that all your hard work matters, you need clear, consistent displays that show your data and results in ways decisionmakers, other analysts, and stakeholders can understand. Use this manual a thought process, tips, and guides for developing effective displays for data, particularly geographic and model data.

When determining how to display your data results, begin with the end in mind:

- Who is the audience?
- What is the purpose?
- What information will these displays provide?
- What is the format for the end product (e.g., print, online, conference poster)?
- How will the display be used (e.g., compare alternatives, make decisions, further analyze)?

Work with the client and team to ensure graphics are consistent across disciplines. Consult with TSC's graphic specialists. Coordinate your displays with the other analyses needed for the end product to ensure consistency and usability, considering Visual Identity requirements, color, scale, order, and labels. Develop draft graphics and discuss and review them with your end audience, if possible, as well as the team and client. Ask how they interpret the graphics and clear up any confusion (Use *Section 2. Plan Your Process and Displays*).

Use a display type that will convey your data in a compelling and practical format tailored to your audience and purpose. Your data could be displayed in many different ways (e.g., a bar chart, scatter plot, Sankey diagram) but you need to determine which display type ensures that your message is clear and accurate. Explore *Section 3. Types of Displays* to see possible ways to display your data.

"Excellence in statistical graphics consists of complex ideas communicated with clarity, precision, and efficiency" Tufte 2001.

- What is important to show and compare?
- Are you showing relative proportions of elements?
- Does the data change over time? By location?

Sound decisions and further analysis depend on others being able to understand and interpret your data and analysis. Therefore, design all displays so that the least technical readers can understand and interpret them accurately and easily. Plan your displays up front to meet these needs as simply as possible. Be consistent and simple. Use colors wisely and effectively. Get tips to ensure your chosen display effectively communicates key results in *Section 4. Create Effective Displays*.

Remember that some readers may not be able to distinguish colors or see the display. Always have another way to get the information across. Refer to *Section 5. Accessibility* for ways to reach these audiences. It's not just a good idea, it is 508 compliance.

Contents

1. Introduction

1.1. Manual Purpose and Need

As the saying goes, a picture is worth a thousand words. Yet pictures are priceless and irreplaceable when it comes to displaying complex information such as monitoring data, model results, and maps. Effective displays [1] (charts, maps, figures, etc.) convey complex processes, data or model results, important trends and issues, and other concepts to a wide range of audiences. The Bureau of Reclamation's (Reclamation) analyses produce information that can be shared using graphics and maps. Reclamation subject matter experts work in multi-disciplinary teams, so displays need to be coordinated between disciplines so that we can present unified, consistent communication products that our audiences can understand and use.

Take time to plan your displays and work with graphics and writing specialists from the outset of your project. This will save you time and money in the long run. Make sure your displays convey your information correctly and easily to your audiences—so your readers can carry your ideas forward

Effective graphics can help audiences:

- Quickly gain the information they need
- Compare results consistently to evaluate alternatives
- Accurately use information for further analyses or to create engineering solutions
- Avoid misinterpretations that could lead to errors in future analyses or decisions.

1.2. About this Manual

Reclamation's Technical Service Center (TSC) developed this manual to help guide thought processes to effectively convey analyses assumptions, results, and data in a clear and consistent manner. We also wanted to share effective techniques for programmers, modelers, engineers, cartographers, and other data analysts to in model and Geographic Information System (GIS) to output consistent graphs and maps. This manual is discretionary and provides only a general overview for programmers and data analysts. Each display process is different and will use different techniques to produce and use effective displays. The principles, tips, and examples in this manual will help you effectively communicate the results of your work to audiences who will act on your analyses.

[1] See the Glossary for terms in this manual. The term "displays" is used as the most generic word possible, including maps, graphs, charts, posters, tables, etc. "Figure" refers to any type of map, chart, or other image, and "table" refers to any form of information with rows and columns.

2. Plan Your Process and Displays

Planning early and often will save time and effort by making it easier to produce consistent displays and avoid revising figures for presentation or publication. Plan how you will prepare and convey your data and information at the beginning of the analysis and make the output (i.e., the display) an integral part of the overall analysis and reporting process.

Overall Goal:
Readers will be able to get the information they need quickly and easily.

2.1. Purpose and Message

To ensure that every graph, figure, and map conveys the analysis results to the reader clearly and correctly, the team should work with the client to answer these questions at the beginning of the project:

- **Why are we creating these displays?** For example:
    - To compare the impacts of a set of water management alternatives under a set of hydrological and meteorological scenarios
    - To show the potential impacts of a particular flood scenario
    - To demonstrate how a reservoir's capacity has changed over time due to sedimentation
- **What is the message?** Often, we won't know this until the analysis is complete, but you can ask the client—what questions do you want your displays to answer? Incorporate these answers as program requirements for the level of detail and presentation in the displays. For example, if analysis is examining what areas contain invasive species, then maps should include details about these areas.
- **What do you want these displays to accomplish?** What do you want the readers to understand or do with your information? For example:
    - Determine whether developing alternatives to address an issue is warranted
    - Make a balanced decision about which alternative to pursue
    - Evaluate whether an action is meeting the objectives

2.2. Audience

Before starting any project, work with the client to determine who the audiences are and what display's purpose is. If your audience is comprised mostly of subject matter experts in your analytical field and has the technical knowledge, then displays can be more complex and specialized. Technical experts in other fields may need to have information clarified, as they may make assumptions based on their specialty that may not be accurate. Stakeholders, decisionmakers, and other lay audiences may need cues on charts, simplified information displays, infographics etc. to grasp the main concepts effectively. Ask:

- Who will read our report and how will they use the information we present? Reports have a wide range of audiences and uses. Ask what do *x* need to know to do *y*?

- What background information will audiences need? What does my audience already know about the subject? Someone can have a very high level of education or reading/analytical skills but still not understand a graphic if their education/skills are not in the relevant subject matter.

- What is the simplest way to convey the data? If data require more complicated explanations for a specialized subset of your audience, put the detailed graphics and explanations in an appendix.

2.3. Level of Detail

Armed with a good understanding of the purpose of the report/map/figure and the audience, determine what level of detail will be needed. Technical audiences may require more data and information, while lay audiences need to focus on the most important information related to their purpose. For example, focus on detail by putting the "noise" (the other less important information) in as a grayscale (Figure 1).

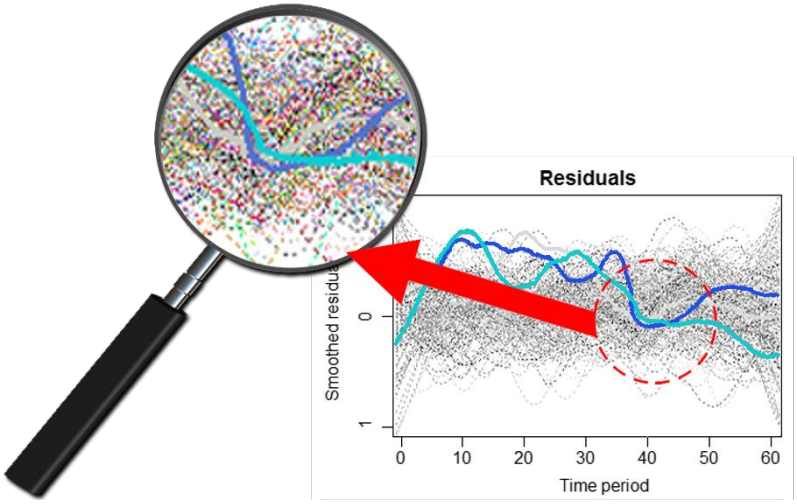

Figure 1. Prominently display important information. In this example, it is important to show the range of all runs, but the text focuses on just two runs (Reclamation/Gray).

To determine a consistent level of detail for multi-disciplinary displays, ask questions in a team planning meeting to:

- **Match the level of detail to the purpose.** What level of detail is needed to ensure that the audience can effectively interpret and use the analysis results?

- **Be specific.** What specific information does your audience need so they can quickly understand your main point? For example, if roads are needed, what type of road should be included (e.g., highways only, all dirt roads, service roads to the facility)?

- **Be simple.** What is the minimal data density needed to convey your results. Delete extra information. See *Section 4.7. Be as Simple as Possible.* For example:

    - A map may need to only show roads that cross a river or pipeline.

    - An overall pipeline drawing showing a general alignment may only need to show stationing at 1,000 feet rather than 10 feet.

    - Model runs could show an average range as a gray background shape or as grayscale and use thicker or colored lines for the most important runs.

2.4. Final Product

From the very start of a service agreement or project management plan, plan and program your analysis, modeling, and mapping with the end product in mind. Include the client in all of these decisions and make sure all of these decisions are approved and understood. If possible, ask a representative audience member for input (this could be someone who would read the final report or anyone with a similar background as the target audience). Drafting a figure ahead of time can help focus the discussion.

Work together. Remember that your professional understanding of how to portray the data should take precedence for technical decisions, and bear in mind who will use the display and how they may perceive the display.

2.4.1. What Will the Final Product Look Like?

Data displays should be as simple as possible, without unnecessary elements cluttering and blurring a viewer's understanding. Ask:

- Will this display be used on screen for presentations only? Or will it be printed? This will help determine the resolution and format needed.

- How will it be presented (e.g., poster, report, banner, physical display?) This will help determine the level of detail you need.

2.4.2. How Will the Final Product be Used?

- Will this display be used in a future analysis, in other words, will others base their analysis and technical solutions on this display? If so, then displays may need to be complex and complete enough to provide the needed data. Decisionmakers, analysts from other fields, and stakeholders will use the display to draw conclusions about trends and may make recommendations based on these figures. (Note that your data as an end product could have many uses, from satisfying open data requirements in a database such as Reclamation's Information Sharing Environment (RISE) to further analysis of the raw data.

- Will this be used to analyze similar situations, compare potential actions and make decisions? Make comparisons should be as consistent as possible to the level of detail possible—compare Honeycrisp apples to Honeycrisp apples, rather than Macintosh apples to Honeycrisp apples. For example, if the figure will be used to compare annual water deliveries to a given irrigation district under two management alternatives, compare flows at the same gage and under the same conditions.

- Will audiences use the displays to explore relationships between different conditions or criterial (e.g., compare flood inundation area to the location of critical habitat)? Work with all subject matter experts involved to determine what relationships need to be compared and how to best display relationships.

- Will results be presented at a conference as a poster or PowerPoint presentation, online as an explanation, or in a report that is both printed and online? Different venues and mediums will require different resolutions, file formats, and planning. For example, you may need a simple graph for a PowerPoint display, a more complex graph showing more details in a paper.

- Will this product be used for social media? If so, then using infographics or very simplified summaries of the data may be needed. You may find it easier to develop these infographics outside of your map or model program. For example, it might be easier to export your figure and modify it in PowerPoint.

TSC's graphic specialists can take your ideas and analysis results and make effective and interesting infographics for you.

2.4.3. What Will the Final Size and Format(s) Be?

When planning, also note what file formats the figures need to be exported to from your original program. Files need to be exported in the correct file format to be able to be used in the final publication software (e.g., Word, InDesign, and PowerPoint).

2.4.3.1 Size Your Display

The final size of the display and corresponding caption must fit within the page margins, including headers and footers. Note that for figures that span for a full page, the longer the caption, the less space is available for the figure. For example, a figure to be printed on an 8½ by 11-inch page (the usual U.S. report page) can be a maximum of 6 $^{1}/_{2}$ inches wide and 8 inches high for portrait—or 9 inches wide and 6 inches high for landscape). When developing displays, minimize any unnecessary white space and borders around them. Set the size of your graphics in your template or your script. For example, most scripting languages will allow you to specify height and width of your figures (see Appendix A).

2.4.3.2 Use the Correct File Format

Always export your figures into an accepted file format from your original program so they can be easily inserted into a final document program (Microsoft Word, PowerPoint, InDesign, etc.). Saving in graphic formats will help export graphics consistently and will make updating them much easier. Save at as high a resolution (as sharp and as clear) as possible. How the image looks on screen may not be the way that image will show up on a hard copy print or on other software. Plan to export and test the image in its final published format (both on screen and in print).

Bottom line for data displays: save graphics in TIFF format whenever possible to retain original data. PNG format can be used if you need to reduce file sizes. JPG format is least ideal because of the loss of clarity.

- **Files to retain clarity and data points (TIFF).** Tag Image File Formats (TIFF) retain all the original data and colors, and they can be resized easily, increasing the number of dots per inch (dpi) without any loss of quality. You can transfer TIFFs from one application to another without loss of quality or any compatibility issues. Save as the raw version of TIFF whenever possible because this preserves the most data in your file and provides the most flexibility for Photoshop or other image softwares. This is the best practice. Note that the file sizes in TIFF can become very large. If needed, export the original figure, save the TIFFs on an archive drive (like the T: drive) and then resave as a smaller file size to use in reports.

- **Files to display online (PNG).** Portable Network Graphics (PNG) files support millions of colors, plus varying degrees of transparency and work well for image files, such as logos, charts, and infographics. These files are usually smaller sizes than TIFF files. However, PNGs can lose data and visual clarity and should not be used for subsequent analyses. This is an acceptable practice if you are concerned with file size and also have the original display in another format.

- **Photos to display online (JPG).** Joint Photographic Experts Group (JPG or JPEG) files are not ideal practice for data displays. Note JPEGs are "lossy" formats, so resaving a JPEG can compress the file and degrade the image. JPEGs are not suitable for images with sharp lines, large blocks of color, or text (Chastain, 2020).

Other file formats are usually not used:

- Portable Document files (pdf) will retain data and reduce file size. However, pdfs will need to be exported as an image to be incorporated into a Word file or PowerPoint.

- Bitmap (BMP) is the native file format for Windows. However, this format does not allow for image compression or scaling.

- Graphics Interchange Format (GIF) are sometimes used for flat and single tone color images or animations, as they are limited to 256 colors. GIF files are mostly used for buttons or banners on websites. (Fisher 2020 [GIF]).

- Scalable Vector Graphics (SVG) are file extensions for a vector[2] image file format to describe images created from mathematical equations. MicroSoft Word and other publishing programs do not recognize any file with an SVG extension. If your program will not export into a TIFF file, you can try to copy the SVG in your program, paste it to PowerPoint, save as a TIFF file, and then save into Word. You can also use a graphics program like Adobe Photoshop (Fisher 2020 [SVG]).

2.4.3.3 Save at the Right Resolution

Print resolution is measured in round dots per inch (dpi) for printed raster[3] images or square pixels per inch (ppi) for digital (on screen) raster images. The larger the dpi or ppi number, the sharper and clearer the image will be and the better it will be for printing or viewing. Save the original figure from the original program in the highest resolution that you will ever need—you can compress and save at lower resolutions more easily, but you may lose data if you try to save at higher resolutions. If the graphic will ever be enlarged for printing, then save at a minimum of 600 dpi—and preferably 1200 dpi. Then in Word or other publishing programs, save that larger image with the smallest file size resolution that will still convey your figure's complexity, allow for enlargement, and preserve data.

- **Small Web graphic:** 72 dpi is usually used for websites to keep file sizes smaller, so pages load faster. However, this same image will vary in detail on different monitor resolutions. Most monitors have a native resolution of 72 or 96 ppi, and this changes as technology changes.

- **Printing:** 300 dpi at the original size is the standard resolution required for printing.

- **Detailed printing:** 600 dpi ensures that the figure retains a high level of detail; however, 600 dpi file sizes are larger.

[2] Vector images use equations to calculate the lines and shapes.
[3] Raster images use pixels to show the image on screen or paper.

- **Data displays and maps:** 1200 dpi is best for figures that may be enlarged or contain a great amount of detail

- **Slide conversion:** 3200 dpi is best for converting slide images to enlarge them.

Higher resolutions create larger files. This may be an issue in larger reports with multiple figures, as many document programs or platforms such as SharePoint or Microsoft Teams do not handle files larger than 30 MB well.

2.4.3.4 Do Not Link to Program Files in Word

Linking a figure from an original program such as Excel into a Word document may be tempting, but do not succumb to temptation—this is not good practice. The files can easily be moved, leading to broken hyperlinks and error messages (Figure 2). Moreover, after subsequent saves and moves to different drives, so the linked file may not be the current and correct version. Linking files use the entire data file rather than the one image can quickly increase document sizes (for example, one linked display can increase the size of a Word document from a 10 megabyte (MB) document to a 30 MB document) (Figure 3).

Export your image to a TIFF to create a static image for the Word document. If there are changes to the data or figure, then update the figure in the original program, re-export, and reinsert into the Word document. This may be a pain—but avoiding entanglements and wrong data versions is well worth the effort!

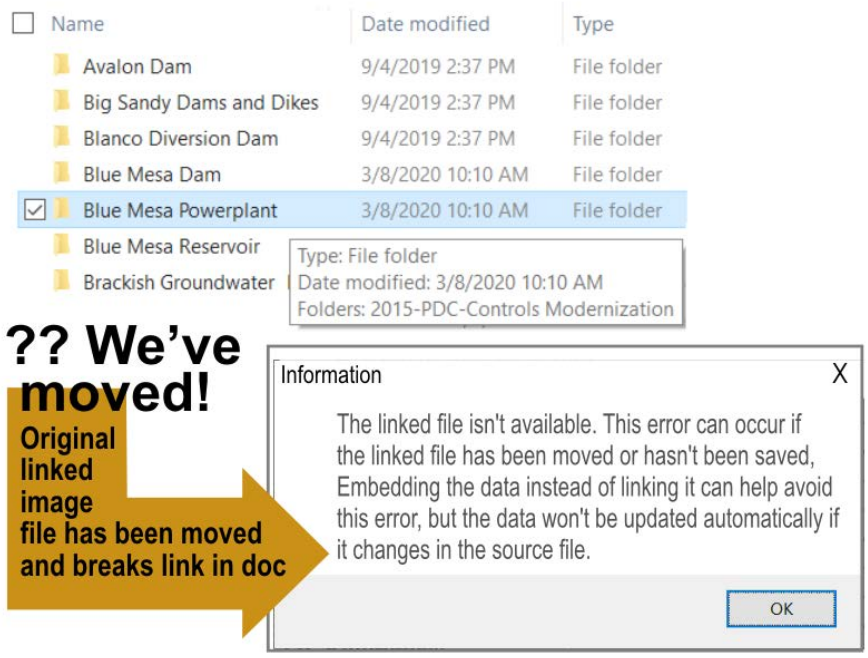

Figure 2. Example of potential errors from a linked file (Reclamation/Gray).

Figure 3. Linking images from programs like Excel into Word can make the file size unmanageable (Reclamation/Gray).

2.4.4. Group All Elements

Group your graphic elements and layers (e.g., arrows, text boxes, legends) in the original program and import one single display in a Word document. If you pull in separate elements, they can get lost as more content moves the display from its original position. If this is not possible, pull the elements into PowerPoint and export the graphic from PowerPoint.

2.4.5. Where and How Will the Final Products Be Stored?

Have a record retention filing and naming convention for each project and use the TSC file conventions as much as possible. Naming figures consistently minimizes errors and helps find figures again, as teams have learned through bitter experience:

- Name your figures so someone can quickly identify what the figure portrays. For example, Project acronym, type of plot, frequency, variable. This would be ND_timeseries_yearly_swe.tiff.

- Do not name these as figure 1, figure 2 in the file name. Figure numbers will change as the report progresses and the file names will be wrong.

- Do not use hyphens, periods, or other symbols in the file name. Use underscores rather than spaces in a file name, as this helps prevent breaking links when sharing files.

2.5. Coordination and Documentation

Readers will compare display series, such as a series of alternatives compared to a baseline or maps showing different scenarios. Therefore, consistency between all display series in an overall analysis and report is critical to:

- Be able to quickly scan for a particular item (e.g., scenario, alternative, region)
- Show relationships more easily.

Not only should your displays be internally consistent, they should be consistent with every other team members' displays. See *Section 2.5.4.1. Consistency Document* for more information.

2.5.1. Comply with Reclamation's Visual Identity

Follow Reclamation's Visual Identity (VI) Program requirements at https://intra.usbr.gov/vip/. At this time (2020), fonts are Segoe UI for labels in graphics and Garamond or Times New Roman for text. Table 1 lists Reclamation's colors. Appendix C provides color scales for Reclamation's VI colors to use in maps or in color bars to show scales of intensity.

Table 1. Reclamation's Color Conversion Table

Color	CMYK	RGB	HEX
*Dark Blue PMS 3035	C: 97% M: 67% Y: 48% K: 38%	R: 0 G: 62 B: 81	#003E51
*Light Blue PMS 633	C: 89% M: 46% Y: 27% K: 4%	R: 0 G: 115 B: 150	#007396
*Mustard PMS 1245	C: 21% M: 43% Y: 100% K: 2%	R: 202 G: 145 B: 23	#CA9117
*Tan PMS 468	C: 13% M: 17% Y: 38% K: 0%	R: 221 G: 203 B: 164	#DDCBA4
**Orange PMS 165	C: 0% M: 74% Y: 96% K: 0%	R: 255 G: 103 B: 32	#FF6720
**Green PMS 357	C: 84% M: 40% Y: 91% K:38%	R: 33 G: 87 B: 50	#215732
**Purple PMS 2091	C: 85% M: 100% Y: 0% K: 1%	R: 76 G: 18 B: 161	#4C12A1
**Red PMS 484	C: 26% M: 90% Y: 96% K: 23%	R: 154 G: 51 B: 36	#9A3324

*Primary colors can be used throughout reports for backgrounds and font colors,
** Secondary colors are to be used sparingly and never as a font color.

2.5.2. Coordinate with Other Disciplines

Your displays will usually be a part of an overall analysis effort involving several disciplines. Therefore, team coordination is vital from the beginning. Determine:

- Who will do what analyses and what displays will be produced?
- What color scheme will be used? (See *Section 4.8. Consider Colors Carefully*)

2.5.3. Work with Graphics and Writing Specialists

When beginning a project, contact the writing and graphic specialists to determine the most effective way to set up and plan your displays. Working with graphics and writing specialists from the outset of your project will save you time and money in the long run. They can:

- Suggest ways to set up your project to create effective displays (e.g., setting up lines, colors, and contrast)
- Guide you on the latest VI and accessibility requirements
- Suggest ways to make your displays convey your message more effectively
- Help you develop and maintain consistency guidelines
- Improve graphic outputs at the end of the process (e.g., adding labels and images, removing grid lines, creating color contrasts, and combining graphs into a single display)

2.5.4. Document Your Plan

2.5.4.1 Consistency Document

Study teams should prepare, regularly update, and use a consistency document so all team members and the client can refer back to these report and display guidelines during the analysis. This document should include:

- Audience
- Purpose
- Consistent styles and terms
    - Order (determine the order for alternatives, scenarios, places, criteria, etc.)
    - Color assigned to each element (e.g., criteria, alternatives, scenarios) (See how to use colors in *Section 4.8. Consider Colors Carefully*)
    - Symbol or line type assigned to each element (see *Section 4.6. Keep Graphic Elements Consistent*)
    - Labels (see labels in *Section 4.4. Label Clearly*)
    - Legend terms and layout (use Reclamation's VI for font)
- Scales and frequencies (See *Section 4.6.3. Keep Consistent Scales*)
- Level of detail (See *Section 4.7. Be as Simple as Possible*)

Agree on specific details up front to avoid changing these details later—and save time and money.

2.5.4.2 Checklist

Agree on what needs to be included in each figure and create a checklist to ensure all figures have everything they need so the readers can quickly understand them. Considerations include:

- **Signatures.** Determine whether each figure needs its own signature for peer review or whether a single signature sheet will suffice for the entire document. Note that the digital signature on an Adobe Acrobat will lock a file and should be done as the final step of the report process.

- **Axes labels.** Keep these consistent and use the same terms and acronyms as in the text (e.g., decide on cubic feet per second as cfs or ft^3/s). Start from a consistent point for each display series. Label your start and end points and keep them as consistent as possible throughout the series. See *Section 4.6.3. Keep Consistent Scales.*

- **Captions.** See *Section 4.5. Use Text and Captions.*

- **Legends.** Determine if a legend is needed. If the line widths or colors used to denote an element are not defined in the text or caption, then they should be defined in a legend in the figure itself (e.g., brown is baseline, orange is alternative 1). Although the same color is used to denote the same element throughout the report, use a legend on each figure in case the figure is used independently.

2.6. Test Displays and Reviewers

2.6.1. Storyboards and Draft Displays

Changing an entire series of displays after they are developed is costly and time consuming, so it is much better to test a display before committing to the entire series. To test, you could create a wire frame or a sample graphic output as a "storyboard"—a quick visual outline, a test graphic to show how a series of graphs or maps will look. These are effective tools to determine what elements will be contained in the display and how the display series will tell the overall story.

Don't worry about actual data at this point as the idea is to ensure that the presentation can be understood easily. You can note that this sample is not correct and is only a test to determine if your display will meet its goals.

2.6.2. Reviewers

After a while, your displays will be too familiar to you, and you will know what you want to convey too well. Get fresh perspectives from others:

- **Team members.** Show your test displays to others on the team to ensure that they are compatible with the displays that the other team members are producing.

- **Peer reviewers.** Peer reviewers can spot mistakes more easily since they are not as familiar with the display. You need an outside perspective to make sure that others can

see what you have in mind. Peer reviewers can help determine if a display is scientifically correct, conforms to policy, and is as error-free as possible.

- **Test audiences.** A test audience are reviewers who represent the type of audience that your report is prepared for. Work with clients to identify stakeholders who may volunteer to look at storyboards or sample displays. If these stakeholders are not available, then ask others who may have that same perspective. Administrative assistants, information technology (IT) professionals, etc. may be good substitutes for the intended audience.

You are not the user. You need different perspectives to ensure your display is effective. Pick someone who represents your intended audience and check your ego at the door!

- **Graphics specialists.** Consult with graphic specialists to ensure displays effectively convey their message and comply with graphic requirements (e.g., VI, accessibility, and consistency).

2.6.3. Usability Testing

Usability testing helps ensure your display is properly understood and used.

You have to see it to change it. So see it early to avoid changing it later!

Create a best-guess draft and consult with the client, other team members, decisionmakers, and representatives of your audience to discuss possible revisions (e.g., lines every 1,000 feet versus 500 feet, different shading, different elements prioritized). Once a client and a test audience have something to look at, it is easier to show exactly what should change and why.

If possible, provide a couple of alternative presentations and ask the client and team what option they prefer and why. Asking open-ended questions, such as:

- **What insights could you glean from this display?** This will elicit answers that may point to potential areas of confusion or may point out strengths.

- **How would you use this display?** This will provide insights on possible interpretations of the data and results.

- **How readable is the display?** Will the presentation, size, and font work at the scale for the final product?

3. Types of Displays

You can display data, information, and results from models and maps in various charts and graphs as described in this section. You can also use tables, text, videos, etc., to display information. Each type of presentation has its own strengths and weaknesses. Determine your main point and use a presentation that will convey that point.

3.1. Infographics, Schematics, and Flow Charts

You can use pictures and symbols to convey information and stories. There are various types ofr drawings that show processes, and terms are used interchangeably. In general:

- **Infographics** are visual representations of information, usually using pictures to emphasize a point. Use infographics to help readers understand physical processes or related concepts (Figure 4). Pictures spark visual interest and help organize presentations and Figure 5). Laying information on a stylized river (Figure 6) or an actual map can help orient readers and provide a better sense of where activities or analyses are.

- **Schematics** show how a system works using symbols. These are often used to show engineering systems such as a water treatment process or electrical circuit.

- **Flow charts** help guide a reader through a process or make decisions, which can also provide a larger context to show how to use your model and map results. Figure 7 shows an analysis and a decision flowchart to explain how to monitor and use sediment analyses.

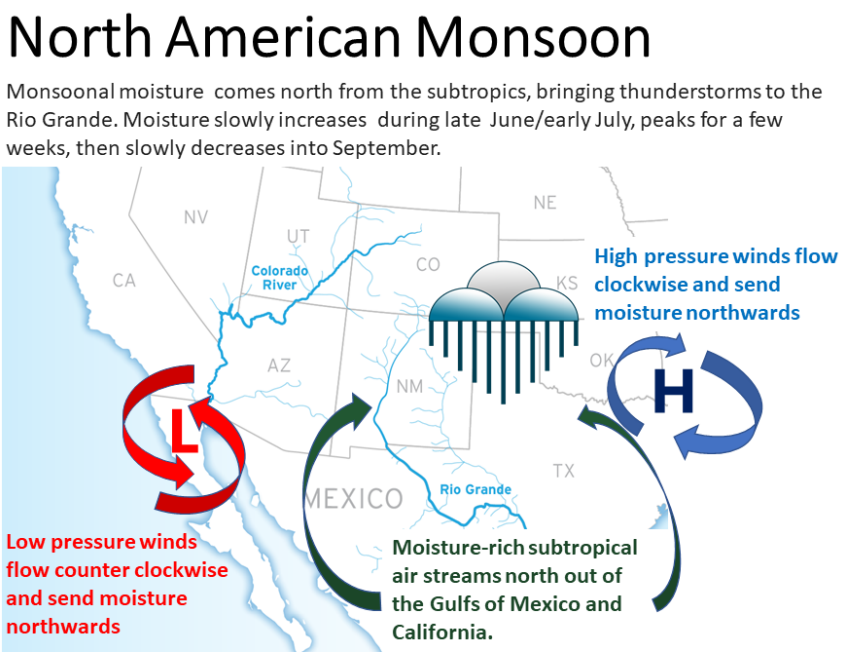

Figure 4. Use infographics to help readers understand processes and concepts (Reclamation/Larsen).

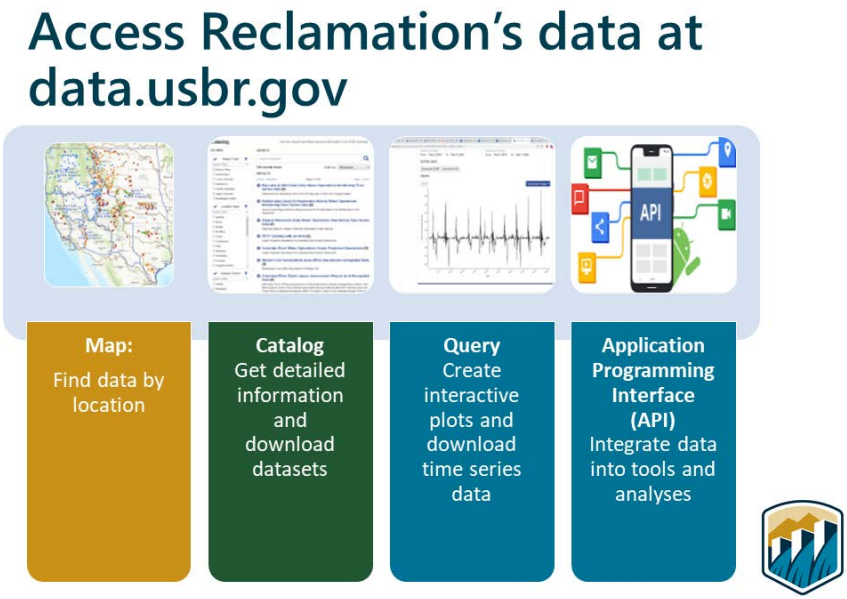

Figure 5. Use text and pictures too organize information. (Reclamation/Larsen).

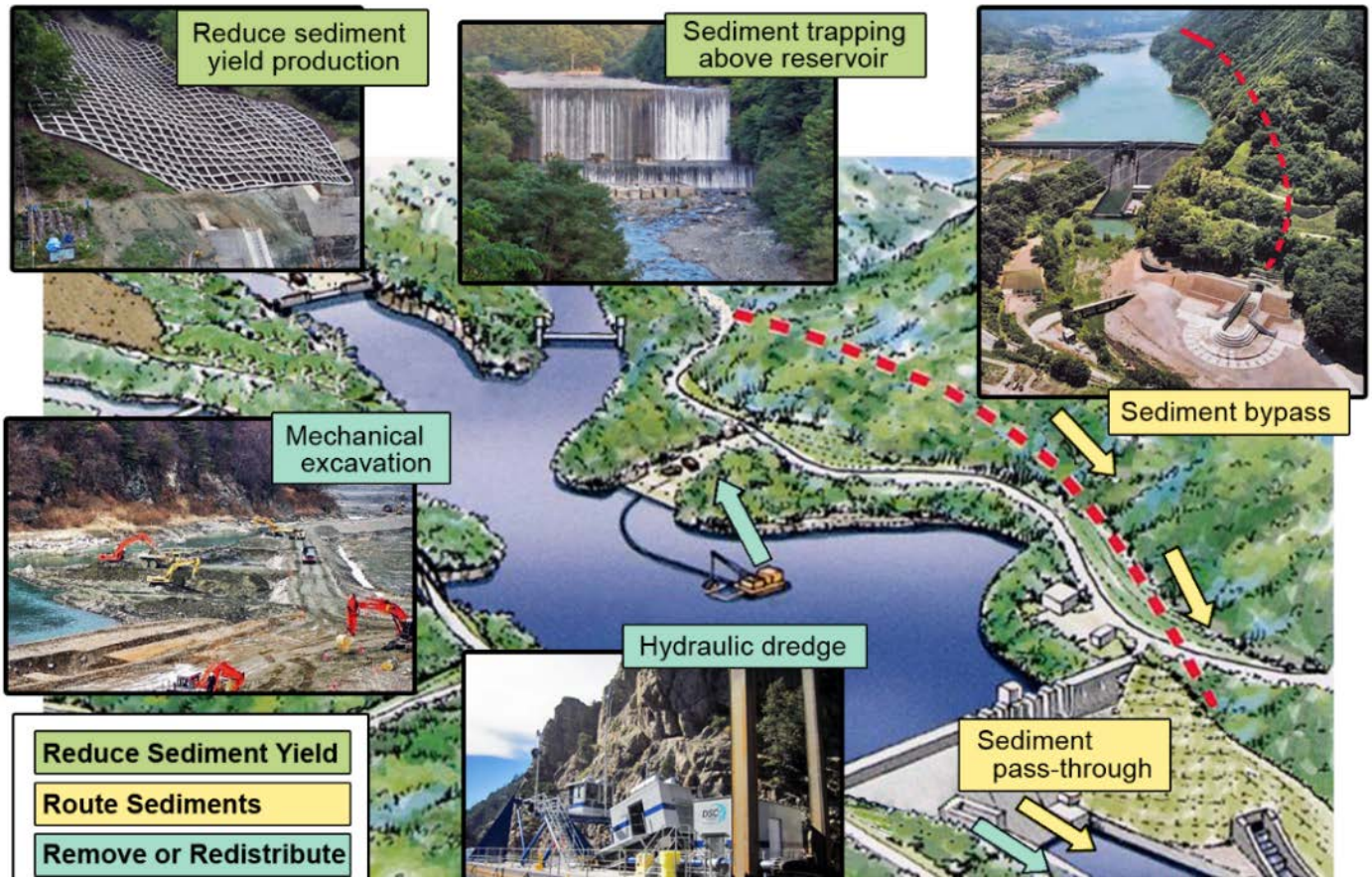

Figure 6. Use maps or images to direct your story and add details of the images in the text (Reclamation/Gray).

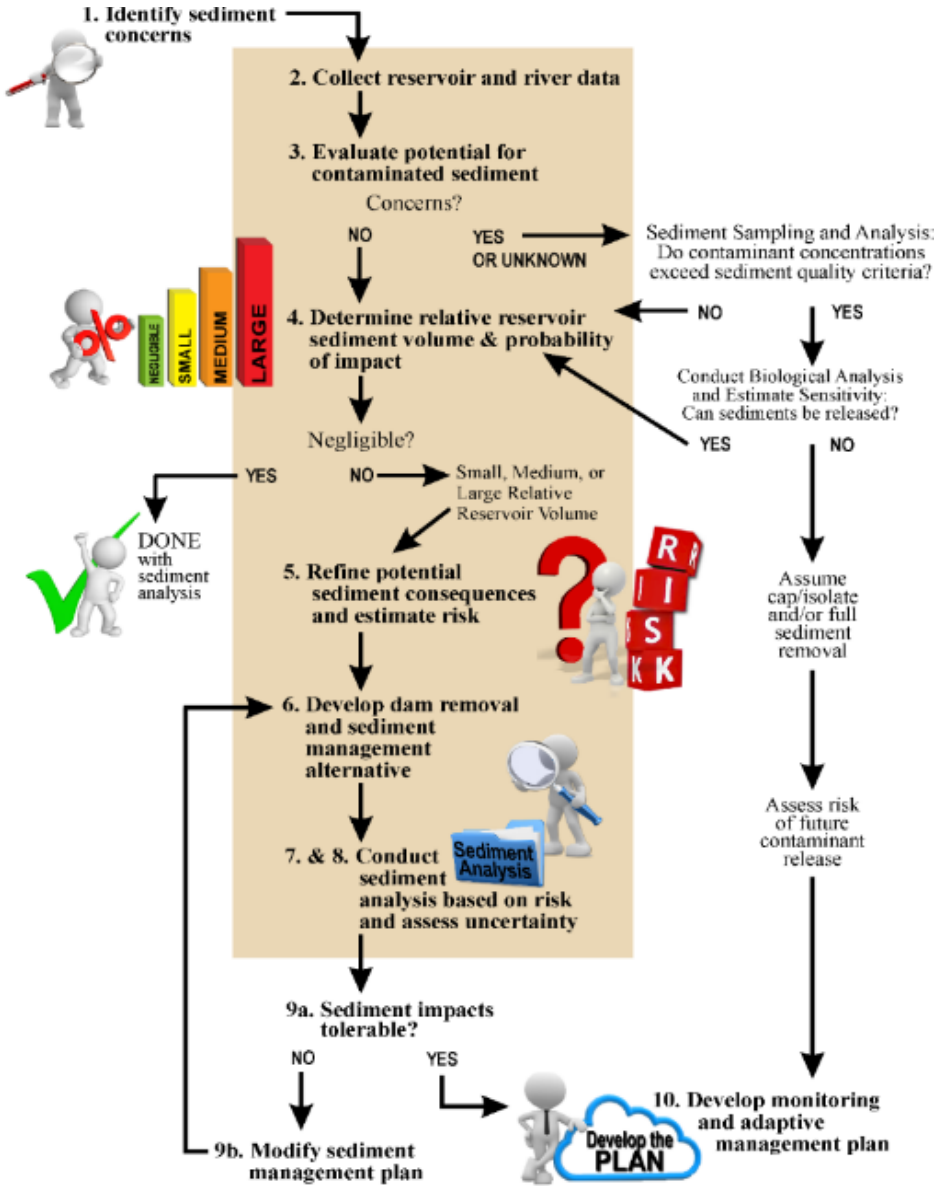

Figure 7. Use flow charts or diagrams to direct your analysis story and then explain each important section in the text (Reclamation/Gray).

3.2. Bar Charts

Bar charts can compare categories of data. A bar graph will always have two axes. One axis will generally have numerical values, and the other will describe the types of categories being compared. For example, the bar chart shown in Figure 8 compares potential actions to improve water supply reliability by overlaying cost with potential water yield and estimates the timing needed to implement the action. Proportions are shown by bar length and numbers are provided, making comparisons easier.

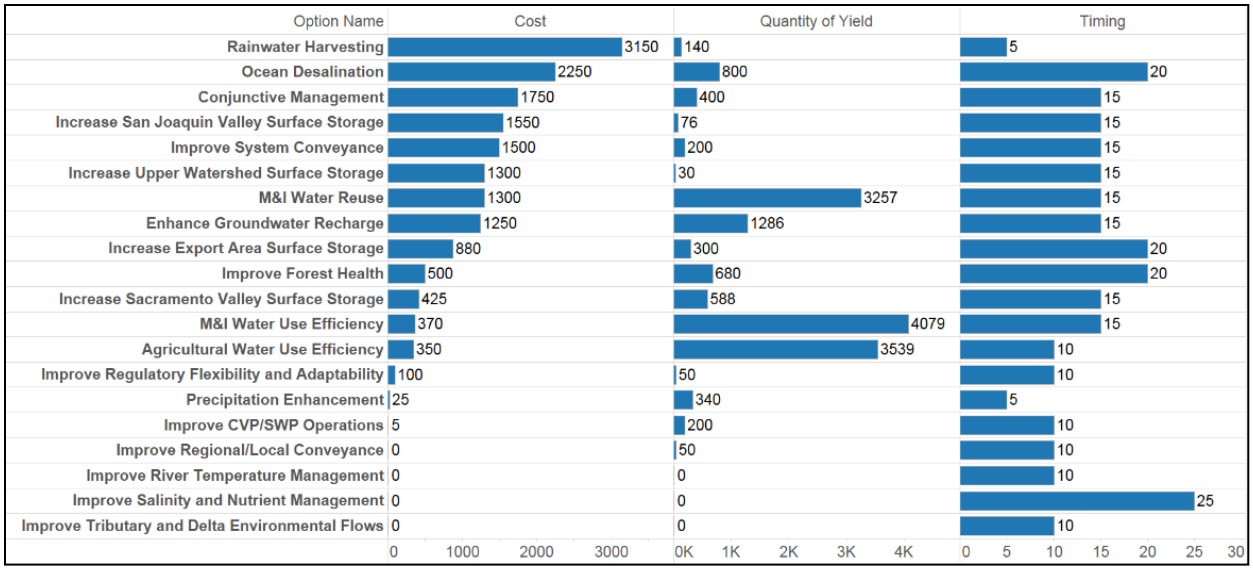

Figure 8. Estimated median cost, quantity, and timing for each of the actions. Costs are in dollars per acre foot, yields in acre feet, and timing in days (Reclamation 2016 [SSJ Basin study]).

3.3. Pie Charts and Treemaps

Pie charts and treemaps are useful for quickly showing relative proportions and work best if actual numbers are not as important as the percentages shown. If there are more than four slices or categories and numbers matter, use a bar chart or a line graph. If proportions change over time, locations, or processes, use a Sankey Diagram (see *Section 3.8. Sankey Diagrams).* Portions can also be broken down further to quickly show subportions within a particular category. For example, Figure 9 uses subportions to illustrate the source and uses for water in the Pecos River Basin in New Mexico. Use colors and labels consistently to represent different factors (see *Section 4.8. Consider Colors Carefully*).

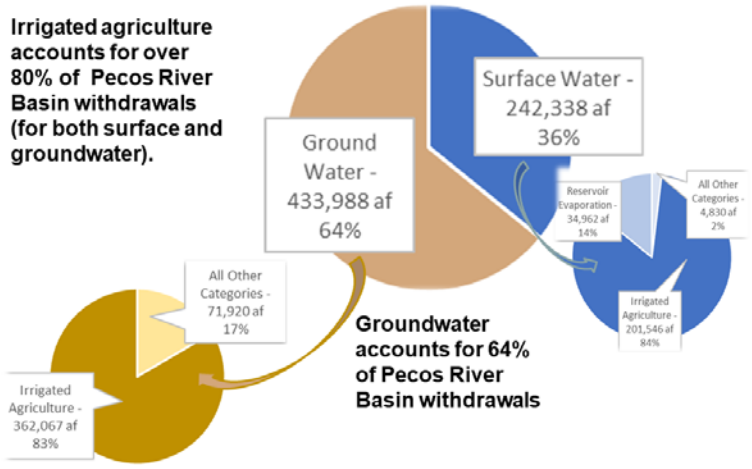

Figure 9. Water supply and use (Reclamation, 2020 [Pecos]).

If there are more than four elements to compare, or if you want to show proportions for several alternatives or scenarios at once, consider using a tree map (Figure 10).

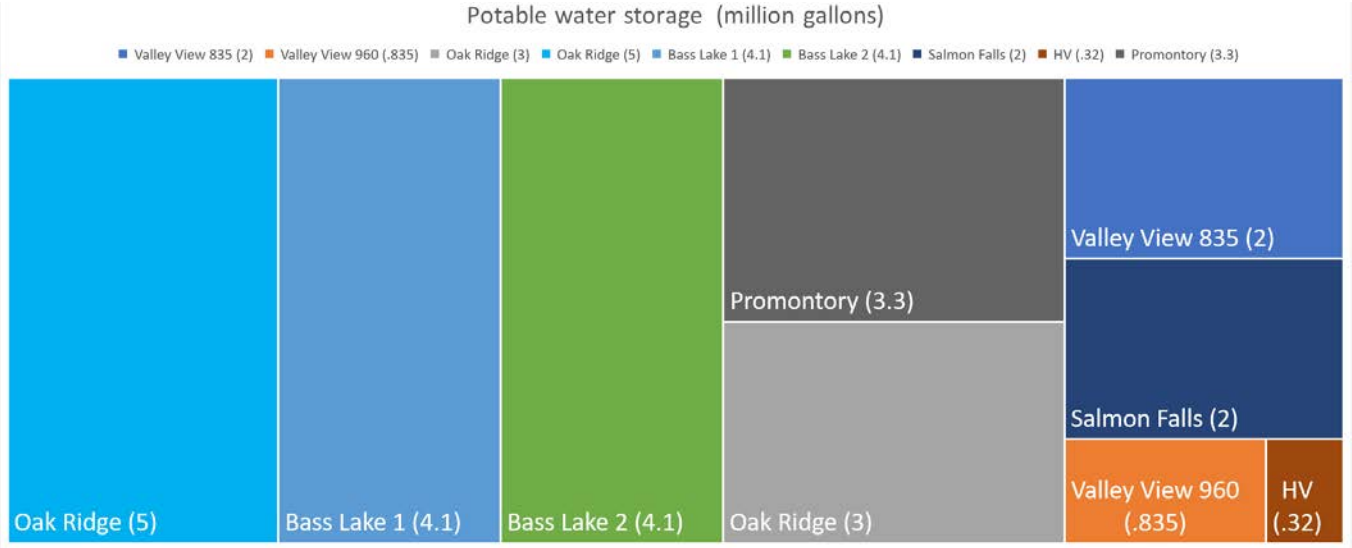

Figure 10. Amount of water used by each irrigation district. (Data from Tully and Young, 2016) (Reclamation/Larsen).

3.4. Scatter Plots

Scatter plots are two-dimensional charts that use dots to represent values plotted on two axes (e.g., temperature and precipitation). Scatter plots can compare selected model runs to all model runs (Figure 11).

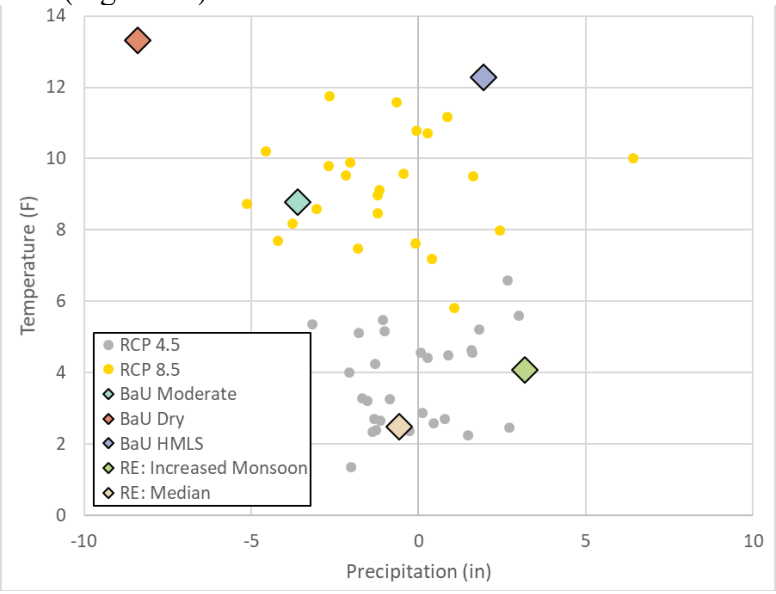

Figure 11. Total change in modeled average temperatures and precipitation in the study area from 2010-2099 (Reclamation, 2020 [Pecos]).

Scatter plots often show relationships and trends. Scatter plots can also show groupings, such as climate ensemble scenarios (Figure 12).

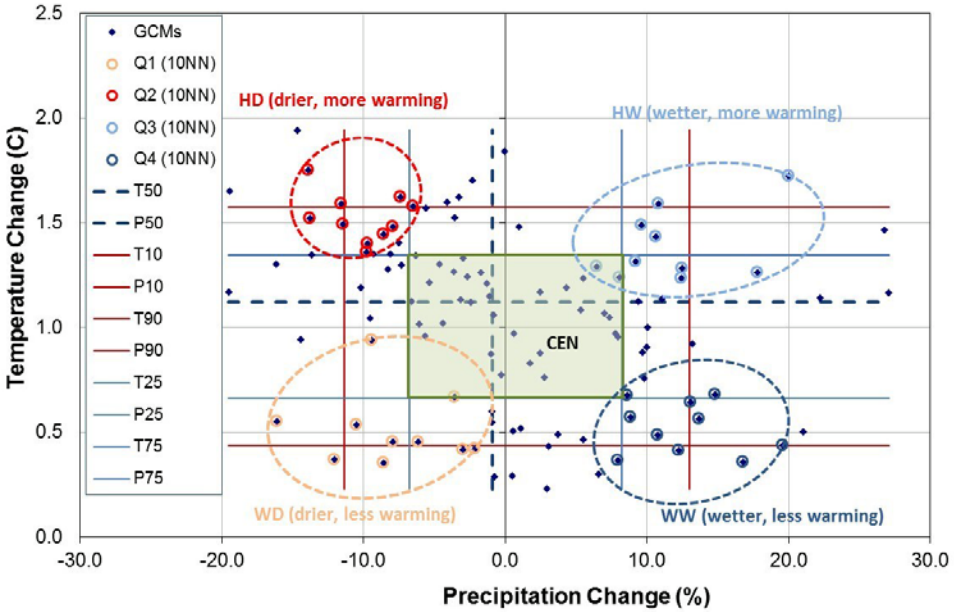

Figure 12. Scatter plot showing various global climate model projections. Each quadrant is then grouped together and analyzed as a scenario.

3.5. Boxplots

Boxplots emphasize the probability distribution of a given metric, including the median, interquartile range, and outliers. Boxplots display metrics, along with outlier values, to provide a quick visual summary of key characteristics of the dataset. These plots are especially useful for indicating whether a distribution is skewed and whether there are potential unusual observations (outliers) in the data set. A boxplot is a graphical method for displaying summary statistics of a group of numeric values. The distribution of values is summarized based on five metrics, listed in order from least to greatest (Figure 13):

- **Lower inner fence.** The lowest point excluding outliers
- **First quartile.** The middle value between the dataset minimum value and the median (25% of the values in the dataset are less than the first quartile and 75% of the values are greater than the first quartile)
- **Median.** The middle value in the dataset

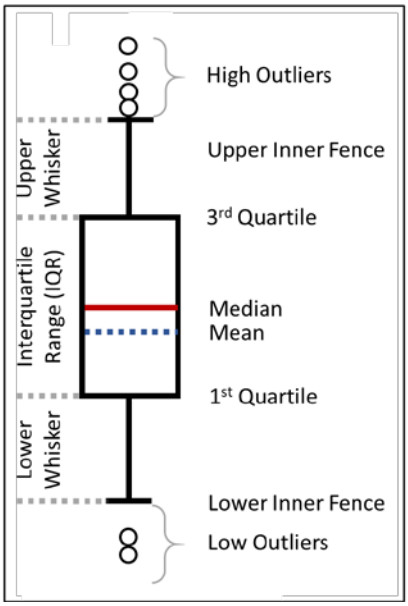

Figure 13: Schematic illustration of a boxplot.

- **Third quartile.** The middle value between the dataset maximum value and the median
- **Upper inner fence.** The largest data point excluding any outliers

Side-by-side boxplots are an effective way to highlight and summarize the essential characteristics of each dataset and the differences between them supplies compared with demand such as historical values compared with projected values as shown in Figure 14.

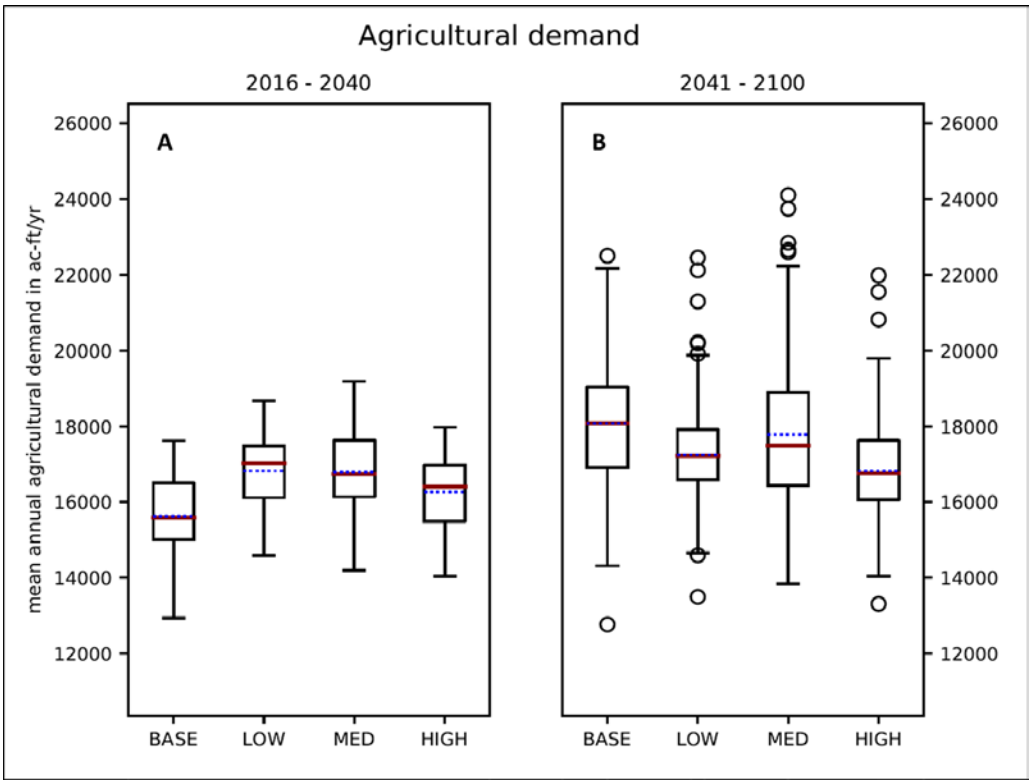

Figure 14: Agricultural applied water demand, defined as the volume of irrigation water required to meet crop water demands (Reclamation/Ferguson).

3.6. Teacup Diagrams

Reclamation commonly uses teacup diagrams to show reservoir surface elevations (Figure 15). These diagrams are useful for showing the status of reservoir storage relative to reservoir storage capacity in one or more reservoirs at a given time. Teacup illustrations show a schematic water level, but this may not accurately represent the actual reservoir storage capacity due to potential sedimentation issues and unknown bathymetry. Moreover, teacup diagrams can be cumbersome if you are comparing two or more time periods or other variables.

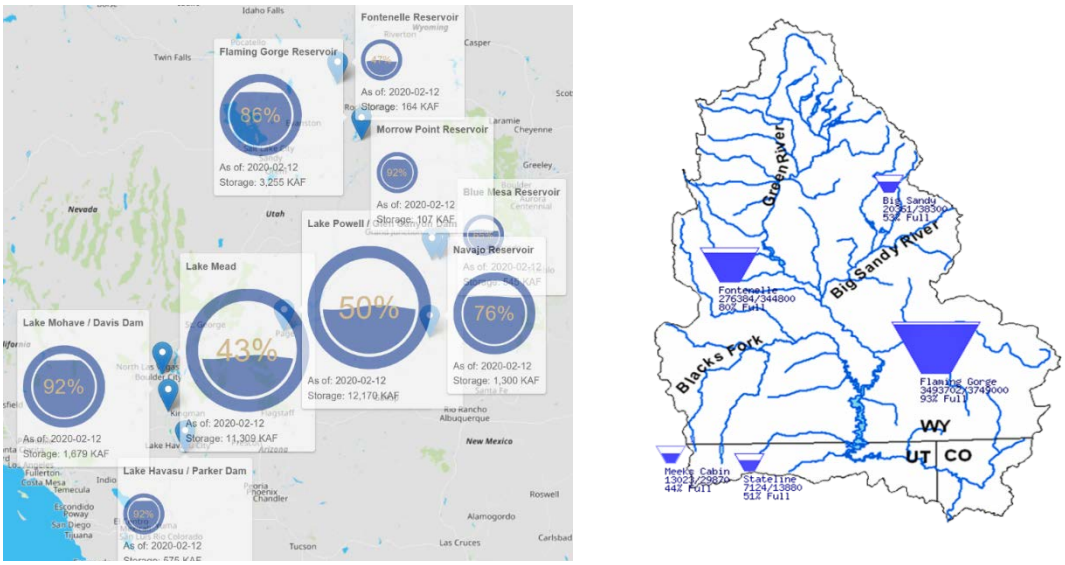

Figure 15. Teacup diagram examples (Reclamation 2020 [RISE]).

3.7. Line Graphs

Line graphs, such as time plots, can compare metrics over time, such as changing reservoir levels (Figure 16). Line graphs can also show relationships over distance, elevation (e.g., changes in elevation along a transect, seepage loss rates along a series of river reaches, and tree density as a function of elevation). For clarity and easier reading, use various types of lines along with color.

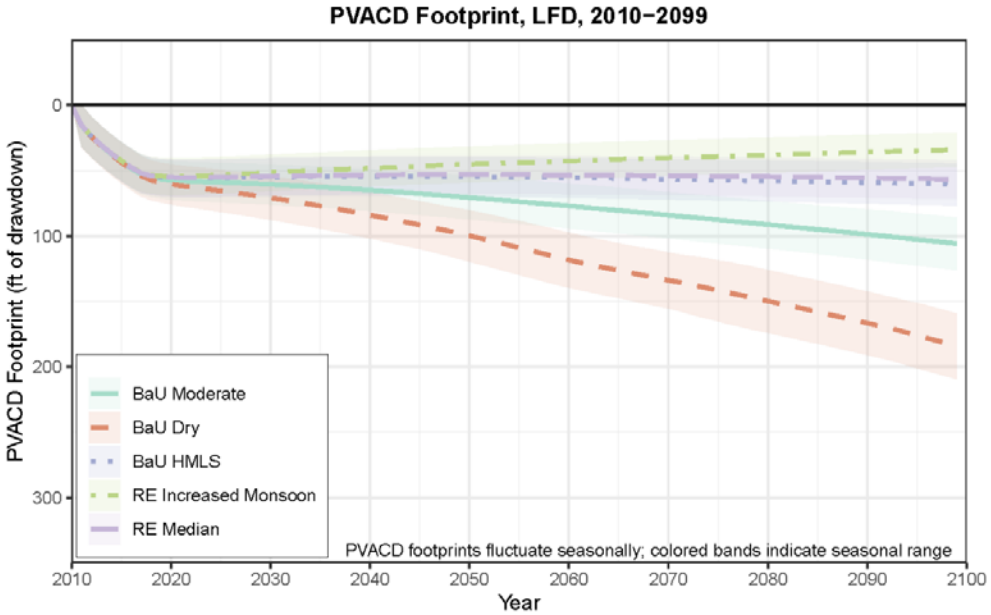

Figure 16. Roswell Artesian Basin groundwater levels: Estimated water footprint at the LFD observation well in the five storylines, in feet of additional drawdown. Lightly shaded areas indicate seasonal variations in groundwater levels (Reclamation, 2020 [Pecos]).

3.8. Sankey Diagrams

Sankey diagrams are a type of flow diagram in which the width of the arrows is proportional to the flow rate. These could be useful for showing the proportions of flows from tributaries into a watershed, proportional canal flows from a reservoir, or water flows through a wastewater treatment process. These can also be used for operations to show proportional amounts of water in a system. Figure 17 shows the relationships between flows and outflows, and readers can gather that about three times as much water in Lake Tahoe is lost to evaporation than flows out of the lake. Arrow directions and proportional shapes help convey this message. Figure 18 shows the flows for the Rio Grande from Colorado to Mexico. The black line indicating that flows to Mexico come through the system visually emphasizes the importance of meeting international treaty obligations.

Figure 17. Sankey diagram for the average relationship between inflow, evaporative losses, and outflow at Lake Tahoe for the Reference Scenario (Reclamation 2015 [Truckee]).

3.9. Geographical Maps

Maps show physical features on a landscape. These can include engineering features (e.g., pipeline alignments), risk analyses (e.g. flood inundation maps, populations at risk), measurement locations (e.g., streamgages, weather stations), model extents, gridlines, and other geospatial features. Appendix B provides Reclamation guidance for developing maps.

Be aware of color contrasts in maps. Tools such as ColorBrewer 2 (http://colorbrewer2.org/#type=sequential&scheme=Blues&n=3) can help select maps that are colorblind safe. Use Reclamation colors whenever possible. See *Section 5.2. Color Blindness* and Appendix C for a color scale for Reclamation's VI colors.

Make sure labels are readable and that the text is not obscured by a map feature.

Consider lowering the opacity on regions or features that hold background or less important information (e.g., watershed boundaries, state boundaries, topographical details) to make these more transparent. The information priorities will depend on the map purpose. For example, topography and elevations may be critical in a pipeline alignment but secondary in a habitat map.

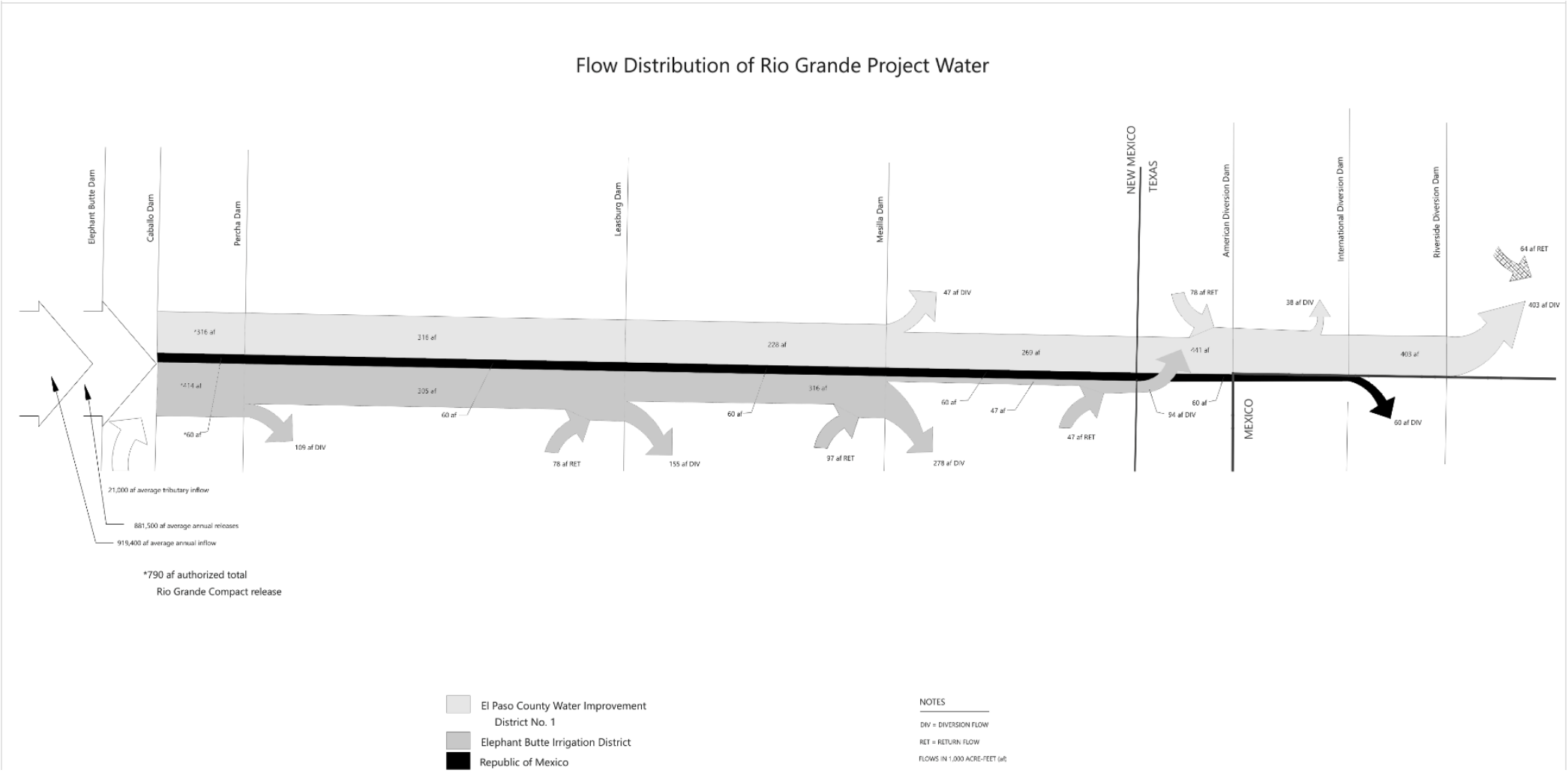

Figure 18. Sankey diagram to show the distribution of flows from the Rio Grande (Reclamation 1995).

3.10. Heatmaps

Color variations give obvious visual cues to the reader about how the phenomenon is clustered or varies over space. Use color scales (Appendix C) that have enough contrast for color blindness (Section 5.2).

Heat maps (sometimes called datamaps) are a simple and concise way to compare average conditions for a given metric across multiple scenarios. A heatmap shows the magnitude of a metric (e.g., precipitation, temperature, groundwater levels, groundwater rate of withdrawals, etc.) as color. Heatmaps can be:

- **Spatial** (overlaid on a map). Heat maps can illustrate values in space, such as gridded datasets of precipitation or temperature. Spatial heatmaps are widely used to plot raster data, (e.g., digital elevation models, gridded climate data, and gridded model results).

- **Non-spatial** (either a table or grid). Color or shading can be added to each cell in the table to better visualize the data. Color/shading can be added either in lieu of values or as background behind values.

Heat maps can show relationships between complex processes, both physical and analytical. For example, Figure 19 not only compares the grid scale of various models, but also shows the precipitation and topography of the area. Readers can tell at a glance that the finer-resolution Precipitation Runoff Modeling System (PRMS) model takes into account more variations in local precipitation than the Variable Inflow Capacity (VIC) model does. Without adding the climatic and topographic variability, readers may not have understood the need to use finer model resolutions.

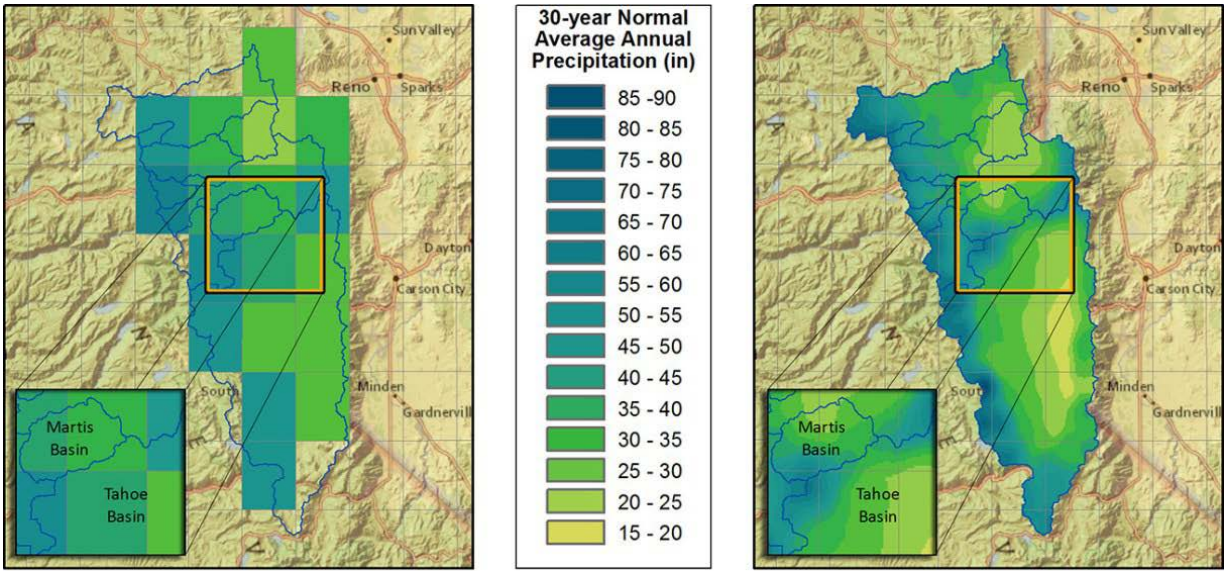

Figure 19. Comparison of Spatial Scale of VIC and PRMS for the Truckee Basin above Farad, Using Average Precipitation to Demonstrate Resolution in Modeled Subbasins (Reclamation 2015 [Truckee]).

4. Create Effective Displays

4.1. Explain Your Model Process

Show inputs and outputs for your model and explain how the model works. Lay audiences may not need the details but need to know what inputs, boundary conditions, and physical processes the model considered. Schematic illustrations of process interactions help explain complex modeling. For example, Figure 20 shows variables and the relationships between variables in a climate model.

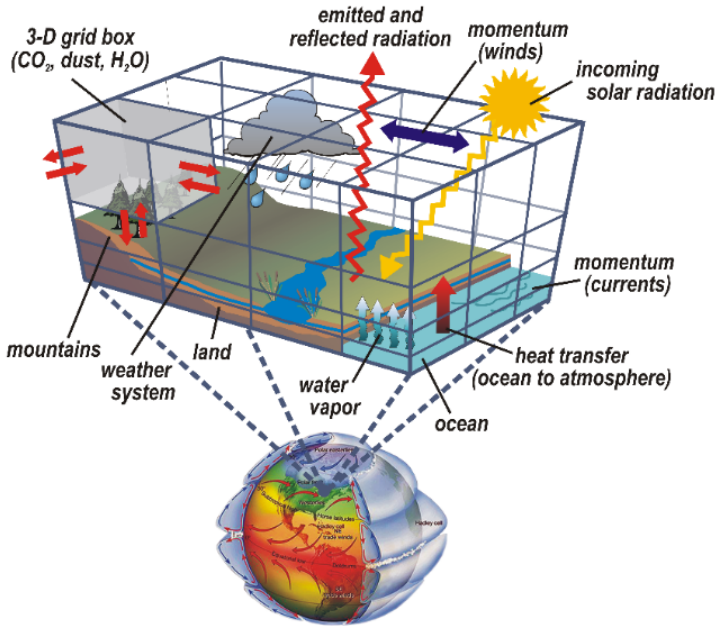

Figure 20. Schematic illustration of a global climate model (GCM). (Reclamation 2016 [Projections]).

Graphics can grab a reader's attention, quickly show types of actions, and can also provide a context for your data or explanation of a physical process.

Flowcharts can use icons or smaller pictures to convey meaning. The imagery is simple and helps a lay audience to understand the relationships and the types of models. How much level of detail to provide depends on the type of audience. Figure 21 works to show the types of models that were a part of analysis, but it is too simplistic for an analyst as it does not detail which inputs go into which models. Figure 22 is a good overall picture of an analytic process, but may be going into too much detail for a lay reader.

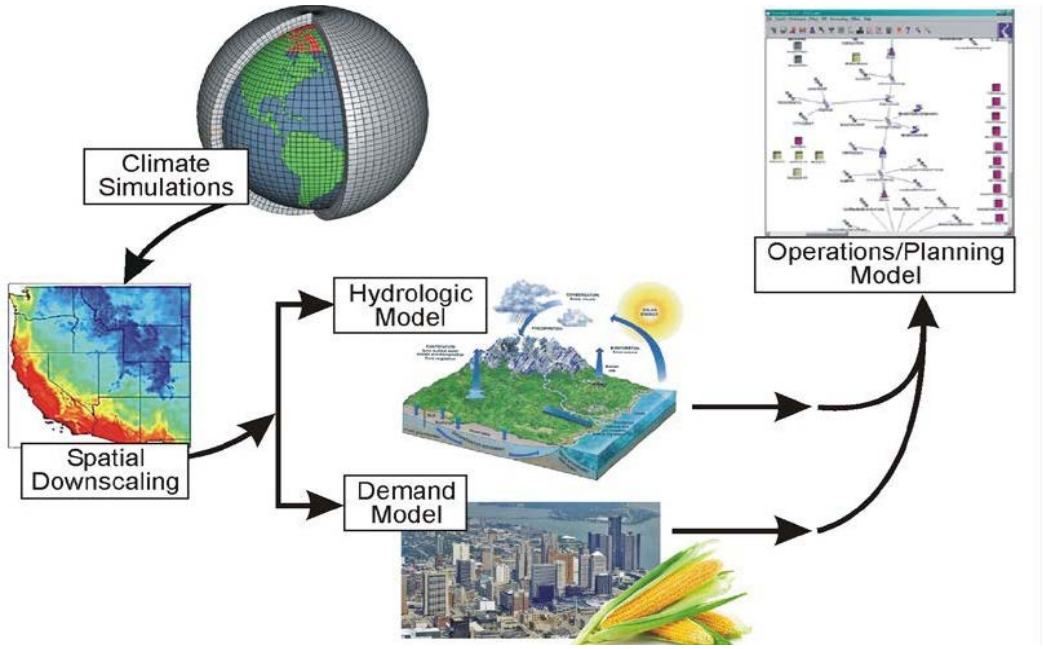

Figure 21. Modeling and analytical steps involved in the development of local hydrologic projections (Reclamation 2013 [URGIA] figure 8).

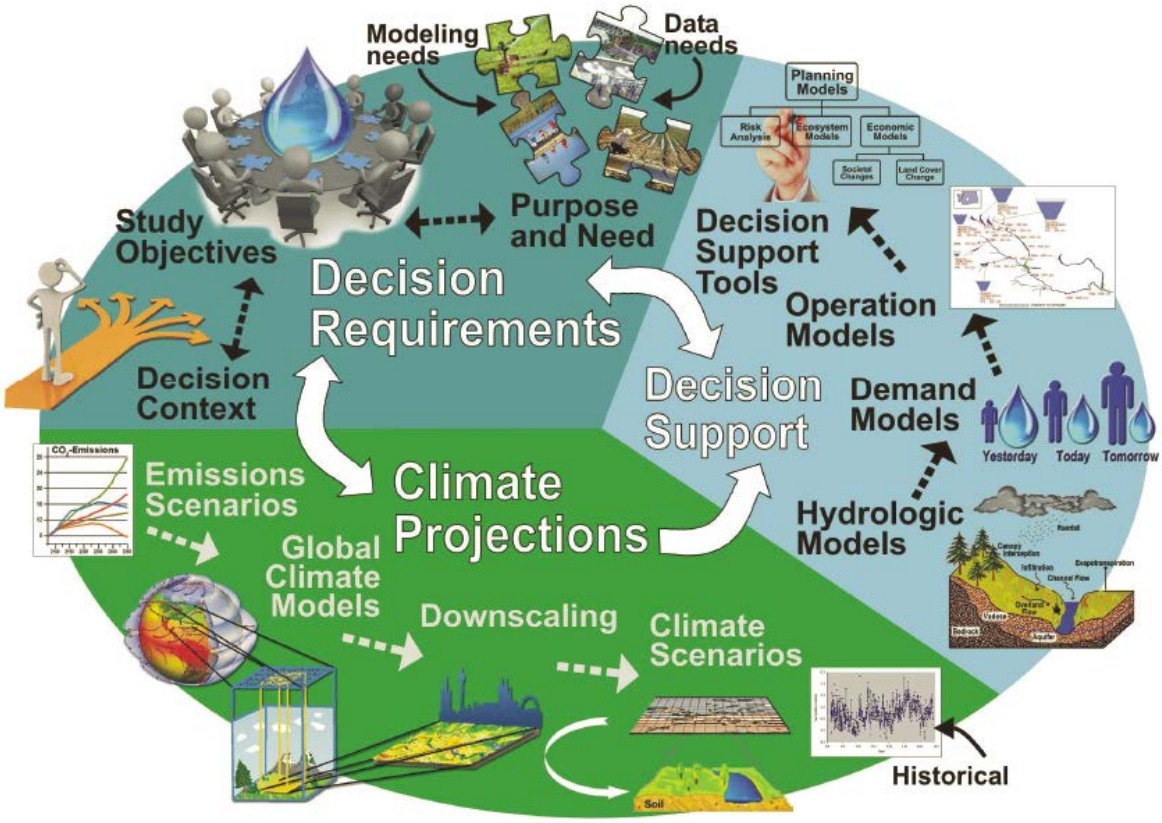

Figure 22. Schematic overview of steps required to develop projections of future climate and to incorporate climate projection information into modeling and analysis in support of water resources and environmental planning, management, and decision making (Reclamation 2016 [Projections]).

4.2. Show Positive and Negative Elements Clearly

Carefully consider how an audience will view negative values. Saying that there will be fewer days when boat docks are available or that there will be more shortages can be confusing, especially if the value is shown as a positive value in a bar graph or scatter diagram. For example, showing negative impacts as a bar chart with positive bars can be misunderstood. Most people will understand downward bars as a negative (the higher the bar, the better) (Chartblocks, 2020). To address these potential misunderstandings, try to format every criterion as a positive. For example:

- Use metrics where targets are met (e.g., months of water deliveries, days of river temperatures, or years of successful cottonwood seeding) rather than metrics where targets are not met (e.g., shortages or critically dry days)

- Count units of availability (e.g., days of boat ramp availability) rather than unavailability.

If this is not possible, then use a 0 line to show the extent of the negative impacts.

You can also show both positive and negative on a horizontal line (Figure 23).

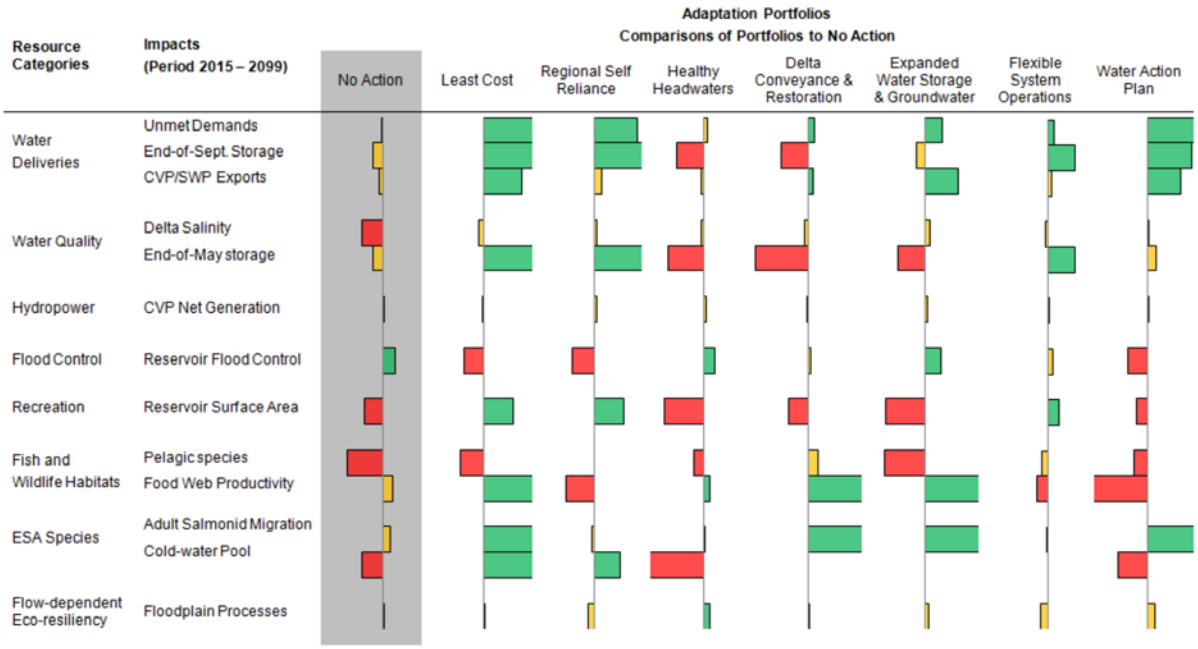

Figure 23. Graph with both negative and positive impacts divided with a center 0 line. Summary comparisons of adaptation portfolios to the No Action Alternative. Green = performance improved more than 10%, yellow = performance is within -10 to +10%, Red = performance declined more than 10%. (Reclamation 2016 [SSJ Basins Study]).

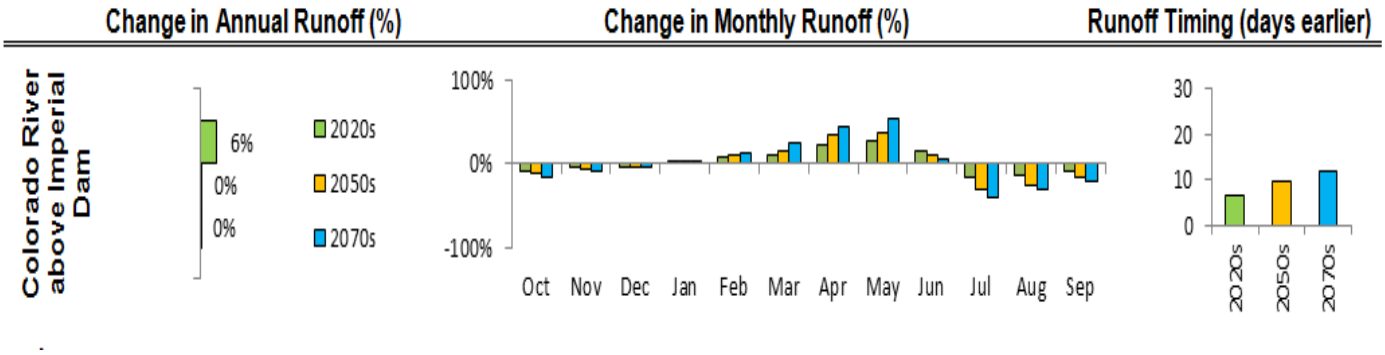

Figure 24. Projected shift in annual runoff, monthly runoff, and peak runoff date relative to the 1990s for the 2020s, 2050s, and 2070s in the major Reclamation river basins (Reclamation 2016 [SECURE Report]).

4.3. Compare Relationships

Pictures can show before and after conditions to explain complex relationships. The infograph in Figure 25 helps readers see habitat changes from a downstream channel before and after a dam or mine.

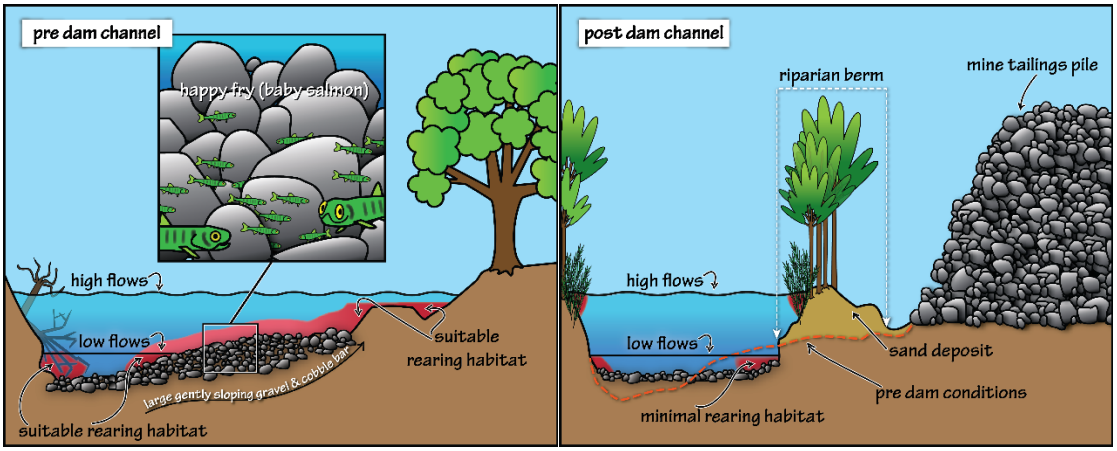

Figure 25. Schematic of a pre-dam channel and a restored post dam channel (Reclamation 2019 [TRRP]).

Time series and mean can be shown on the same graph, which can contrast year-to-year fluctuations with decadal or long-term average conditions. For example, Figure 26 contrasts two time series: annual values (solid red) and the 25-year moving average (dashed blue).

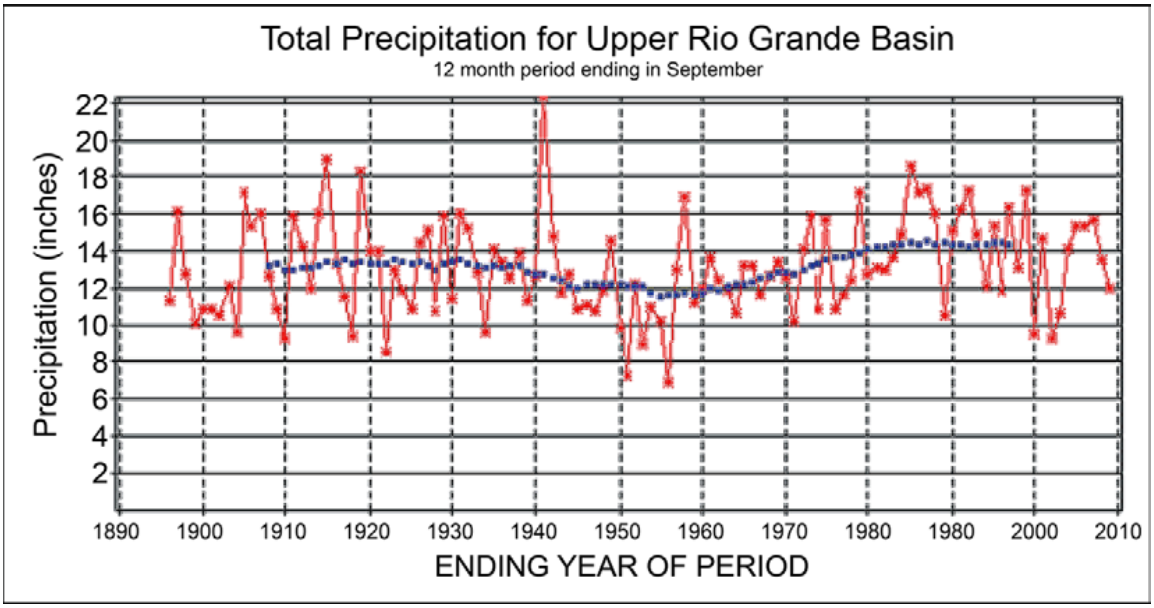

Figure 26. Observed annual precipitation, averaged over the Upper Rio Grande Basin. Red line indicates annual time series for the given geographic region. Blue line indicates 25-year moving annual mean (Reclamation 2013 [URGIA]).

Provide context using lines or scales for readers understand the context of the information. For example, Figure 27 has a black dashed line to show the top of the conservation pool and a yellow dotted line to show the top of the flood pool so readers can note when the water surface elevations have reached those levels.

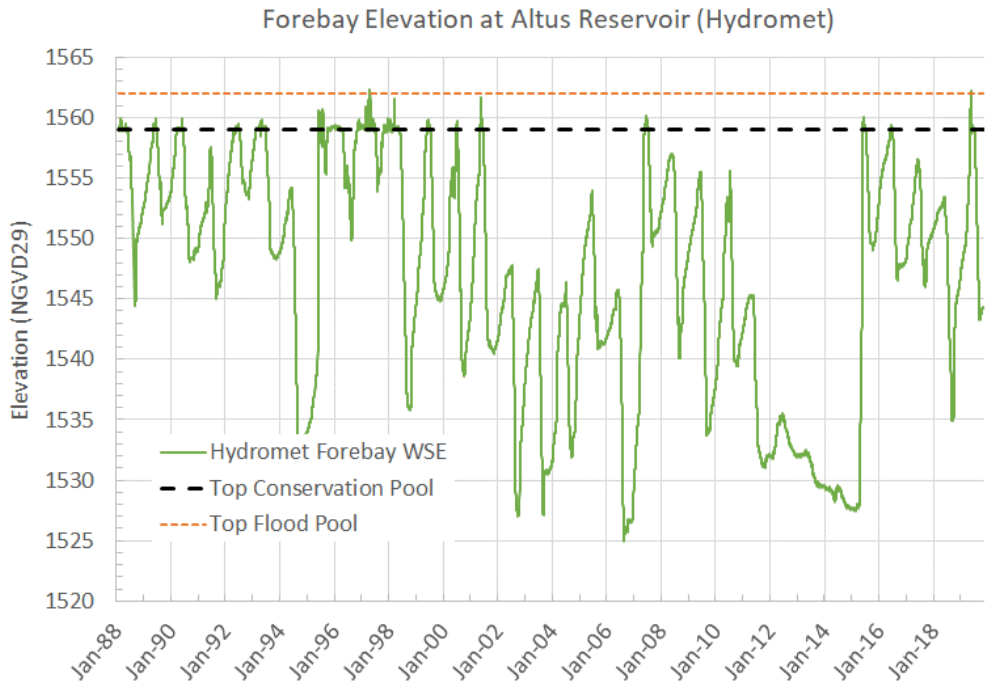

Figure 27. Historic Lake Altus water surface elevations (project datum) (Reclamation 2020 [Altus]).

4.4. Label Clearly

Make sure that your readers understand every element of your figure by labelling clearly and consistently.

Include a title on each figure. This will help ensure that figures are placed in the correct order in the report.

Label your horizontal and vertical axes with what is measured and the units used.

Use a large enough font to read (no smaller than 8 point) and use a sans serif font. See . *2.5.1 Comply with Reclamation's Visual Identity.*

4.5. Use Texts and Captions

In Reclamation reports and some professional journals, captions are very basic and any explanation should be in the text. Ensure that the text explains the display so that the reader is able to understand the display. Your captions will depend on the display's context:

- **By itself.** If the display is presented on its own, then include sufficient information in the caption to fully understand the display.

- **Journal publication**. In academic and some professional journals, captions are used to explain the figure in detail and to draw conclusions. Check with the journal's style.

- **In a Reclamation report.** In most government reports and some professional journals, captions are very basic and explanations are included in the text. Moreover, the table of contents for figures should be shortened and exclude any extraneous information.

Reclamation follows a few conventions for table and figure captions:

- Table captions are treated like headings. Use Initial Capitalization (where each major word starts with an upper case letter) and no ending punctuation (just like a title). For example: Table 1. Initialized Parameters from Named Dam Study.

- Figure captions are treated like a sentence. Use lower case letters and end in a period. . For example: Locations of initial parameters from Named Dam study.

4.6. Keep Graphic Elements Consistent

Keep your readers focused on the content by keeping all elements consistent. Try to understand how each graphic element will work together (color, font, order, icons, text, etc.) to convey your meaning. Be as consistent as possible among sets of displays as well.

If anything is not consistent, note that in the captions for all similar figures. Otherwise, your readers could make incorrect assumptions about the scale, alternatives, impacts etc.

Although Ralph Waldo Emerson said, "a foolish consistency is the hobgoblin of little minds," well consistency is vital to help your reader quickly understand the report and display.

4.6.1. Develop and Use Team Crosswalks

Using the same colors, line widths, and symbols for the same elements and metrics (e.g., alternatives, scenarios, parameters, or historical periods) to help readers track and compare consistently. At the outset of a project, use a consistency table (termed a crosswalk)[4] so that all team members can use the same colors for the same scenarios/alternatives (Table 2).

Table 2. Sample Crosswalk

Report Element	Color	Line Width/ Shape	Symbol	Notes
Alternative 1: Water Conservation	**Dark Blue PMS 3035** R: 0 G: 70 B: 88	½ point dashed		
Alternative 2: Pipeline Conversion	**Light Blue PMS 633** R: 0 G: 115 B: 150	½ point long dash		
Scenario 1: Average year	**Mustard PMS 1245** R: 202 G: 145 B: 23	1 point solid		
Scenario 2: Wet year	**Orange PMS 165** R: 255 G: 103 B: 32	1 point solid		
Parameter 1: Reservoir storage	**Green PMS 357** R: 33 G: 87 B: 50	1 point solid		
Parameter 2: Water delivery target	**Purple PMS 2091** R: 76 G: 18 B: 161	1 point solid		
Parameter 3: River flows at USGS gage.	**Red PMS 484** R: 154 G: 51 B: 36	1 point solid		

4.6.2. Use Consistent Language

When labelling titles, x and y axes, and legends, be as consistent as possible. Use consistent language for all displays and text. For example, use one term in both the text and graphs to describe whether a factor increases or decreases and how substantial or rapid that increase is. Agree on these relative terms within the team and try to quantify as much as possible (Figure 28).

[4] **Crosswalk.** A table making comparisons between elements, mapping one schema (e.g., color of element) to another schema (e.g., map shape for element).

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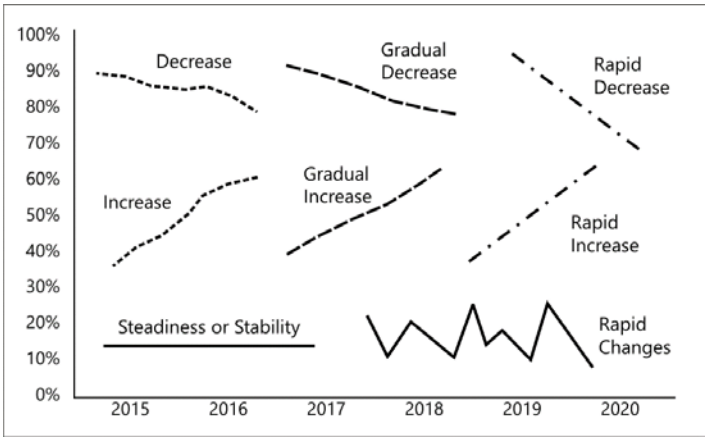

Figure 28. Determine terminology with the team so you can use consistent language in the text and images (e.g., what do you mean by "gradual" or "rapid"?) (Reclamation/Gray).

4.6.3. Keep Consistent Scales

Always include a scale—either in the legend or on the axes.

Try to agree on scales with other team members, so every discipline's scales can be consistent throughout a document. At the same time, select a scale that will accurately and appropriately convey the information. Too small a scale will cause small variations to appear large and too large a scale will lose important variations. If it is not possible to keep the same scale for every similar chart (e.g., timeframes differ, one scenario doubles or triples the impact, one area is a quarter of the size of another, or one element represents 90 percent of the issue), be sure to include a note on the display itself about the scale so readers know that they are not comparing the same things. For example, Figure 29 and Figure 30 both show the relative impacts of actions under two different future storylines; however, the red line and text on Figure 30 show that the scale of the impact in the Dry Storyline is over twice as much as in Moderate Storyline in Figure 29.

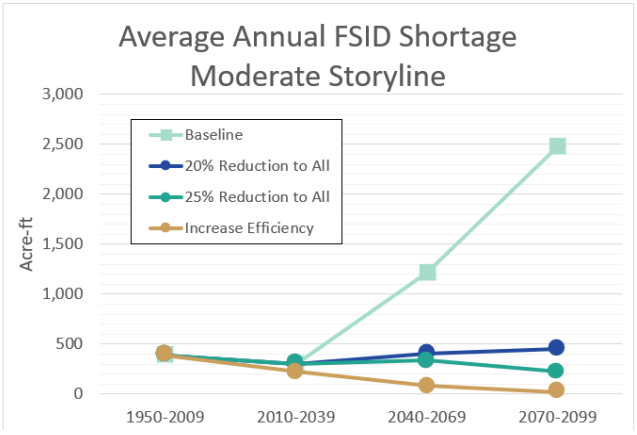

Figure 29. Average annual FSID shortages under the Moderate Storyline for the Water Management Strategies. Note that scales are to 3,000 acre-feet. (Reclamation 2020 [Pecos]).

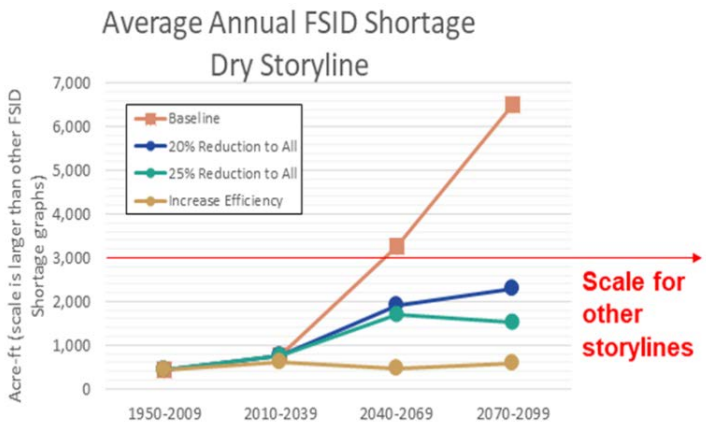

Figure 30. Average annual FSID shortages under the Dry Storyline for the Water Management Strategies. Note that scales are to 7,000 acre-feet. (Reclamation 2020 [Pecos]).

Note that in this example, the strategies have the same colors, but as they are being compared to different future climate scenarios, the climate scenario baseline is a different color.

Another approach is to include a small chart at the top of each figure and size it proportionally to the scale.

4.6.4. Use the Same Names in the Same Order

Readers can find things more efficiently if they are in the same order each time they are mentioned in the text and in the displays. Before writing your text or developing your display, agree on the names and order. Document this in your consistency document and make sure that every label, line, and text explanation uses that order.

4.6.5. Carry Consistency across Projects

You do not have to reinvent the displays for every project. Rather, keep libraries and stylesheets wherever possible. Keep a list of common elements and then develop a library or style for each of these common elements. With a library, you can use the same code, legend, or other snippet and "plug and play." This will:

- Save time and work by avoiding duplication
- Make it easier to adjust to any changes as the change would only need to be made once, and all elements using that library or style would change
- Help create consistent documents

If you make a template, share it with others who need a similar template. Put templates, styles, and libraries into an accessible location such as SharePoint. Create a process with other analysts that use the same program, code, or mapping processes to ensure you are working with the most recent libraries and stylesheets.

4.7. Be as Simple as Possible

The less cluttered your display is, the easier it is to understand. Provide the data needed for your purpose—and no more.

Don't include unnecessary information. For example, you may not need background gridlines or background topography on the map. Ask "what information needs to be here to convey the main point of the display" then delete all other information.

For every graphic element, ask: is this needed to convey the information at the appropriate level of detail to the audience to serve the overall purpose?

Not everything has to be on one display. Consider creating a series of maps or charts for different audiences or to convey different messages. These should show the same information as consistently as possible, but they can highlight different aspects. This may be easier than putting a variety of information on the same display for a range of differing audiences.

Use white space (blank areas) to help readers focus in on what is important. Delete everything that does not relate to conveying data (e.g., gridlines, decorative items, shadows, extra text) (Figure 31).

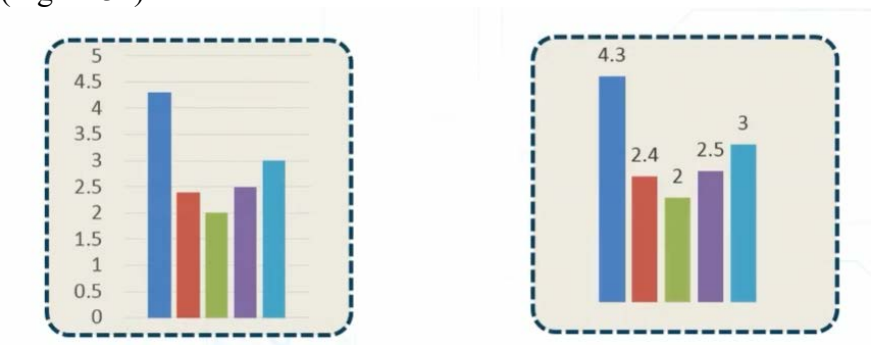

Figure 31. Declutter your tables. Make it easier for the reader to follow.

4.8. Consider Colors Carefully

4.8.1. Don't Depend on Color Alone

Don't depend solely on color to distinguish among data elements. Use various symbols, dotted lines, dashed lines, and lines of different thickness. Figure 32 shows various levels of area capacity over the years. Different lines and symbols make it easier to compare changes.

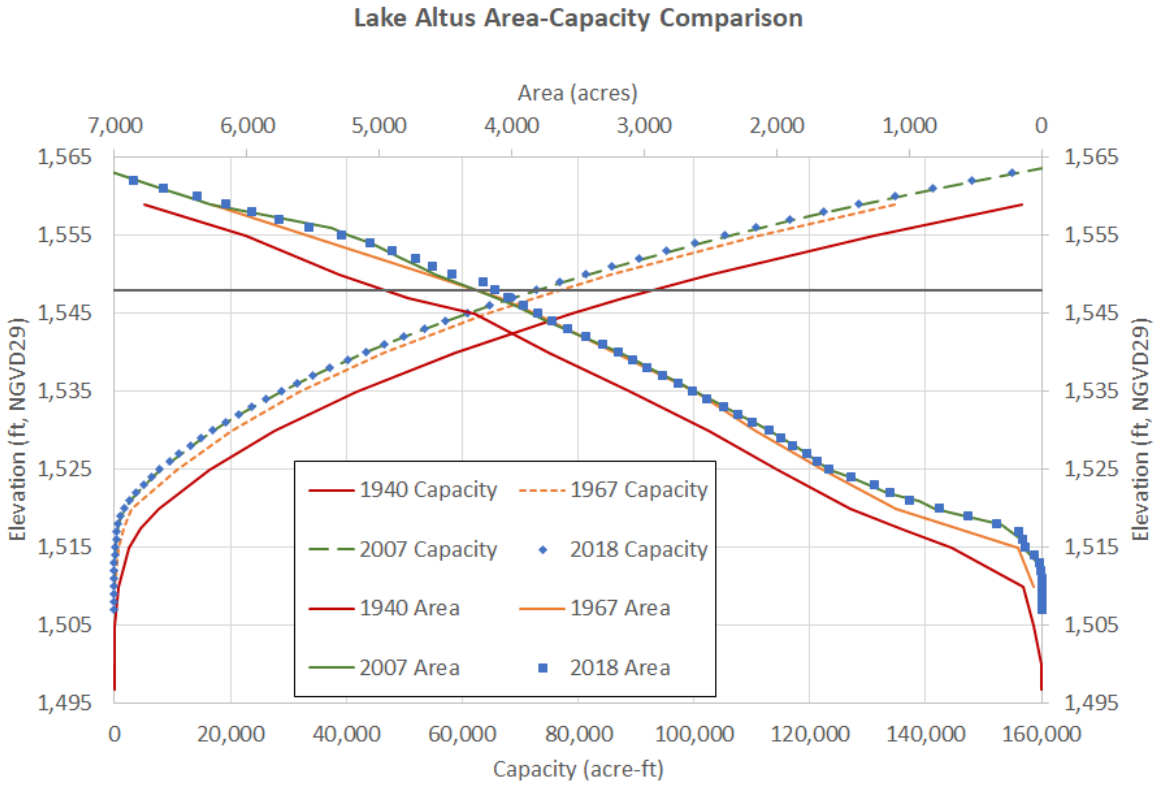

Figure 32. Plot of Lake Altus surface area and storage capacity versus elevation. The gray horizontal line represents the top of the 2018 bathymetric data. Area-Capacity values above this elevation were obtained using LiDAR data. (Reclamation 2020 [Altus ACAP]).

Figure 33 uses shapes to distinguish between elements on a scatter diagram.

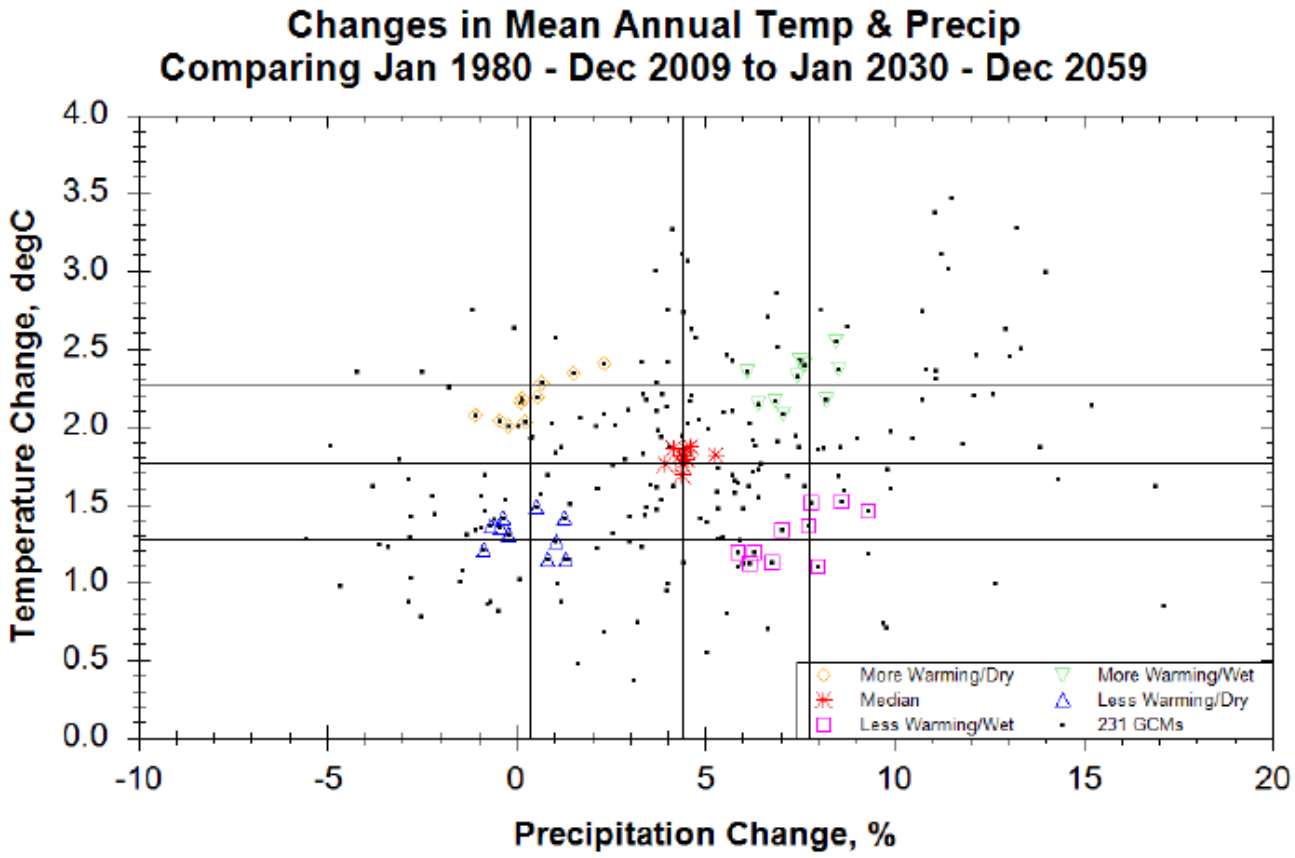

Figure 33. Projection membership diagram to define climate change scenarios (Reclamation 2015 [Irrigation Demand]).

See *Section 5.2. Color Blindness* for more tips on color contrasts.

4.8.2. Use Distinguishable Color Scales

Heatmaps and other graphics can use sequential color scales (sometimes called color bars) to denote ranges of values (see *Section 3.10. Heatmaps).* Tables can also use color bars, as shown in Table 3.

Table 3. Drying Days at Acme Gage for each Water Management Strategy (Reclamation 2020, [Pecos])

Storyline	BaU Moderate	BaU Dry	BaU HMLS	RE Increased Monsoon	RE Median
1950-2009 Modeled Historic	**11**				
2070-2099 Baseline	44	117	40	10	21
	More Days	11			**Fewer Days**
Water Management Strategy	**2070-2099 Change from Baseline under each Water Management Strategy**				
20% Reduction to Districts	-16	-17	-17	-8	-10
25% Reduction to Districts	-19	-21	-19	-9	-13
25% Reduction to PVACD	-2	-1	3	1	0
30% Reduction to PVACD	-1	-1	2	0	2
Increase Efficiency	0	0	3	3	0
	Drying Strategy	0			**Wetting Strategy**

Sequential color scales can help visualize values. Color scales can use a single hue (see the colorblind safe scales based on Reclamation's VI in Appendix C). They can also be based on various spectrums. Use Reclamation's VI colors whenever possible.If a wider range is needed, then consider color scales designed to accurately represent data (i.e., be perceptually uniform), designed to display well on a screen, and to be easily interpreted (i.e., maximize contrast). The Viridis color palette and scales, for example, use a wide blue to yellow scale (see Smith and van Der Walt 2015, Rosanbalm 2017, and Gotelli 2018). This scale was also designed to work well for people with colorblindness (Rudis et al 2018).

Sometimes color bars just don't work, especially in complex situations with images with various opacities on top of imagery. Showing landmarks in a separate image can make it difficult to tell exactly what value in the heatmap overlies or aligns with a location/area of interest. You could use the heatmap (e.g., gridded temperature field) as a base layer in GIS and overlaying key landmarks as open polygons. This allows you to show locations and boundaries overlaid on top of the heatmap.

Determine what the gradients mean and where the variables fall—what kind data are you working with? If data can be binned, then provide a discrete color bar with numbers.

4.8.3. Consider Contrast

Contrasting colors are needed to distinguish elements in displays, particularly in spatial displays and maps. However, adding contrast becomes more complex as soon as there is an image background. Images with limited opacities, or transparencies, (e.g., overlaid flood data to see underlying imagery information) also add complexities.

Trial and error may be needed to determine effective and accessible contrast levels. Print the display in black and white to see the contrasts. Usually brighter colors will have better contrast.

For any government website to comply with Section 508 compliance, comply with Web Content Accessibility Guidelines (WCAG) requirements.[5] You can use tools such as:

- Contrast checker: https://webaim.org/resources/contrastchecker
- Contrast picker: http://colorsafe.co/

Do not use any color other than white or a light gray against any Reclamation color background, as there will not be enough contrast (Table 4).

Table 4. Failed contrast for normal text (Less than 4.5:1 contrast ratio)

Dark Blue #003E51	Light Blue #007396	Mustard #CA8117	Orange #FF6720	Green #215732	Purple #4C12A1	Maroon #9A3324
Dark Blue #003E51	Light Blue #007396	Mustard #CA8117	Orange #FF6720	Green #215732	Purple #4C12A1	Maroon #9A3324
Dark Blue #003E51	Light Blue #007396	Mustard #CA8117	Orange #FF6720	Green #215732	Purple #4C12A1	Maroon #9A3324
Dark Blue #003E51	Light Blue #007396	Mustard #CA8117	Orange #FF6720	Green #215732	Purple #4C12A1	Maroon #9A3324
Dark Blue #003E51	Light Blue #007396	Mustard #CA8117	Orange #FF6720	Green #215732	Purple #4C12A1	Maroon #9A3324
Dark Blue #003E51	Light Blue #007396	Mustard #CA8117	Orange #FF6720	Green #215732	Purple #4C12A1	Maroon #9A3324
Dark Blue #003E51	Light Blue #007396	Mustard #CA8117	Orange #FF6720	Green #215732	Purple #4C12A1	Maroon #9A3324
Dark Blue #003E51	Light Blue #007396	Mustard #CA8117	Orange #FF6720	Green #215732	Purple #4C12A1	Maroon #9A3324

4.9. Cite Sources and Get Permissions

Citing sources and documenting permission to use any non-Reclamation graphic (even other Federal agency ones) is important to ensure Reclamation complies with copyright laws. Graphics specialists can help you find photos and images that are appropriate for your document and can help trace permissions.

4.9.1. Citations

Always provide the source for your figures. All photos, figures, and data tables—including those that Reclamation staff have developed—need to be attributed. Reclamation VI requires a note for citations on each caption, such as (Reclamation/Staff Name). If the figures were not generated within Reclamation, then appropriately cite the report.

[5] WCAG 2.0 level AA requires a contrast ratio of at least 4.5:1 for normal text and 3:1 for large text. WCAG 2.1 requires a contrast ratio of at least 3:1 for displays and user interface components (such as form input borders). WCAG Level AAA requires a contrast ratio of at least 7:1 for normal text and 4.5:1 for large text.

4.9.2. Permissions

4.9.2.1 Reclamation Photos and Images

Attribute to a particular photographer whenever possible. If the photo is from a Reclamation site, and you do not know the name of the photographer, attribute to Reclamation. The caption should include (Reclamation/Name).

4.9.2.2 Google Earth and Maps

Check with TSC's Geographic Applications and Analysis (8260) Group for the latest directions on permissions needed for maps.

4.9.2.3 Non-Reclamation Photos and Images

Try to avoid using non-Reclamation photos as much as possible. Reclamation's materials are assumed to be in the public domain, so we need to be extremely vigilant about ensuring copyrights for non-Reclamation generated data and displays are protected. For every non-Reclamation chart, map, photo, table, or dataset; we need to ask for permission and document that we have received permission from that source. If you use non-Reclamation figures or data plan on time to get permissions to use these sources. It is a good idea to note these permission requests on the team's Consistency Document (see *Section 2.5.4. Document Your Plan).*

Although other Federal agencies' materials are also copyright free, the provenance of each graphic must be documented. Therefore, it is always best to get permission first and confirm whether they are copyrighted. Try to find the original source if at all possible. Captions should include (Courtesy of Agency name). As all other photos and images are copyrighted by whomever created the work, we need to get specific permission to use these. Contact the original developer and ask for permission. Keep a record of this permission with the report. Captions should include (Courtesy of Company Name, all rights reserved.)

5. Accessibility

5.1. Alternative Text (Alt Tag)

Alternative text, or an alt tag, is text that a screen reader will read if a visually impaired person is listening to your document. Try to put enough detail in the alt tag so everyone can understand your meaning and results. Put as much information as needed in the alt tag to understand the figure. If it is a flow chart, put the words and order into the alt text. If the content and relevant conclusions from the figure are in the text, then refer to those explanations in the alt tag. Usually, if you have described the major results in the text, you do not need to exhaustively describe the data graphics or maps using alternative text.

5.2. Color Blindness

Some color-blind people will have difficulty distinguishing between Reclamation's colors. Check to see what your figure would look like for someone who is color blind at https://www.color-blindness.com/coblis-color-blindness-simulator/.

Th Quick Test:
Print in black and white to see if there is enough contrast (difference between the colors).

Never rely solely on colors to provide a meaning. Try to ensure that color is not the only way for readers to distinguish between elements such as alternatives, scenarios, or sites. Use symbols, dashed lines, icons, or other markers.

Use contrasting colors. Color contrasts are calculated as the difference between bright and dark (calculated as the ratio of luminance, i.e., the amount of light that passes through an object). These ratios provide a measure for contrast, and the Web Content Accessibility Guidelines (WCAG) have defined these for large and smaller print to show readability for larger and smaller print against a background as well as for contrasts for color scales (see *Section 4.8.2. Use Distinguishable Color Scales.*). The U.S. Web Design System has guidelines on use of color at https://designsystem.digital.gov/design-tokens/color/overview/. Nichols (2020) also has a description of colorblind "confusion lines" and shows the way some suggested palettes will appear for contrast.

Upload any image and see if from various color blind perspectives at https://www.color-blindness.com/coblis-color-blindness-simulator. Figure 34 shows an example of Reclamation's VI colors and their contrast. Use Appendix C for colorblind safe color scales for VI colors.

Reclamation's colors in a normal view. Note that using a Reclamation color as a font over another Reclamation color will not provide enough contrast. Use white over a colored background for readability.

People with difficulty seeing red may see the colors like this:

Or even like this:

Always print your materials in black and white—this is an easy test to see if the contrast between lines with different colors is enough to convey your information and to allow readers to quickly see your points.

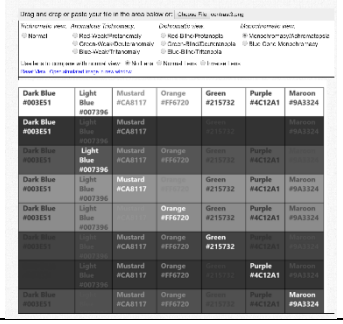

Figure 34. Examples of color-blind results for Reclamation colors.

6. Example for Improving a Figure

This section takes a contour plot series (Figure 35), explains several problems, and provides some solutions for solving these problems (Figure 36 and Figure 37) .

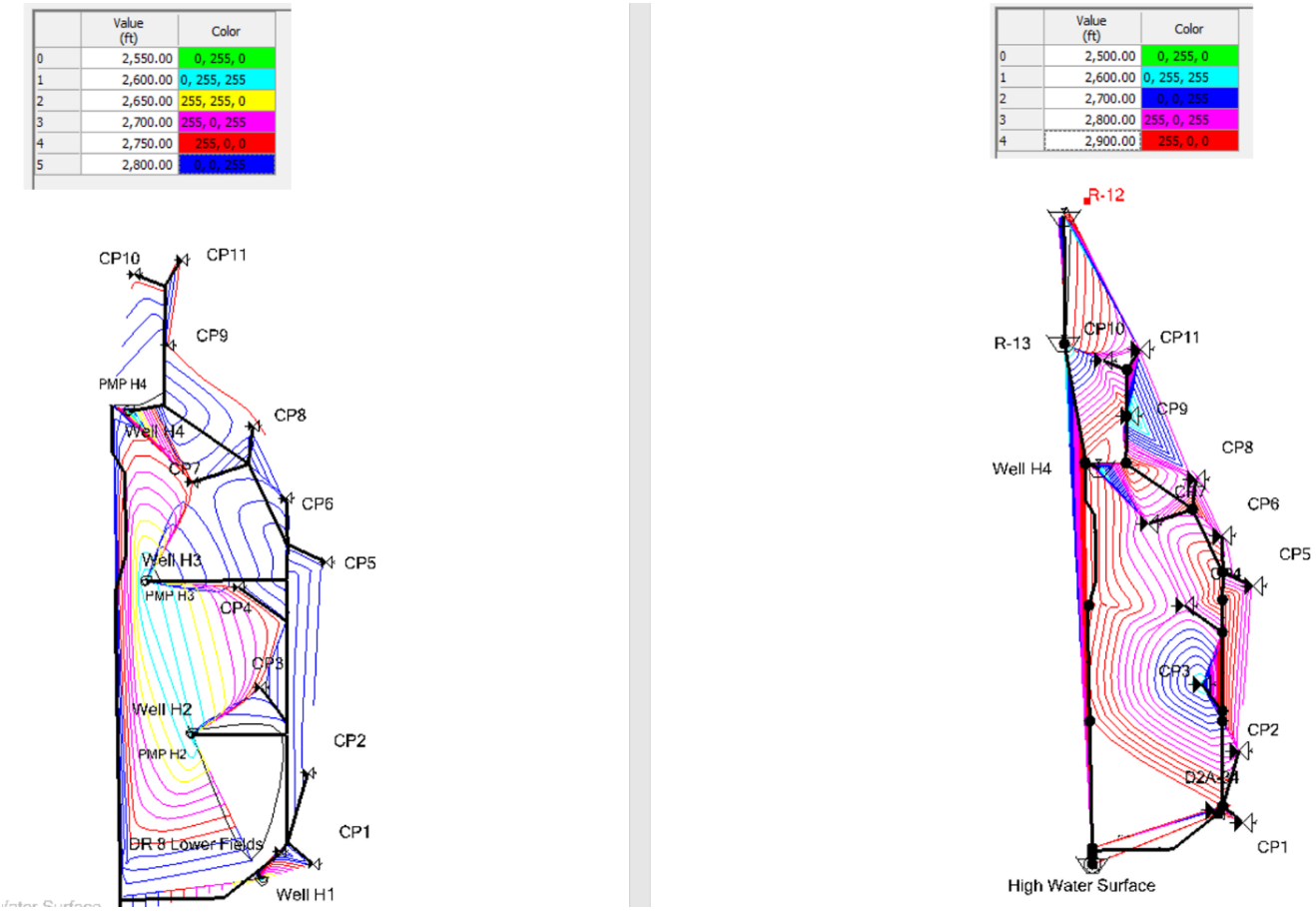

Figure 35. Original sample image.

This contour plot series has several issues:

- **Figures are not labelled in the original program.** It would be very easy to get these displays confused or turned around in the editing process. Incorporate labels in the original program.

- **Figure can't be interpreted by someone who is color blind.** The figure only uses color to distinguish between parameters. Use line thickness, dashed lines, dotted lines, or other ways to distinguish between parameters.

- **Legend does not have contrast.** The legend uses black on a dark blue, which cannot be read. Check the contrast on legends or use another column so that you can have black text on a white background.

- **Not all elements are defined.** Define all elements (e.g., define the black lines as the existing pipeline). If you use acronyms, ensure they are the same as those defined in the text that explains the graphic.

- **Figures in the same series have different scales.** Whenever possible, use the same color for the same scale. In this example, using pink for 2,700 and blue for 2,800 consistently would be a better choice. If scales are radically different (e.g., comparing a very small reservoir with a very large one or a scenario with twice the impact as others in the series, note clearly on the figure itself that this is a different scale.)

- **Figures show different areas.** Left figure begins at CP10/CP11. Right figure starts higher up at R12, which makes it difficult to compare locations and compounds the differences in the scales.

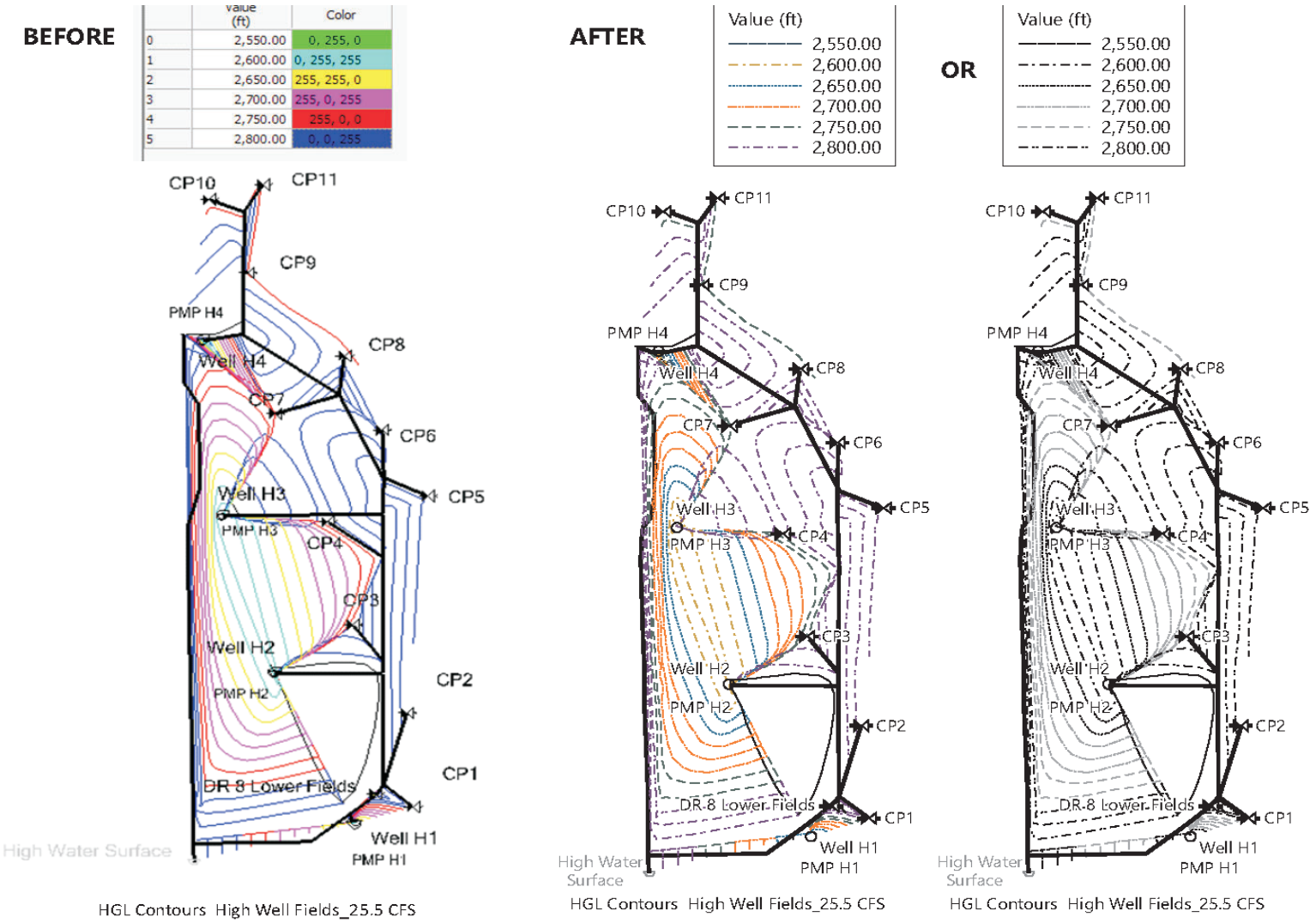

Figure 36. Sample image reworked adding various line weights in new VI colors and also shown in grayscale (Reclamation/Gray).

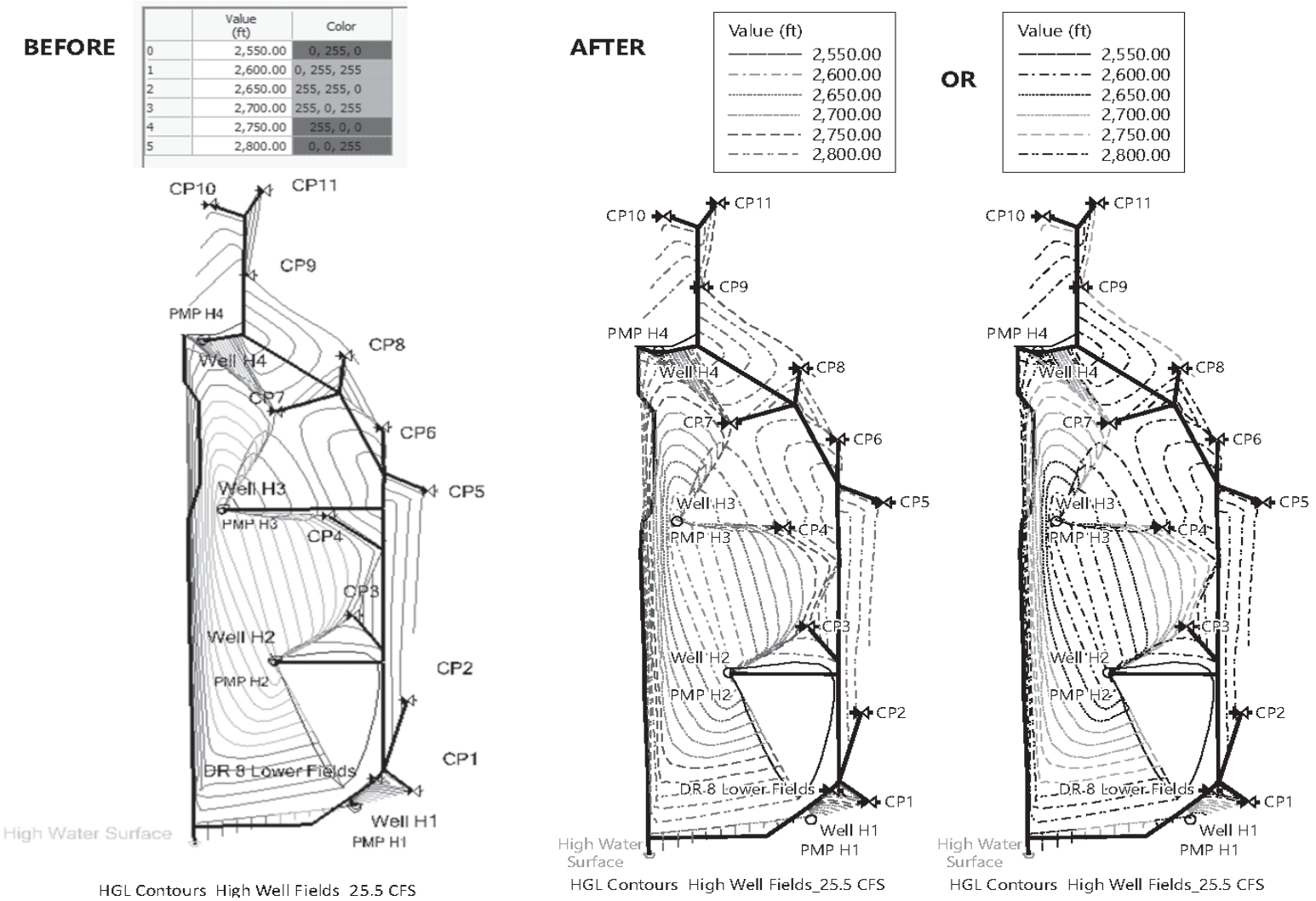

Figure 37. Sample image reworked in grayscale to show contrast without colors and only different line weights (Reclamation/Gray).

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8. Glossary

508 compliance. Requirements to make content accessible to people with disabilities. This also makes it easier for everyone to understand.

Alt tags. Image attributes applied to images to provide a text alternative (for web and accessibility)

Axis. A reference line in a chart indicating the measurement of coordinates.

Color bar. A gradient with ascribed values using a color scale to show minimum to maximum range of values.. See heat map.

Consistency Document, or style guide. A set of standards for a set of displays for the entire cross-disciplinary team to follow to help ensure that figures, texts, and presentations are consistent.

Contrast. The difference between two colors. More contrast makes it easier to read (Black and white would provide the greatest contrast).

Coordinates. A group of numbers used to indicate the position of a point, line, or plane.

Copyright. The exclusive legal right, given to an originator or an assignee to print, publish, perform, film, or record literary, artistic, or musical material, and to authorize others to do the same.

Crosswalk. A table making comparisons between elements, mapping one schema (e.g., color of element) to another schema (e.g., map shape for element).
.
Display. A generic term for graphics, including maps, graphs, charts, tables, posters, etc.

Figure. Any type of map, chart, or other images.

Flat file. A file exported from a software where all layers are combined into one.

Gradient. A gradual change of colors (e.g., green turning gradually into blue) or a color fading into transparency.

Heat map. A map or table where sets of values are displayed as different shades or colors (e.g., 75% or higher is dark red, 50 -75% is medium red, 25-50% is light red, 0 – 25% is white).

Icon. An image used to represent an action or an object.

Initial Capped. When the first letter of each substantive word is a capital letter.
Layer. A layer of information in a graphic software, such as CAD or Photoshop.

Legend. A box on a display (e.g., chart or map) which lists the label and visual appearance for elements used in the display.

Lossless format. A file format that does not lose data each time it is saved.

Luminance. Photometric measure of the amount of light travelling in a given direction.

Margin. The space around the edge of a page

Opacity. The degree that an image is transparent. The lower the opacity, the more transparent an element is (e.g., 100% opacity means an object is solid and 0% is so transparent you can not see it).

Pixel. The smallest basic unit of programmable color on a computer or printer. Images are made up of many individual pixels.

Public Domain. Belonging or being available to the public as a whole, and therefore not subject to copyright.

Raster. Comprised of a set grid of pixels. This means when you change the size of stretch a raster image it can get a little blurry and lose some clarity.

Resolution. The sharpness and clarity of an image.

Scale. Refers to the size of an object, impact, or factor in relationship to another object. Two elements of the same size can be seen as being equal and elements with a clear variation in size tend to be seen as different.

Serif. An extra stroke or curve at the ends of letters. Sans serif is without these strokes.

Storyboard. A visual outline for data. A quick and not exact depiction of what the displays will look like.

Table. Any form of information with rows and columns.

Test audience. A representative of the type of audience that your report is prepared for.

White space (negative space). The area of a design left blank.

Vector. Comprised of points, lines, and curves that are calculated using a mathematical equation. Vector images can change size without losing any quality.

Visual Identity. A branding using consistent colors, fonts, etc. See intra.usbr.gov/vip for Reclamation's Visual Identity requirements.

Appendix A: Programming Tips and Examples

Using a scripting language to create the figures to help build consistency and are comparatively easy to modify and rerun—rather than a system that draws each figure separately.

Using a post processing program specific to a particular model has less flexibility and may be more difficult to modify.

When you use a scripting language, you can:

Set up your scripts to make your output figures easy to modify. No matter what, there will be changes at the last minute

- **Track plotted data.** For example, you can add comments in the script describing the input data. Anyone familiar with the program can then understand how the figure was created, and what data and analyses were used to create the figure. This facilitates reproducibility and supports best analytic practices. Since your data and graphs may be used for multiple planning phases (appraisal, feasibility, specifications, construction, as built, and follow up) and potentially may be required to be reproduced for legal processes, it is critical that all data underlying your figures be clearly documented, archived, and reproducible.

- **Re-use scripts.** It is easier and faster to reformat previously created scripts to plot out new data.

- **Ensure consistency.** Scripts can have standard colors, sizes, labels, etc. It is best practice to ensure consistency not only within a report but with other similar data.

Tips

Develop standard libraries of scripts to create different types of plots (e.g., time series, spatially gridded plots).

Standardize labels for data, variables, and time scales so you can loop through variables with one script.

Try to create scripts that can be modified for the next project to save time and to promote consistency.

Sample R Script

This example R script loops through different scenarios (SCNNAME), time periods (TMPRD), areas (AREAS) and months (MONTH). It also could easily loop through different variables if need be (VNAME).

```
#ARBS - hydrology script
#Timeseries plots from scenario data (spatially averaged over the basins)
#Plots all scenarios on plot, facets by time period for each basin

###*run w/ wba subbasins and when input data is in volumetric units

#### Input/Output #####
# -- variable
FILEDIR <- c( "vic_data/timeseries")
FILESTR <- c( "%s.%s.arbs_ssj.%s.month.%s.txt") # SCNNAME, TMPRD, VNAME, aname

outdir <- "figures/timeseries/monthly/scn/%s" # vname
outstr <- "%s.%s.monthly.april.timeseries.scn_loca.png" # insert: bname, vname

VNAME <- c( "swe.max")
VUNIT <- c( "in")
VNAME_PLT <- c( "Maximum SWE")

SCNNAME <- c( "BASELINE","HD","HW","CT","WD","WW" )

TMPRD <-c( "2040_2069","2055_2084", "2070_2099")

AREA <-c("basin")

MONTH <-c("JAN", "FEB", "MAR", "APR", "MAY", "JUN", "JUL", "AUG", "SEP", "OCT", "NOV", "DEC")

#### Plot Options ####
SCOLOR <- c( "blue","darkgreen","orange","black")

# ##############################################################
# CODE
# ##############################################################

library( broom )
library( ggplot2 )
library( gtools )
library( ncdf4 )
library( raster )
library( reshape2 )
library( rgdal )
library( rgeos )
```

```
library( scales )
library( sp )
library(dplyr)
library(plyr)
library(tidyverse)
library (Kendall)
library (trend)

snipdir <- "C:/Users/kmikkelson/Documents/R/Clark_Canyon/snips/"
source( paste(snipdir,"organizedDateColumns_function.R",sep="") )

# GRAB DIMENSIONS FOR LOOPING
# (datasets, variables, timescales, polygons )
nscn <- length( SCNNAME )
nvar <- length( VNAME )
ntim <- length(TMPRD)
narea <- length(AREA)

#Loop through the variables and the scenarios
for ( v in 1:nvar) {

 for(a in 1:narea){
 aname <- AREA[a]

 # read in the txt file to get basin names
 fdir <- sprintf( FILEDIR)
 fname <- sprintf( "BASELINE.1980_2009.arbs_ssj.%s.month.%s.txt",vname, aname)
 fpath <- sprintf( "%s/%s",fdir,fname )
 the_data <- read.table(fpath, sep="\t", header=TRUE)

 BLIST = colnames(the_data)
 BLIST = BLIST[-1]
 nbas <- length(BLIST)


 for (b in 1:nbas) {
 bname <- BLIST[b]


 #Create empty dataframe for plotting
 pltdata <- data.frame( Date=character(),
 Data=numeric(),
 TimePeriod=character(),
 Scenario=character(),
 month_abb=character(),
 stringsAsFactors=FALSE )

 for (s in 1:nscn) {
```

```
sname <- SCNNAME[s]
vunit <- VUNIT[v]
vname <- VNAME[v]
vname_plt <- VNAME_PLT[v]

for ( t in 1:ntim) {
tname <- TMPRD[t]

fdir <- sprintf( FILEDIR)

if(sname=="BASELINE"){
fname <- sprintf( "BASELINE.1980_2009.arbs_ssj.%s.month.%s.txt",vname, aname)
} else{
fname <- sprintf( FILESTR,sname, tname, vname, aname)
}

fpath <- sprintf( "%s/%s",fdir,fname )
the_data <- read.table(fpath, sep="\t", header=TRUE)


#select only the one basin you need
the_data <- subset(the_data, select=c("DATE", sprintf("%s", bname)))
#Change column name to 'Data'
names(the_data)[2] <- "Data"

#format date column
the_data$DATE = as.Date(the_data$DATE, "%Y-%m-%d")
#pull out year
the_data = OrganizeDateColumns(data.x= the_data,ncol.date = 1, orders = "ymd", ncol.day = NULL,
ncol.month = NULL, ncol.year = NULL)
#add 84 year offset to dates to find future time slices:
the_data$Date = the_data$year + 84

#Create column w/ month abbreviations
the_data$month_abb=MONTHS[the_data$month]

#Create column w/ scenario name
scn_name <- sprintf( "%s",sname )
the_data$Scenario = scn_name

#Create column with time period
tm_pd = sprintf("%s", tname)
the_data$TimePeriod = tm_pd

#Keep only certain columns
the_data3 = subset(the_data, select=c("Date", "Data", "TimePeriod", "Scenario", "month_abb"))

#Add to new dataframe with all scenario/time period data in it
```

```
pltdata <- rbind( pltdata,the_data3 )



} #end of ntim loop
} #end of nscn

melt_plt = melt(pltdata, id = c("Date","Scenario", "TimePeriod", "month_abb"), measure.vars = "Data")

#Change units for future period

melt_plt$value = melt_plt$value*0.0393701

melt_plt$TimePeriod = ifelse( melt_plt$Scenario=="BASELINE", "1980 - 2009", melt_plt$TimePeriod)

melt_plt$TimePeriod <- factor(melt_plt$TimePeriod,
labels = c("1980 - 2009", "2040 - 2069", "2055 - 2084", "2070 - 2099"))

#Subset into just April data
plt_apr = subset(melt_plt, month_abb=="APR")



#### Timeseries Plot ####
ylab <- sprintf( "Maximum April SWE [%s]" ,vunit)
gline <- ggplot( )
gline <- gline + geom_line(data=plt_apr,aes(x=Date,y=value,color=TimePeriod), size=0.25,
linetype="solid", na.rm=TRUE )
gline <- gline + facet_wrap(~ Scenario, scale="fixed", ncol=1)

gline <- gline + scale_color_manual( name="Time Period",values=SCOLOR )
#gline <- gline + scale_x_continuous(breaks=c(2020, 2050, 2080))
gline <- gline + labs( x="Year", y=ylab)
gline <- gline + theme(plot.title=element_text(face="bold",color="black",size=16))
gline <- gline + theme(plot.subtitle=element_text(face="bold",color="black",size=14))
gline <- gline + theme(axis.title.y=element_text(face="bold",color="black",size=16))
gline <- gline + theme(axis.title.x=element_text(face="bold",color="black",size=16))
gline <- gline + theme(axis.text.y=element_text(face="bold",color="black",size=14))
gline <- gline + theme(axis.text.x=element_text(face="bold",color="black",size=14))
gline <- gline + theme( strip.background=element_blank() ) + guides(colour = guide_legend(override.aes
= list(size = 1)))
gline <- gline + theme( strip.text=element_text(face="bold",color="black",size=12) )
gline <- gline + theme( panel.border=element_rect(linetype="solid",color="black",size=1,fill=NA) )
gline <- gline + theme( panel.grid.major=element_line(color="gray50",linetype="dotted") )
gline <- gline + theme( panel.grid.minor=element_blank() )
gline <- gline + theme( panel.background=element_blank() )
gline
```

```
 # save plot
 fname <- sprintf( outstr,bname, vname)
 fdir <- sprintf(outdir, vname)
 fpath <- sprintf( "%s/%s",fdir,fname )
 if (!dir.exists(fdir)) { dir.create(fdir,recursive=TRUE) }
 ggsave( gline , filename=fpath, width=7, height=10, dpi=600, device = "png" )
 rm(fname, fdir, fpath)

 } #end nbas
 } #end narea
} #end nvar
```

Appendix B: Guidance for Development of Maps for Briefing, Presentation, and External Outreach Materials

Note: This is a copy of the official guidance from Christopher J. Beardsley, Acting Director, Policy and Administration and David Raff, Science Advisor, Reclamation, November 18, 2019. Please contact the TSC Geographic Applications and Analysis Group for updated policies.

Introduction

This document establishes guidance for maps included in briefing materials, presentations, and external outreach materials. This guidance was developed at the request of the Commissioner to ensure consistent use of effective maps in across Reclamation, and to showcase Reclamation's GIS capabilities. The Guidance was developed by a team of GIS Coordinators representing RLT members, led by the GIS Program Coordinator within Policy and Administration, and has been in use since July 2019. GIS Coordinators are responsible for a broad range of GIS Program activities, including program development and identification of standards.

This Guidance should be used to prepare maps for briefing papers and presentations such as PowerPoint presentations, as well as other materials generated by Public Affairs. Included within this document are:

1) protocols for communication between each directorate's identified Geographic Information Systems (GIS) contact and the Washington Office liaison (or other employee responsible for the materials),

2) defined mapping guidance for briefing materials, and

3) options for technical mapping support by Reclamation staff available to assist with map production.

1. Communication Process

Each directorate has identified a GIS contact who is available to consult with subject matter experts within the Directorate to develop maps for briefing and other materials. Whenever a map is necessary as part of briefing, presentation, or outreach materials, the Reclamation employee responsible for the materials (e.g., subject matter expert, Washington Office liaison, Public Affairs) should engage the GIS contact to ensure that materials are developed consistent with this

Guidance. The communications process between the GIS contact and Washington Office liaison should be defined by the region or directorate. The GIS contact should work with the subject matter expert to produce a map that contains relevant information that enhances the briefing paper or other material. To be effective, maps should be designed for the intended audience with a clear communication goal defined by the subject matter experts and produced by the GIS contacts.

2. Mapping Guidance for Briefing, Presentation, and External Outreach Materials

This Guidance will be updated as templates are developed and additional standard mapping elements are identified. With that in mind, communication with GIS contacts is critical to ensure that up-to-date information can be shared with subject matter experts and liaisons.

Maps should be included in all briefing, presentation, and external outreach materials that are associated with spatial locations or features. The briefing map will likely be printed out for viewing and should be letter sized, embedded into the briefing paper when possible, and be presented in color. We have developed the following "Mapping Elements Checklist" to improve the consistent use and quality of maps across Reclamation:

Mapping Elements Checklist
Use this checklist of mapping elements to be included in briefing maps used in Commissioner's Office materials:

Title/Description
A detailed title/description that gives the map audience a succinct explanation of the subject matter of the map.

Legend
A legend that provides a key to the symbology contained within the map, inclusive of all data layers.

Scale Bar
A scale bar providing a reference of distance and size of features that displays U.S. units of measurement. When displaying division blocks or tics on the scale bar, choose a 'rational' subdivision, (e.g., 5, 10, 15, 20 rather than 12.5, 25.5, 37.5.)

Locator Map (Inset)
An inset locator map within a map providing context to the broader location of the subject of the map. The locator map should show the map audience, who may not be familiar with the area or subject, the larger geographic region that the map relates to. All maps should include a locator map except when the map subject is a larger geographic region such as a state or groups of states.

North Arrow
All maps should include a north arrow.

Projections

Large scale maps - UTM or State Plane.

Logo
Reclamation logo should be included.

Map Production Information
Last revised date or printed date, map prepared by (office) and/or local office filename and file path.

Reclamation Assets
Important Reclamation and Reclamation funded assets should be included as a layer when available to give the Commissioner area information and location perspective. The GIS contact should work with the subject-matter expert preparing the material to identify the relevant features that should be included to provide appropriate context for the map. For example, it may be important to show the State water project, major rivers or streams, county lines and other features in some maps but not in others. Maps should provide the appropriate amount of context for the subject matter of the material without including information that is unnecessary.

3. Review of Maps

The GIS contact and Washington Office Liaison (or other Reclamation employee tasked with developing the briefing or presentation materials) will be responsible for using the Mapping Elements Checklist to review maps before they are finalized.

4. Technical Mapping Support

Maps for briefing, presentation, and external outreach materials can require a swift turn around, and the GIS contact to the Washington liaison may not be present to generate or review the map. In this case, contact Kenneth Richard, GIS Program Coordinator, to facilitate the map being produced.

5. Existing Symbology

Standard colors denoting land ownership are at:
https://www.ntc.blm.gov/krc/uploads/223/Ownership_Map_Color_Reference_Sheet.pdf
https://pubs.usgs.gov/gip/TopographicMapSymbols/topomapsymbols.pdf


RECLAMATION
Managing Water in the West
Washington Inset
California/Oregon Inset
Northern California Inset
Phoenix Inset
Utah Inset
Colorado Inset
Legend
RECLAMATION
Managing Water in the West
Recreation Opportunities at Bureau of Reclamation Projects

Appendix C. Color Scales for Reclamation's VI Colors

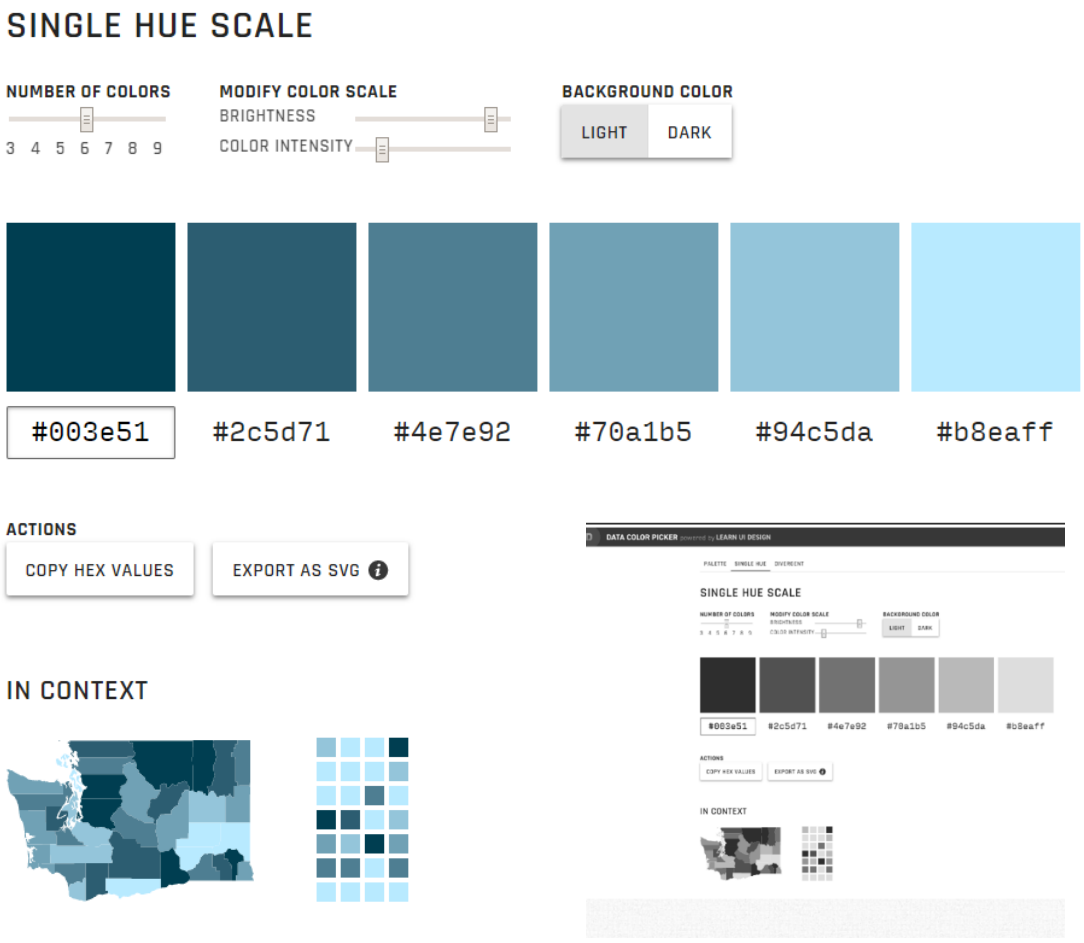
Note: only the darkest colors are the official Reclamation VI colors. Reclamation VI colors should be used in all corporate materials whenever possible and should be the primary colors in other applications as well. However, we often need to use sequential scales to signify the level of factor.

These were developed using the color bar picker at https://learnui.design/tools/data-color-picker.html.

Color blindness testing was from https://www.color-blindness.com/coblis-color-blindness-simulator.

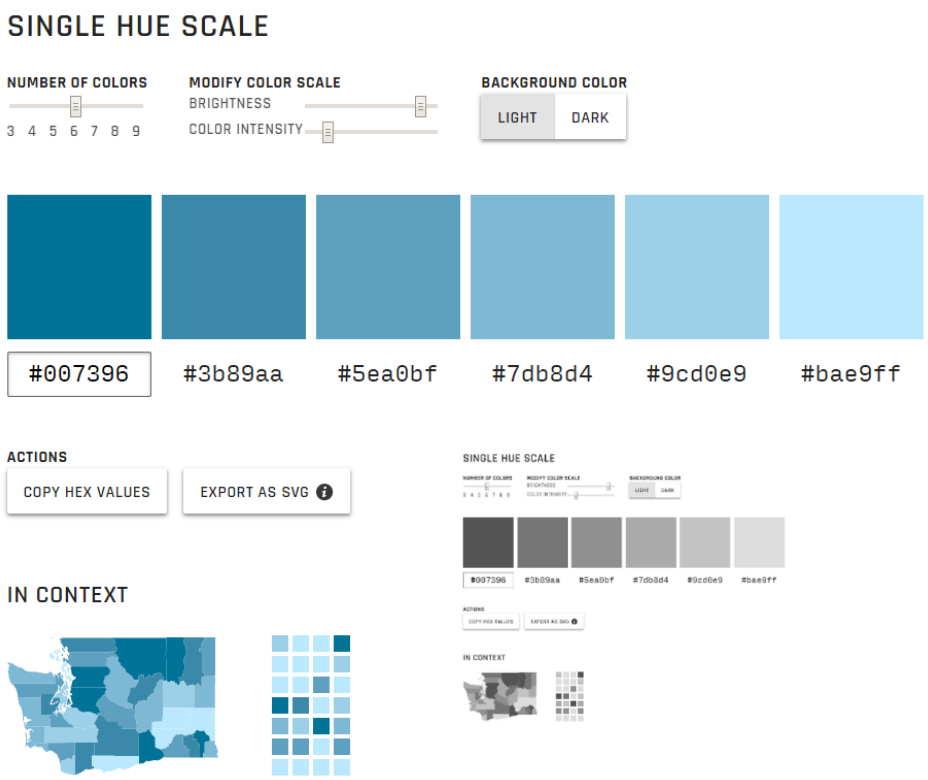
RGB to hex https://www.rgbtohex.net/hextorgb/

Dark Blue (PMS 3035)



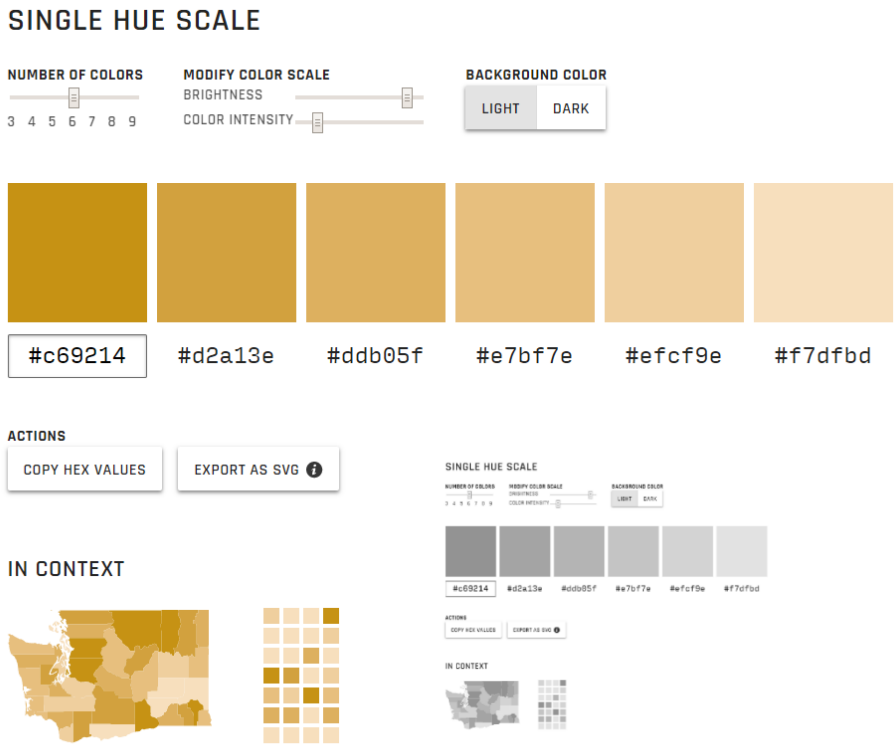
Hex	003e51	2c5d71	4e7e92	70a1b5	94c5da	B8eaff
RGB	R: 0 G: 62 B: 81	R: 44 G: 93 B: 113	R: 78 G: 126 B: 146	R: 112 G: 161 B: 181	R: 148 G: 197 B: 218	R: 184 G: 234 B: 255

Light Blue (PMS 633)



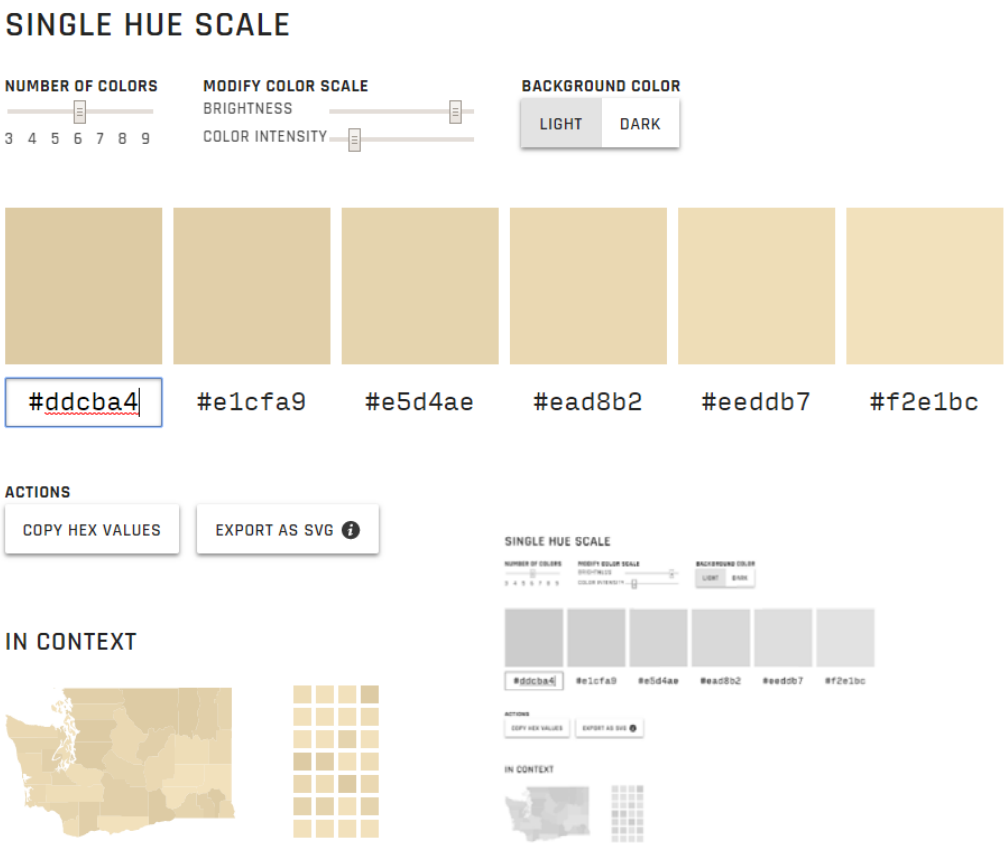
Hex	007396	3b89aa	5ea0bf	7db8d4	9cd0e9	Bae9ff
RGB	R: 0 G: 115 B: 150	R: 59 G: 137 B: 170	R: 94 G: 160 B: 191	R: 125 G: 184 B: 212	R: 156 G: 208 B: 233	R: 186 G: 233 B: 255

Mustard (PMS 1245)



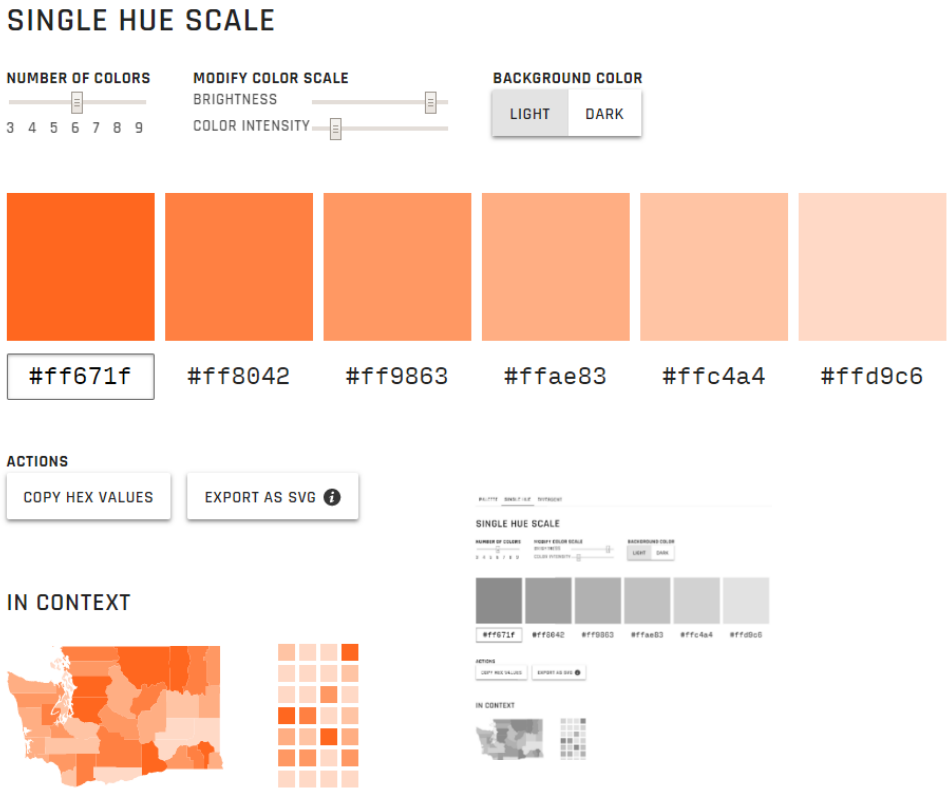
Hex	C69214	D2a13e	Ddb05f	E7bf7e	Efcf9e	F7dfbd
RGB	R: 198 G: 146 B: 20	R: 210 G: 161 B: 62	R: 221 G: 176 B: 95	R: 231 G: 191 B: 126	R: 239 G: 207 B: 158	R: 247 G: 223 B: 189

Tan (PMS 468)



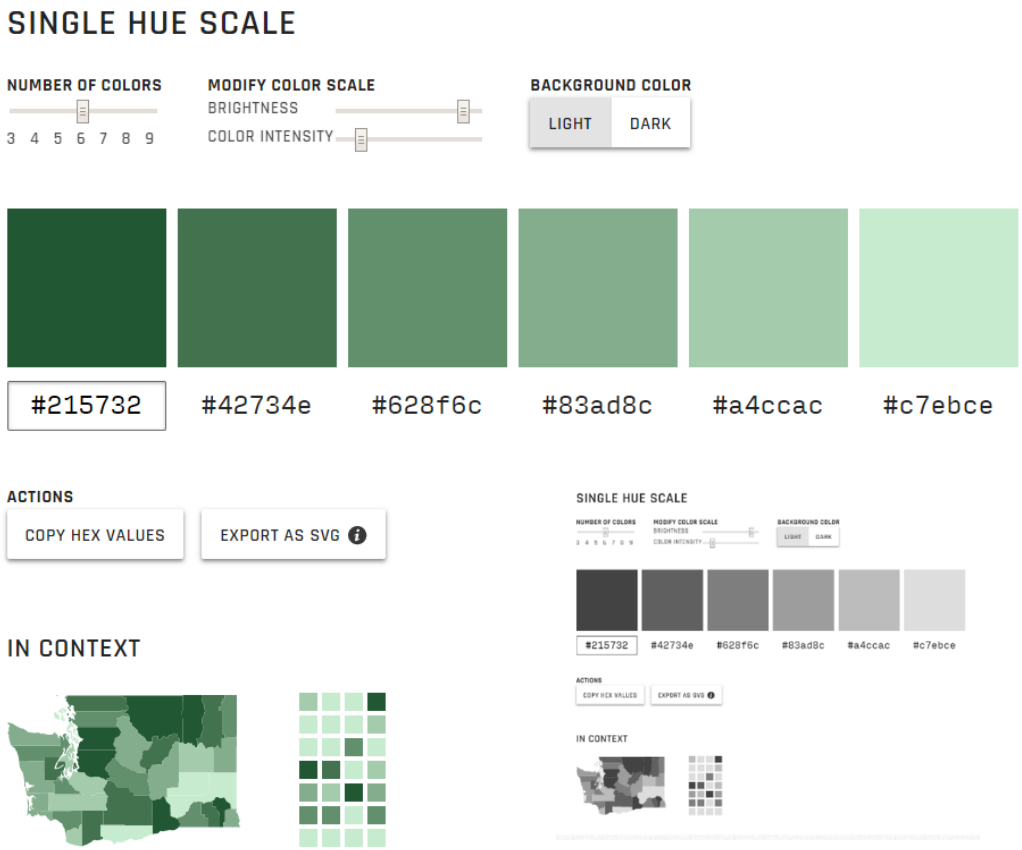
Hex	Ddcba4	E1cfa9	E5d4ae	Ead8b2	Eeddb7	F2e1bc
RGB	R: 221 G: 203 B: 164	R: 225 G: 207 B: 169	R: 229 G: 212 B: 174	R: 234 G: 216 B: 178	R: 238 G: 221 B: 183	R: 242 G: 225 B: 188

Orange (PMS 165)



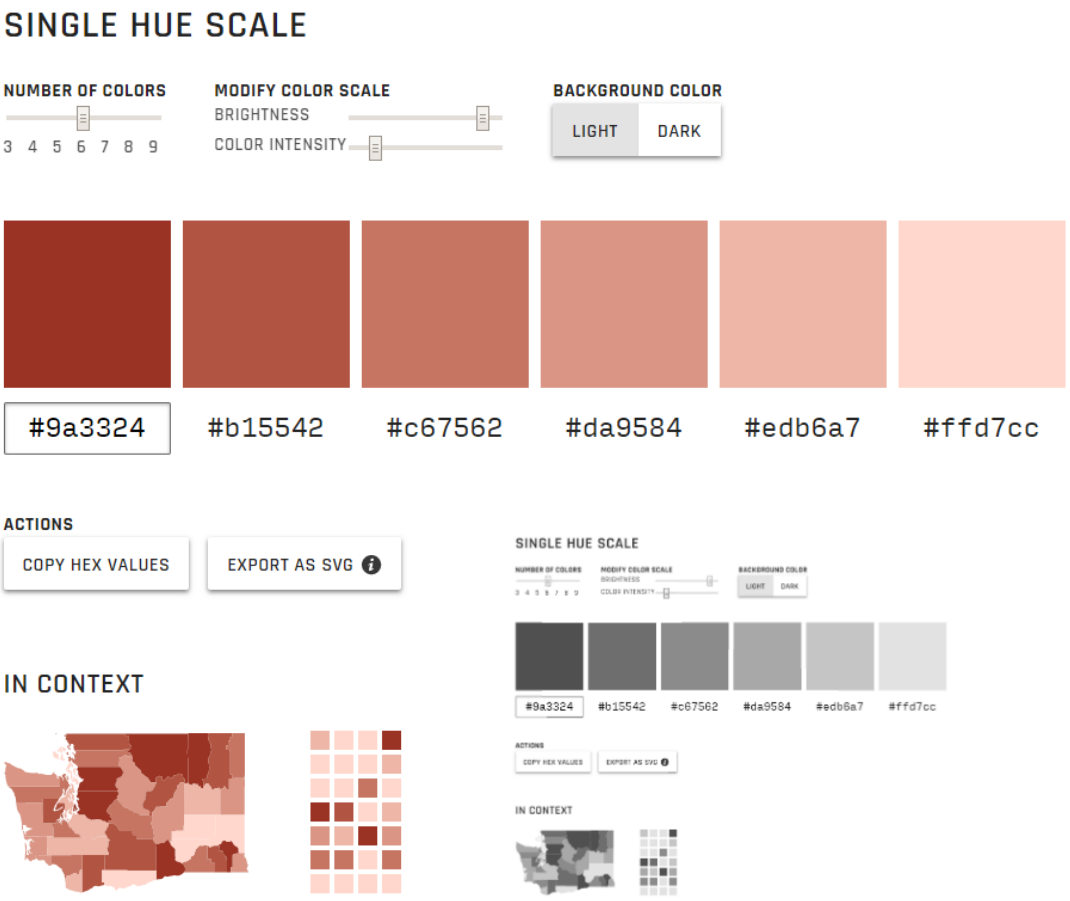
Hex	Ff671f	Ff8042	ff9863	Ffae83	Ffc4a4	Ffd9c6
RGB	R: 255 G: 103 B: 31	R: 255 G: 128 B: 66	R: 255 G: 152 B: 99	R: 255 G: 174 B: 131	R: 255 G: 196 B: 164	R: 255 G: 217 B: 198

Green (PMS 357)



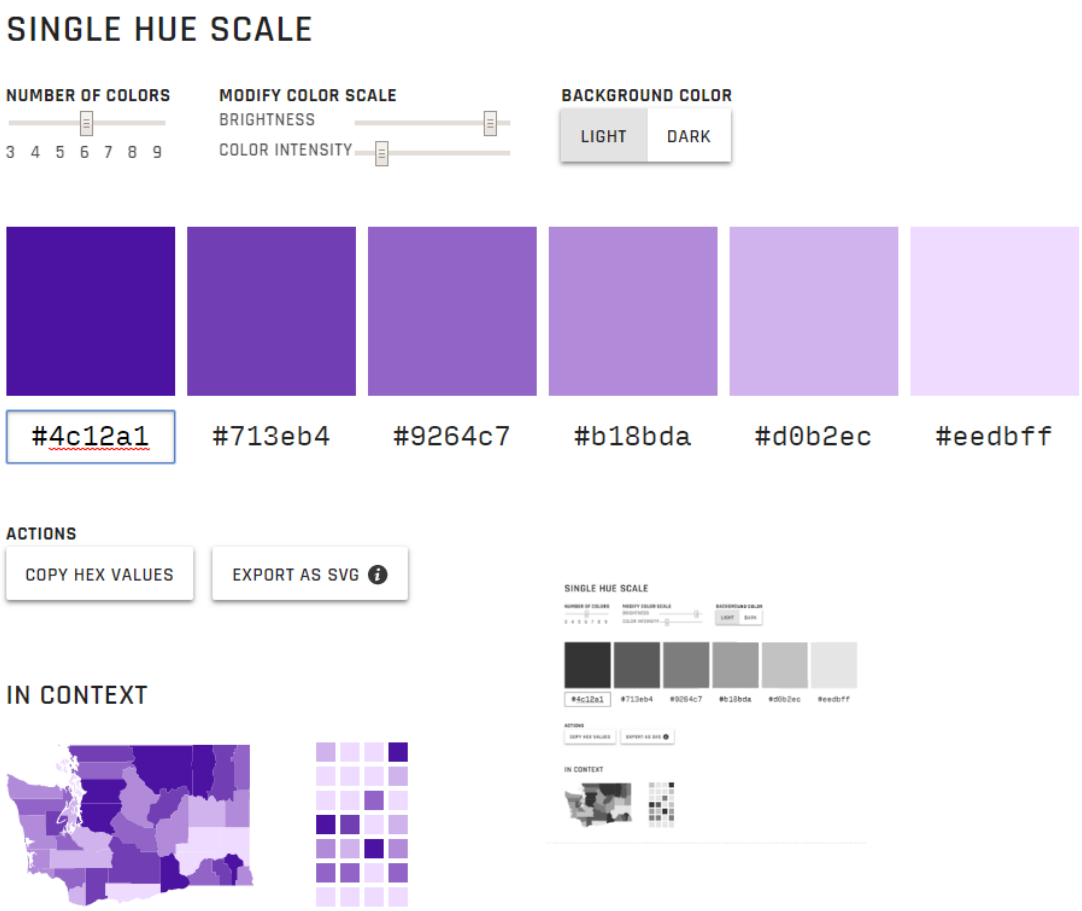
Hex	215732	42734e	628f6c	83af8c	A4ccac	C7ebce
RGB	R: 33 G: 87 B: 50	R: 66 G: 115 B: 78	R: 98 G: 143 B: 108	R: 131 G: 175 B: 140	R: 164 G: 204 B: 172	R: 199 G: 235 B: 206

Red (PMS 484)



Hex	9a3324	B15542	C67562	Da9584	Edb6a7	Ffd7cc
RGB	R: 154 G: 51 B: 36	R: 177 G: 85 B: 66	R: 198 G: 117 B: 98	R: 218 G: 149 B: 132	R: 237 G: 182 B: 167	R: 255 G: 215 B: 204

Purple (PMS 2091)



Hex	4c12a1	713eb4	9264c7	B18bda	D0b2ec	Eedbff
RGB	R: 76 G: 18 B: 161	R: 113 G: 62 B: 180	R: 146 G: 100 B: 199	R: 177 G: 139 B: 218	R: 208 G: 178 B: 236	R: 238 G: 219 B: 255