AGENCY:	City Council
MEETING DATE:	June 15, 2019
DEPARTMENT:	Public Works
PRESENTED BY:	Diane O'Connor

AGENDA ITEM SUMMARY

TITLE:
Present City Water Supply Model, Including Development, Functionality, and Model Results

ISSUE:
This presentation is intended to help educate the City Council and the public about Fort Bragg's Water Supply Model. It includes some model history, the source and manipulation of model data, including source supply and water demand. It also includes some modeling results.

ANALYSIS:
The following text provides a brief explanation of each of the primary slides in the presentation.

SLIDE 1– Model History and Background
The water model was first built in early 2014, by Bonnie Lampley of Lawrence and Associates, located in Shasta Lake, CA. The water model uses data from 1973 to 2015 to analyze our ability to provide water to the citizens of Fort Bragg. This includes the drought of 1977, as well as the more recent drought of 2015. Numerous iterations occurred with former Public Works employees Terry Jo Barber, Sergio Fuentes and myself. A Special City Council Water Workshop was held on January 5, 2016, where Sergio Fuentes gave a brief demo of the Water Model as it was at that time. I worked with Bonnie Lampley from August 2017 to September of 2018, when I took over the functionality myself. I am much more confident that we are as close to the "real world" as we can get, with the information we have.

SLIDE 2 – Model Data
Daily precipitation data from the Fort Bragg Station 5N was obtained from usclimatedata.com, and daily evaporation volumes were calculated using evapotranspiration data from State of California Natural Resources Agency, Department of Water Resources. The model is not currently using the evaporation and precipitation volumes, as the impacts are negligible, but the data exists in case the situation changes.

The model uses the volume of water historically drawn from Newman Gulch and Waterfall Gulch, which have been metered since 1994, and compiles maximum flows for the Noyo River, based on actual flow and tidal data. Source intake data for Newman and Waterfall Gulch prior to 1994 was estimated using the 2008-2013 metered data.

Newman Gulch provides a legal maximum of 0.99 acre-feet (AF)/day, equivalent to 225 gallons per minute (gpm) or 0.5 cubic feet per second (cfs). Waterfall Gulch provides a legal maximum of 1.325 AF/day, equiv. to 300 gpm or 0.668 cfs. The Noyo River can legally provide up to a maximum of 5.95 AF/day, equiv. to 1345 gpm or 3 cfs. This translates to a maximum supply of 8.265 AF/day. ***The model considers what portion we can take of any of our supply sources on a daily basis.***

SLIDE 3 – Noyo Tidal Constraints
The Noyo source is constrained by the State Water Resources Control Board Division of Water Rights such that we must bypass 3 cfs during the summer (June-September) and 10 cfs during winter (October-May), whenever the tide is equal to or less than 2'.

SLIDE 4 – Sorting Tide Data
The historic tide data, obtained from CeNCOOS, the Central and Northern California Ocean Observatory System, and from NOAA, the National Oceanic and Atmospheric Association, was incorporated in the model for use in those calculations. The data was input as a large string of data, as provided by CeNCOOS, which the model then extracts to a usable form. The model calculates the number of hours that the tide will be above 2', 5', and 6.7' (King Tide), rounded to the nearest increment of 6 or 8 hours, for 4 or 3 tides/day, respectively.

The model excludes days which are impacted by King Tides when evaluating the Noyo contribution, although operationally we may pump some on those days. We took the conservative approach when using these data to determine the maximum amount of supply for each day. The model will also allow us to evaluate a situation in which the volume of water drawn from any of the sources becomes reduced due to regulatory or other considerations.

SLIDE 5 – Source Flow Constraints
Waterfall Gulch was recently restricted by US Fish and Wildlife, through a new Streambed Alteration Agreement, when we constructed the Summers Lane Reservoir. The new Agreement supersedes previous Agreements going back to 1977. We are now required to bypass 25% of the flow, unless we are in a drought situation, in which case the bypass can be reduced to 10%. Current modeling is set for a constant 25% bypass.

SLIDE 6 – Historic Water Supply Data
When Lampley created the model in 2014, she used some variation of the demand data from the 2012-2013 fiscal year to analyze all years. This was accomplished by creating some slight variations within the actual values but honoring the annual trend for all years in the model. I went back and reentered the volume of water filtered at the Treatment Plant, as demand, from 7/1/2010 to 12/31/2015. The volume of filtered water accounts for losses in the system. The metered sales volume for calendar year 2015 was about 195.5 million gallons (MG), while the filtered volume was almost 247 MG, a difference of just over 50 MG. The "demand" for the 2017-2018 fiscal year, was just under 247 MG, very close to the 2015 volume. It should be noted, however, that the demand for the **2018 calendar year was 262.4 MG**, an increase of a little over **6%** from the 2015 calendar year demand. Overall there has been a **decrease in demand of over 23%** since the 1995-1996 fiscal year.

SLIDE 7 – Model Constants and the User Interface
The volume of stored water available includes the amount of untreated water in the storage ponds at the Treatment Plant (9.2 AF or 3 MG) and in Newman Reservoir (0.9 AF or 0.3 MG). It also includes the treated water in the two older 1.5 MG tanks on Cedar Street, and the 0.3 MG tank on Highway 20, for a total of 10.1 AF, or 3.3 MG. These provide a total storage of **20.25 AF, or 6.6 MG**. At this point, I have not included the new 1.5 MG tank in the model, but it can easily be incorporated. Summers Lane Reservoir has a capacity of **44.3 AF, or 14.4 MG** of untreated water. These individual volumes result in a ***total storage capacity of 64.5 AF, or 21 MG***. The model allows us to "turn" the reservoir "off" and "on" to evaluate the effects it has on our supply. Running the model without Summers Lane Reservoir is a good "ground truth" for actual conditions in the past.

The water model allows the user to modify/adjust some of the parameters to evaluate various scenarios. We can change the % of flow that we can take from any of the 3 sources, or change the volume of bypass required for the Noyo or for Waterfall Gulch. We can increase demand by a % over the 2015 demand, and we can turn the Summers Lane Reservoir “on” and “off.” We can adjust the modeled precipitation by a specific %, although we are not currently incorporating precipitation or evaporation, as their effects are insignificant to the model. We can also add the evaporative reduction devices to our ponds, which we are currently using. The last “dials” on the model are the ability to use groundwater, should the City ever have access to a groundwater source, and the volume of the groundwater that will be input to the system.

SLIDE 8 – Definition of Water Emergency Stages

The definition of a Water Emergency and the Stage criteria were defined and adopted by City Council as Ordinance 923-2016, amending FBMC Section 14.06. A Water Emergency is when “the City is unable to maintain a 10% buffer between its ability to replenish water in its storage tanks and the total daily demand for water.” Stage 1 is defined as 10% goal of reducing water usage. Stage 2 is defined as 20% goal of reducing water usage. Stage 3 is defined as 30% goal of reducing water usage. Stage 4 is defined as “all available water sources cannot provide sufficient flow for water users or cannot maintain adequate flows or pressures for fire-fighting; and the conservation measures required by a Stage 1, Stage 2, and Stage 3 water emergency are no longer adequate to address the water shortage.”

The Model automatically calculates a **Water Alert**, when demand exceeds 90% of supply, and **Stage 4**, when supply is exhausted. The **Stage 1** Water Emergency will be determined by evaluation of daily model results. The Water Alert is an early indication of the potential for a water shortage.

SLIDE 9 – Determining Stage 1 Criteria in the Model

The model evaluates supply and demand on a daily basis. On days when the demand exceeds the supply, water is drawn from storage. As a general rule, there is always some water entering Summers Lane Reservoir, from either, or both, Waterfall Gulch and Newman Gulch. The 10% buffer described above equates to approximately 11% of the storage volume of Summers Lane Reservoir. The model is not designed to evaluate this, but it can be determined by adjusting the demand at the User_Input tab and then reviewing the calculations until the drawdown reaches 11%. That will be the % increase that will trigger the Stage 1 Emergency. With Summers Lane we do not encounter Stage 1 Water Emergency until we reach a 6% increase in demand.

SLIDE 10 - Stage 4 Criteria

In the model, Stage 4 is triggered when all of the storage has been depleted. The current model hits Stage 4 in 2015, with Summers Lane on and Waterfall at 75%, at **180.1% of 2015 demand.** This equates to about **444.81 MG.**

SLIDE 11 – Example Run with Summers Lane Reservoir

Adding the reservoir greatly increases our stored water supply, reducing the severity of supply loss.

SLIDE 12 - Ground Truth Model with Actual 2015 Conditions

Storage without Summers Lane is 20.25 AF. An 11% drawdown equates to a volume of 18.0 AF. We hit the Stage 1 criteria on 8/7 with a low of 17.9 AF. Storage is full again from 8/11-8/22. We hit another low of 19.2 AF on 8/25. Storage is full again from 8/26-9/2. A low of 17.9 AF is encountered on 9/7. Storage is full again 9/9-9/21. A low of 18.9 is encountered on 9/24. Storage is full again 9/25-9/30. A low of 18.0 AF is encountered on 10/6. Storage is full again 10/8-10/18. A low of 19.1 is encountered on 10/23. Storage is full again on 10/24.

If the model was set up to determine the Stage 1 Water Emergency automatically, it would have counted 6 days. If the City declared Stage 1 on the first day we hit the 18 AF (8/7), and continue until there were no more days below 18 AF for the year (10/7), Stage 1 would have been declared for 61 days (from 8/7-10/6)

The City declared a Stage 1 Water Emergency at City Council on **8/10**. Stage 3 was declared at City Council on 9/30. On **10/26** Council issued the non-emergency water conservation ordinance. The timing of actual events relative to the modeling results gives us some confidence that the model is a fairly accurate representation.

SLIDE 13 - Maximum Growth While Retaining 5 MG Storage
The model indicates that we can manage a ***growth of 74.8%*** (174.8% in model) and still reserve 5 MG in storage. A growth of 74.8% equals to a total demand of **431.72 MG**.

SLIDE 14 - 60% Growth Analysis
The model indicates that we can still maintain 13.49 MG in storage under 2015 drought conditions, even with a loss of 25% of the Waterfall Gulch supply. A growth of 60% equals to a total demand of **395.17 MG**.

RECOMMENDED ACTION:
The workshop is intended to provide information. No actions are necessary.

ALTERNATIVE ACTION(S):
None.

FISCAL IMPACT:
N/A.

CONSISTENCY:
N/A.

IMPLEMENTATION/TIMEFRAMES:
N/A.

ATTACHMENTS:
1. PowerPoint Presentation

NOTIFICATION:
None.