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September 2, 2016

Scott Boettcher  
Chehalis River Basin Flood Authority  
2025 NE Kresky Avenue  
Chehalis, WA 98532

Re: Annual Flood Warning System Update

Dear Scott,

The following paragraphs summarize our work maintaining and supporting operations of the Chehalis River Basin Flood Authority Flood Warning System in 2015-16.

WEST maintains the following gages: Haywire Ridge, Beeville, WF Satsop River at Cougar Smith Rd, Brooklyn, Cedar Creek, Chehalis below Thrash Creek, Newaukum-Weyerhaeuser, Riverside, Rock-Weyerhaeuser, and Skookumchuck.

WEST also monitors reservoir elevations on Skookumchuck Reservoir utilizing sensors operated by TransAlta. If automated data reporting from TranAlta is interrupted, WEST coordinates with TransAlta to restore data communications.

The Chehalis River Basin Flood Warning System website is also managed by WEST Consultants.

### **Field Maintenance Site Access Permits**

In 2016, site access permits to Weyerhaeuser and State of Washington lands to perform maintenance work on the Flood Warning System rainfall and stream gages located in the Chehalis River Basin expired. After several months of coordination and negotiation, with the help of Scott Boettcher, new permits were obtained.

- Washington Dept. of Natural Resources Land Use License - Authorized from July 1, 2016 through December 31, 2020.
- Weyerhaeuser Company – Authorized a 1-year extension to the original agreement which shall expire on August 7, 2017. (Signed by Washington Dept. of Ecology, Office of Chehalis Basin. Waiting final signature from Weyerhaeuser Company)

### **2016 Chehalis River Basin Flooding Warning System Field Work**

All gages are checked at the beginning of each week using the Contrail/OneRain website. Periodic communications with OneRain take place via phone or email to make sure alarms and notifications are working correctly and to correct any other communications issues. Gage sensor data is viewed graphically to check for problems.

#### **October 28<sup>th</sup> – 30<sup>th</sup> 2015:**

- All sites visited.
- Tip test on rain gages to USGS standards performed, funneling buckets removed and cleaned to manufacturer standards, and general inspection of equipment at all sites. End of orifice line checked at stage sites by visual inspection with purge.
- Skookumchuck rain gage replaced due to failed calibration on last field trip.
- Reset rain gage counters for 2016 WY.
- All raw data downloaded from sites and backed up in WEST time series software.

### November 11<sup>th</sup> - 13<sup>th</sup> 2015:

- Chehalis below Thrash site visit to troubleshoot gage. Site was not transmitting data. Reset EDL and checked programming. Site functioning again.
- WF Satsop site visit. Bubbler line damaged by bank failure.

### January 25<sup>th</sup> – 27<sup>th</sup> 2016:

- All sites visited except WF Satsop.
- Tip test on rain gages to USGS standards performed, funneling buckets removed and cleaned to manufacture standards, and general inspection of equipment at all sites. End of orifice line checked at stage sites by physical inspection.
- All raw data downloaded from sites and backed up in WEST time series software.

### February 9<sup>th</sup>, 2016

- WF Satsop. Replaced stage sensor damaged by high water in November 2015. New radar sensor to measure stage and new data logger (H500XL) were installed.

### February 24<sup>th</sup> 2016

WF Satsop. Check on radar sensor. Tip test rain gage.

### March 21<sup>th</sup> 2016

- WF Satsop. Gage not transmitting. Data logger error (H500XL). Installed spare EDL (H350XL). EDL that was removed was sent in for warranty repair.



**Figure 1: West Fork Satsop Rain Gage (foreground) and New Stream Gage (mounted on bridge in background)**

### April 1<sup>st</sup> – 19<sup>th</sup> 2016:

- All sites visited.
- Tip test on rain gages to USGS standards performed, funneling buckets removed and cleaned to manufacture standards, and general inspection of equipment at all sites. End of orifice line checked at stage sites by physical inspection.
- All raw data downloaded from sites and backed up in WEST time series software.
- WF Satsop. Reinstalled EDL that was sent in for warranty work (H500XL). Tip test rain gage.
- Haywire. GOES antenna replaced with spare. Site was not transmitting. Antenna sent in for repair.

### August 2<sup>nd</sup> – 4<sup>th</sup> 2016:

- All sites visited.
- Tip test on rain gages to USGS standards performed, funneling buckets removed and cleaned to manufacture standards, and general inspection of equipment at all sites. End of orifice lines checked at stage sites by physical inspection.
- Inspected solar panel and GOES alignment and angle
- Calibration test performed at all rain gages. All gages meet acceptable calibration for Chehalis Flood Warning System objective.
- Haywire: installed repaired original YAGI GOES antenna. Site successfully transmitting confirmed.
- All raw data downloaded from sites and backed up in WEST time series software.

### October 2016 (tentatively scheduled for the first week of October):

- All sites will be visited and inspected. A tip test to USGS standards will be performed, funneling buckets will be removed and cleaned to manufacture standards and end of orifice lines physical inspected, if low water.
- All raw data will be downloaded from sites and backed up in WEST time series software.
- Rain gage counters will be reset for 2016 WY.

## Chehalis River Authority Flood Warning Website: Contrail

- The website was continuously monitored throughout the year.
- Periodic website software upgrades were monitored and verified.
- Alarms were managed and responded to as needed.
- Information sheets for outreach activities were updated.

Several high water events occurred during the 2015-16 wet season. During December 2015, several locations on the Chehalis and tributaries reached moderate to major flood elevations in December. (See Figure 2 and Figure 3)

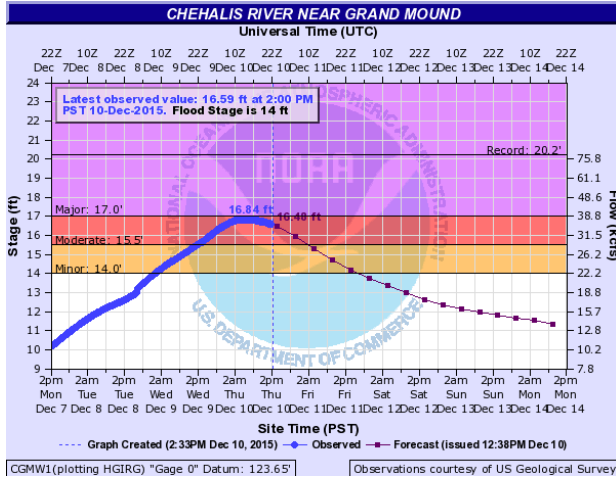


Figure 2: Chehalis River Flood Hydrograph Near Grand Mound - December 10, 2015

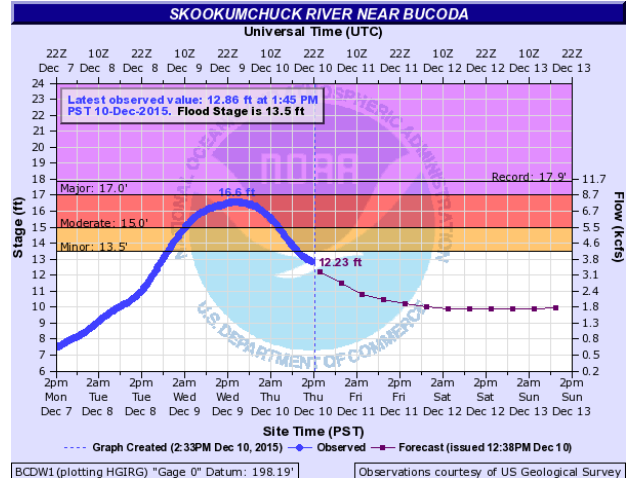


Figure 3: Skookumchuck River Flood Hydrograph Near Bucoda - December 10, 2015

For the past three years, WEST has been working with the National Weather Service (NWS) to implement a pilot effort to install flood inundation maps on the NWS website. This past year saw the official implementation the flood inundation maps for the Chehalis River at Centralia on the NWS Seattle website. (See Figure 4) The link to the NWS site is: <http://water.weather.gov/ahps2/inundation/index.php?gage=cenw1>. The NWS also issued a press release highlighted in the attached article published in “The Chronicle.”

The Flood Authority’s Contrail website has the ability to automatically send alarms and alerts via text or email triggered by observed data. Since the website’s inception, high water alerts have been available as a test to approximately 40 individuals closely associated with the Authority. At the beginning of the 2015-16 wet season, the opportunity to receive high water alerts for selected river elevations was opened to the general public. About 100 new individuals signed up which more than doubled the total number of requested high water alerts to more than 800. (See summary in Figure 5.)

With support and coordination by Scott Boettcher, a sample of people receiving high water alerts were surveyed to determine if the alerts were deemed beneficial and how were they being used. In general, the alerts were very well received. We received feedback that to help improve the messaging for the next season. Figure 6 shows examples of the reported uses of the high water alerts. Respondents were split evenly between male and female. Ages spanned from persons in their 20s to their 80s. Desktop computers, laptops, and smart phones were all used to receive alerts and interact with the website.

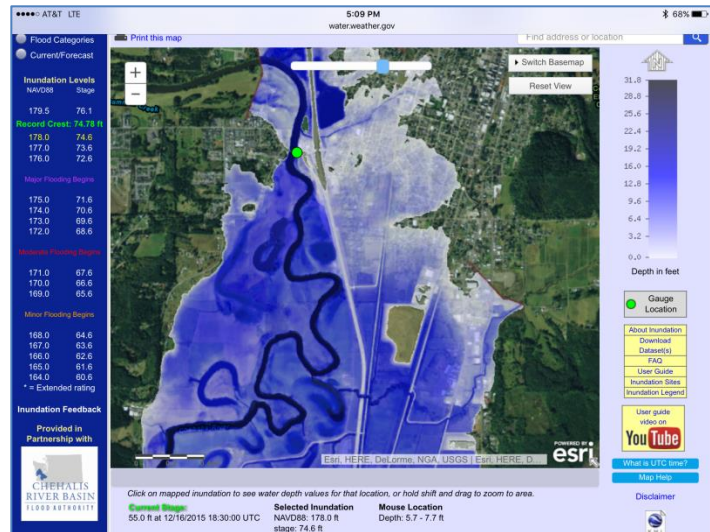


Figure 4: Chehalis River Flood Inundation Maps Displayed on the NWS Seattle Website.

## Distribution of Requested Flood Alerts

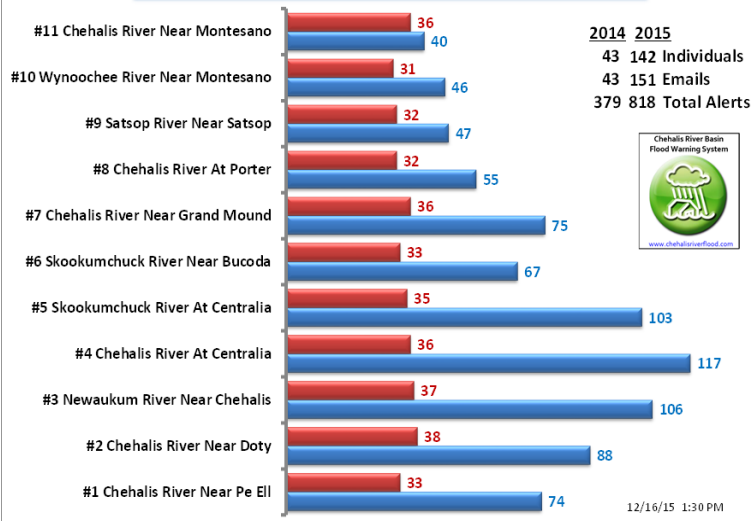


Figure 5: Summary of Requested High Water Alerts for the 2015-16 Wet Season.

## Purpose

News gathering	Travel concerns
Residence	General Interest
Elected Official	Job
Early warning	Testing
WSDOT EOC	Employee/student safety
Relatives in Chehalis	General Interest
Weyerhaeuser	First responder
Lewis County Pub Works	Animal safety
Employee safety	Elected Official

Figure 6: Summary of Reported Uses for the High Water Alerts

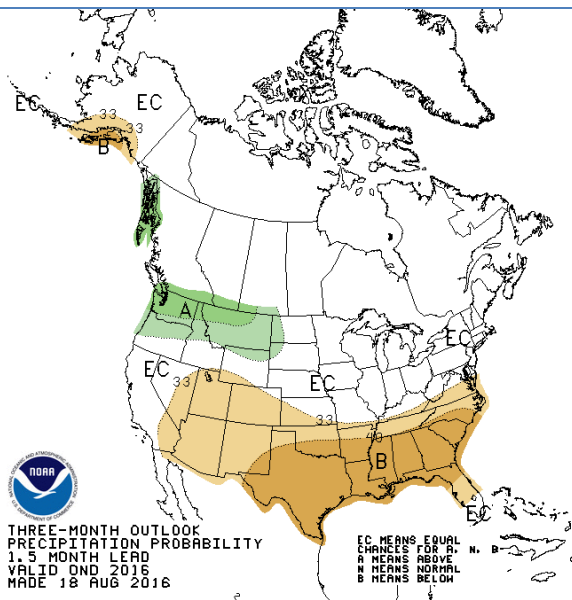


Figure 7: Precipitation Outlook for Oct-Dec

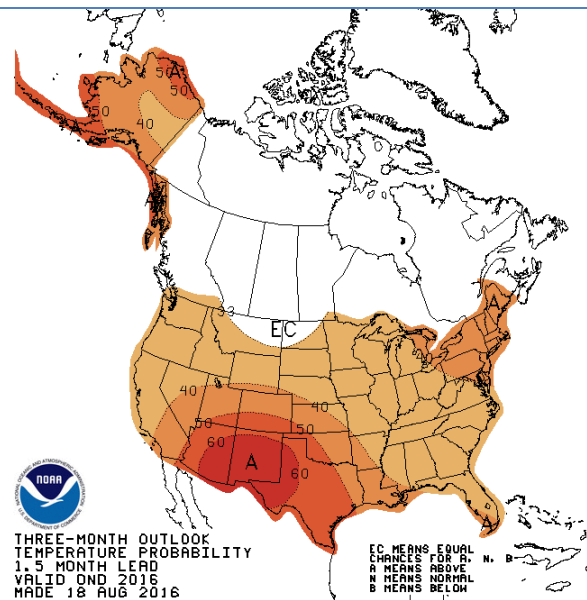


Figure 8: Temperature Precipitation Outlook for Oct-Dec

## 2016-2017 Outlook

Figures 7 and 8 show the latest October-December precipitation and temperature outlooks from the NWS Climate Prediction Center. Current projections suggest a strong chance of above normal precipitation and a good chance of above normal temperature through the end of 2016.

With support from Scott Boettcher, we anticipate further community outreach to expand the high water alert program and to increase flood threat awareness and utilization of the Chehalis River Authority Flood Warning System Website. If you have any questions, feel free to contact me directly.

Sincerely,

David C. Curtis, Ph.D.  
Sr. Vice President  
dcurtis@westconsultants.com