

## Submitted 2/4/19: Tom Lee Award Nomination – Chehalis River Basin Flood Authority Awarded 4/17/19: James Lee Witt Award – Chehalis River Basin Flood Authority

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**Summary:** Over the past decade, the Chehalis River Basin Flood Authority has led an aggressive program to mitigate flood risk, reduce flood damage, and increase flood threat awareness in order to transform floodplain management in the Basin from a reactive to a proactive culture. Program highlights include unique loss reduction projects such as: retrofitting homes with effective flood vents; constructing “Farm Pads” at numerous rural locations to save livestock, farm equipment, and feed; and mitigating flood risk with fish friendly engineered log jams and permit-friendly log-jacks.

While the Flood Authority has had numerous effective basin initiatives, this submittal focuses on two of them: adoption of improved regulatory standards; and implementation of an innovative flood warning system. Because of these initiatives, communities and residents in the Chehalis River Basin are now substantially more aware and better prepared for flooding than ever before. This work warrants recognition with the ASFPM Tom Lee State Award for Excellence in Floodplain Management.

**Background:** The Chehalis River and its tributaries form the second largest basin by area in Washington, next to the Columbia River basin. It drains 2,700 square miles from the foothills of the Cascades to the Pacific Ocean at Grays Harbor. In 2000, over 140,000 people lived in the Basin.

The Chehalis River Basin Flood Authority was created by act of the Washington State Legislature in 2008 after one of the worst floods in state history. The Flood Authority consists of officials from the principle jurisdictions in the Basin affected by flooding: Lewis County (lead agency), Thurston County, Grays Harbor County, the Cities of Centralia, Chehalis, Napavine, Aberdeen, Cosmopolis, Hoquiam, Montesano, Oakville, and the Towns of Pe Ell and Bucoda. Even though the cities’ populations range from less than 600 to 17,000, each community has one vote. Two Indian tribal governments have also participated in some of the projects.



The 2007 Chehalis River flood closed Interstate 5 for five days



The Flood Authority’s focus is two-part: reduce flood damage while at the same time enhance aquatic species. The attached “Chehalis Basin Strategy” provides an informative overview of flood hazard reduction and aquatic species enhancement activities in the basin as well a map of recent projects. Examples of the flood damage reduction efforts include:

- Planning a 65,000 acre-foot reservoir in the upper basin to protect against a repeat of the damage caused by the catastrophic 2007 basin-wide flood,
- Local projects, such as enlarging bridge openings,
- Protection of critical facilities with local floodwalls, and

→ Acquisition of buildings in the floodway.

There have been two unique loss reduction projects.

1. A pilot program to retrofit homes with effective flood vents. This low-cost program had a dramatic effect on the cost of flood insurance, effectively “elevating” the designated lowest floor from below to above the base flood elevation at an average cost of \$7,000 per home.
2. “Farm Pads” have been built in numerous rural locations. They provide high ground in the floodplain to save livestock, farm equipment, and feed during a flood. Farms pads provide a 14:1 return on investment. More information on this program can be found here: <http://arcg.is/2b632Ai>.

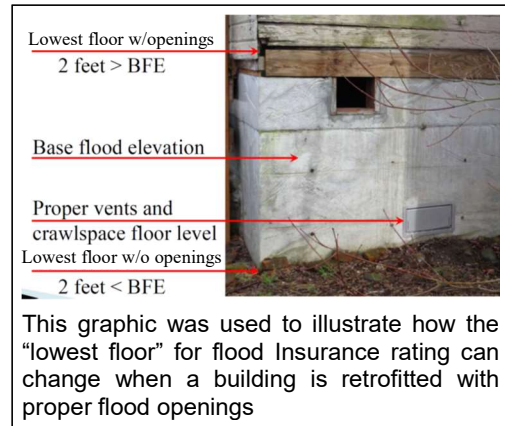
While the Flood Authority has implemented a variety of activities that prevent and reduce flood damage, this submittal expands on just two of them to show their effectiveness and impact on flood losses: regulatory standards and flood warning.

### Regulatory Standards

In 2014, the Flood Authority conducted a comprehensive review of local floodplain management programs and practices. A team of floodplain managers composed of a retired FEMA Regional floodplain management section chief and two former state NFIP Coordinators, visited each city and county, toured their floodplains, and met with staff. A report was prepared for each community. The table of contents (right) shows the breadth of these analyses.

Because the reports included critical comments for several communities, a master basin-wide assessment was prepared and publicized. It is attached. It acted as a master plan to improve local floodplain management programs. The basin-wide report and the Flood Authority encouraged adoption of regulatory standards that are higher than the minimum state and NFIP requirements.

In 2016, the Flood Authority seized on an opportunity to facilitate such adoption. The Flood Insurance Rate Map and Flood Insurance Study for Grays Harbor County had been revised and communities were told in August that they had until February 2, 2107, to adopt the new map and data. The Flood Authority offered to assist communities in drafting the needed ordinance language, provided local officials agreed to review appropriate higher standards that could also be adopted. It was made clear that the higher standards were voluntary.



Floodplain Management Analysis Table of Contents	
1.	Introduction
2.	Floodplain Mapping
3.	Floodplain Development
4.	Flood Hazard Area Regulations
5.	Building Code
6.	Other Development Management Tools
7.	Regulations Administration
8.	Flood Insurance Coverage
9.	Flood Hazard Mitigation
10.	Public Information Activities
11.	Community Rating System
12.	Conclusions

The recommended higher standards are listed in the table below. They include regulating to the flood of record when it is higher than the base flood elevation, protecting critical facilities from the 500-year flood, and tracking improvements cumulatively. The “No adverse impact” provision is in effect where there is no mapped floodway. It allows new developments to increase flood heights up to one foot (the NFIP minimum), but if there is *any* increase in flood heights, the developer must obtain written statements that the increase is acceptable to affected property owners.

All six of the cities in the Chehalis Basin part of the County agreed to the assistance, although the County did not. The list of recommended standards was tailored to each community’s situation. For example, the “best available data” provision was not relevant where there are no existing flood studies. Instead, communities were encouraged to adopt the “no available data” provision, which requires on site flood studies before a permit is issued.

The Flood Authority team met with the staff of these communities, walked through the recommended standards, and drafted appropriate ordinance language. They then prepared a four-page handout on the NFIP requirements, why the minimums do not provide sufficient flood protection in the area, and recommended improved standards. The handout explained the relevant recommended standards. It included section references so council members could modify or even delete the recommended ordinance sections. The handout for Hoquiam is attached.

Status of Adoption of Improved Regulatory Standards – January 31, 2017															
Recommended Standard		Grays Harbor County	Aberdeen	Cosmopolis	Elma	Hoquiam	Montesano	Oakville	Lewis County	Centralia	Chehalis	Napavine	Pe Ell	Thurston County	Bucoda
1	Flood of record		A	A	A	A	A	A			A			A	
2	Best available data		NR	NR	A	NR	A	A		NR	NR	NR	NR		A
3	No available data		A	A	NR	A	NR	NR		NR	NR	NR	NR		NR
4	No adverse impact		A	A	A	A	A	A		NR		NR	NR		NR
5	Filling restrictions		A	A	A	A	A	A		P				A	A
6	Critical facilities		A	A	A	A	A	A	P	P	P	P	P	A	P
7	Hazardous materials		A	A	A	A	A	A							
8	Subdivision set asides		A	A	A	A	A	A	A	P	P			P	
9	Freeboard (3 feet)	P	P*	A		A	A	A	P	P	P	P	P	P	P
10	Non-conversion agreements		A	A	A	A	A	A							
11	Substantial imprv't tracking		A	A	A	A	A	A	A	A				P	
	A = Adopted		9	10	9	10	10	10	3	1	1			3	2
	P = Partial adoption	1	1						1	4	3	2	2	3	2
	NR = Not relevant		1	1	1	1	1	1		3	2	3	3		2
	* Aberdeen adopted 2 feet plus a requirement that all buildings must be 1.5 feet above the street														

The Flood Authority team also met with council members and city attorneys and made presentations to one planning commission and three city councils.

As seen in the table on the previous page, all six communities adopted the new FIRM by the end of January. All six adopted nine of the ten relevant standards. Four of the six adopted all ten standards, including the recommended three feet of freeboard.

On March 29, 2017, the Flood Authority sponsored a workshop on regulation administration and the higher standards. All of the communities in the Basin were invited and all but two attended. The Flood Authority team continues to respond to requests from communities for assistance in interpreting and enforcing the new standards.

These higher standards, coupled with full enforcement of them, will go a long way toward protecting future development from flood damage and protecting existing development from flood problems aggravated by new development. That they were adopted by all participating communities is a testament to the work of the Flood Authority over the years and the trust that local officials have in the Flood Authority's advice and recommendations.

## **Flood Warning**

The Flood Authority authorized the development and implementation of an improved flood warning system. System objectives were two-fold: improve flood forecasts in the basin and improve flood hazard communication in the basin.

Three guiding principles were adopted to plan system improvements:

1. Define cost effective solutions,
2. Leverage existing resources to the maximum extent possible, and
3. Achieve immediate tangible and visible benefits.

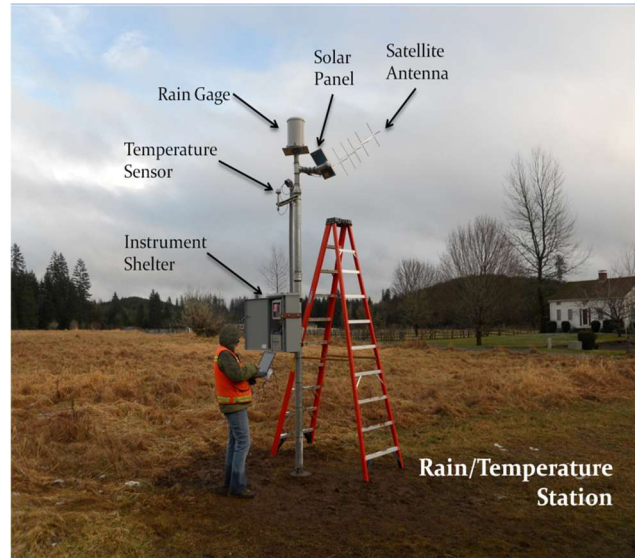
A needs analysis recommended that improved monitoring of precipitation, river levels, and other hydrometeorological parameters would contribute to both improved flood forecasts and improved flood hazard communication. Also, a web-based internet portal would serve to improve flood hazard communication.

During system development, existing hydrometeorological gage networks operated by a variety of federal, state, local, tribal, and private agencies were reviewed. Data from approximately 120 hydrometeorological sensors in and near the Chehalis River Basin that were internet accessible were identified and incorporated into the Chehalis River Basin Flood Warning System. Previously, these data sources were independently operated. Integrating these data into the Chehalis system made the data accessible to the public in one location, providing an immediate benefit.

Based on the location and distribution of the existing network gages, strategic data gaps were identified. The Flood Authority installed eight additional sites measuring rainfall and temperature (illustrated on the next page) plus two sites measuring rainfall, temperature, and river level. The Flood Authority made certain that all new data were transmitted to the National Weather Service.

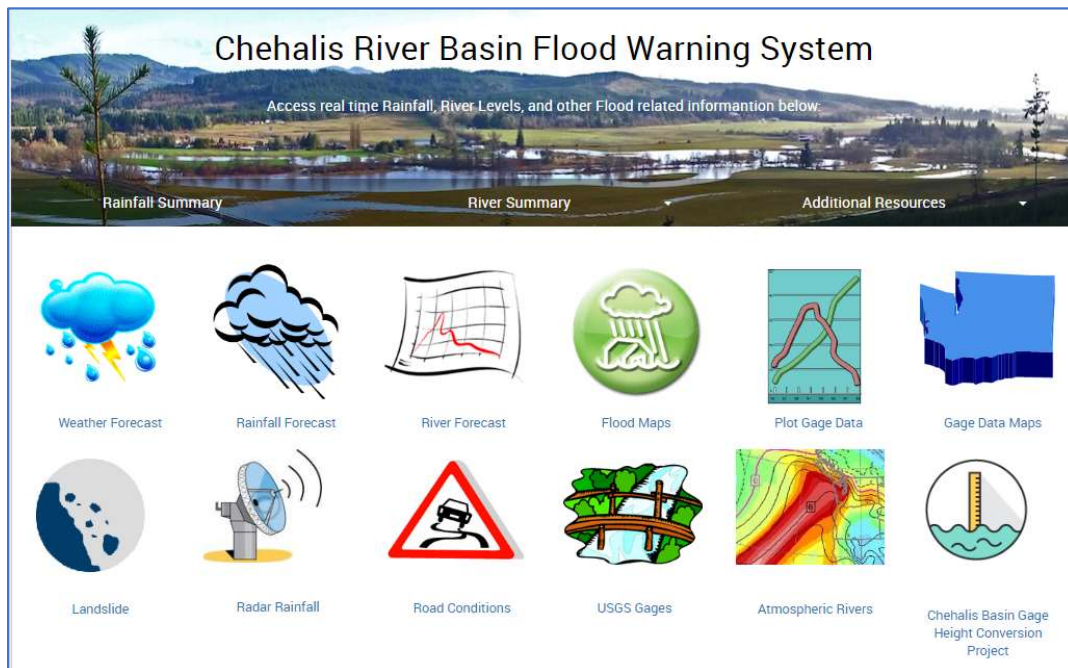
The new data immediately added real-time value to NWS weather and river forecasts in the Chehalis basin. Users can access the Chehalis River Basin Flood Warning System webpage from any internet accessible device, including desktops, laptops, tablets, and smart phones at [www.chehalisriverflood.com](http://www.chehalisriverflood.com).

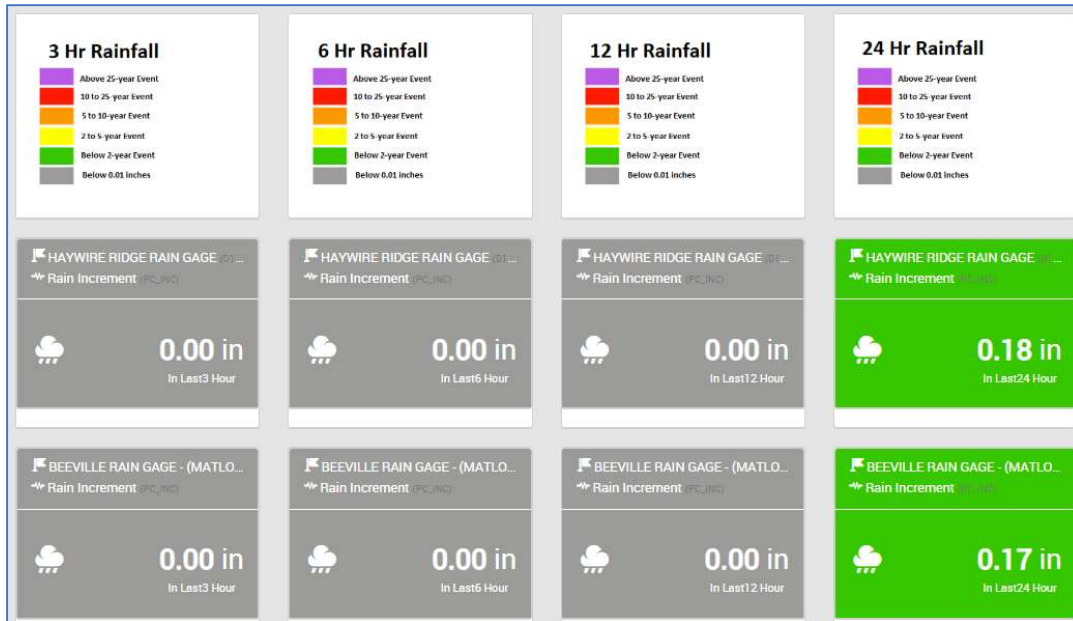
All hydrometeorological data in the system can be displayed in map or chart form by users. The webpage links users to the latest relevant weather and flood forecasts from the NWS, real-time radar-rainfall imagery, USGS gage data, USGS landslide potential guidance, and Washington Department of Transportation road closures.



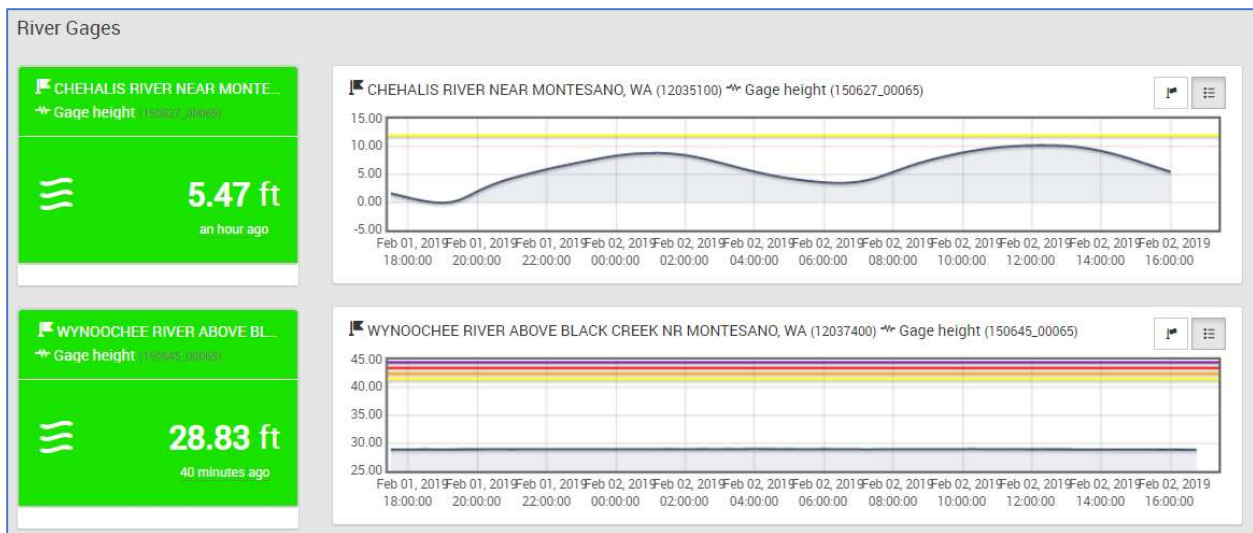
Since over 90% of the major flood events in the Basin are the result of landfalling atmospheric river events, a link to the Center for Western Weather and Water Extremes at the Scripps Institution of Oceanography, the leading institution researching atmospheric rivers, provides access to current atmospheric river forecasts.

The website's dashboards (next page) provide users with a quick visual overview of the current flood situation in the basin. Rainfall totals for the most recent 3-, 6-, 12-, and 24-hour period are noted. The dashboards are color coded by rainfall frequency to indicate event severity.

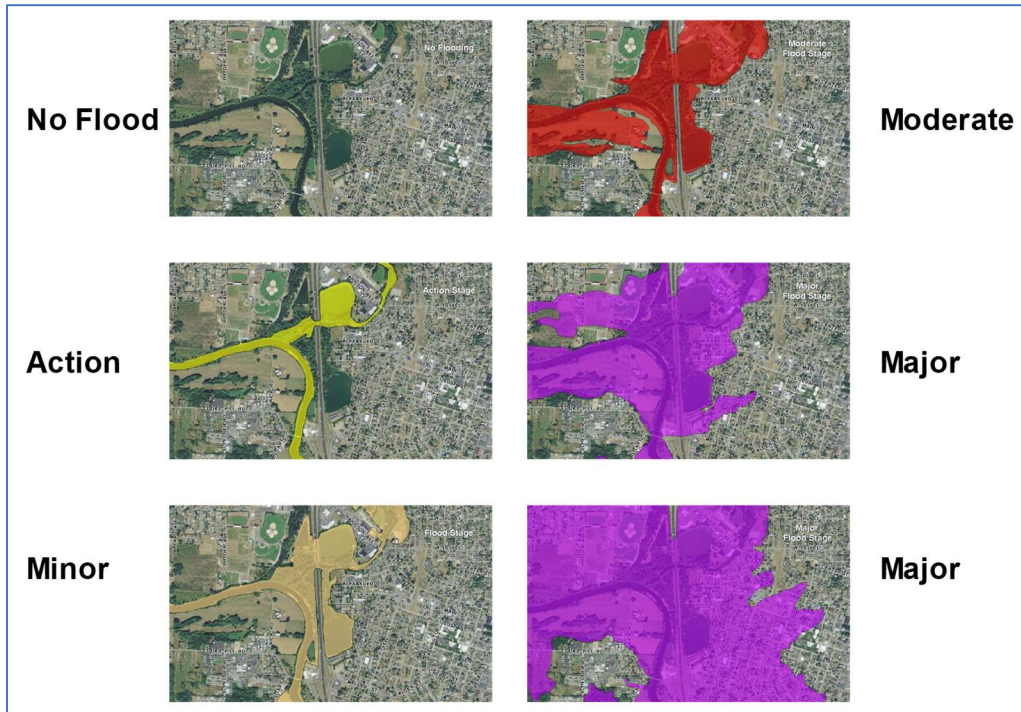




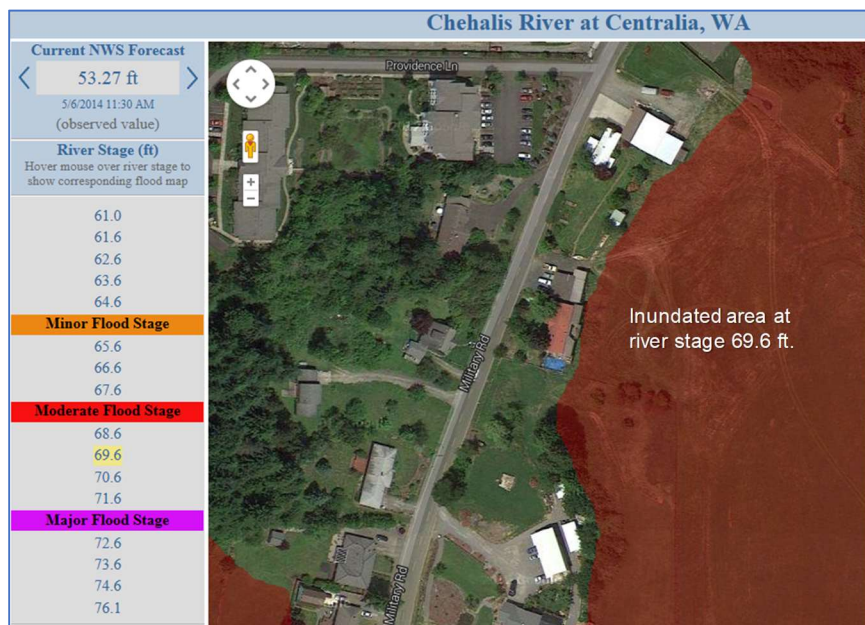
Similar color-coded dashboards are provided for river gages indicating current water elevations relative to high-water alert stage, flood stage, moderate flood stage, and major flood stage as shown below. Stages shown for minor, moderate, and major flood stages as well as color configurations are consistent with NWS usage to avoid message confusion.



One of the most important provisions in the Flood Authority's flood warning system is the inclusion of flood inundation maps at NWS forecast points in the Chehalis basin. On the next page are example maps showing inundation at various levels of flood severity. Users select a location of interest and can zoom in and see inundation detail at the structure level.



In the upper left corner of this example, the elevation, date, and time of the current valid NWS river forecast is shown. Arrow keys on either side of the forecast allow users to scroll through the complete NWS forecast hydrograph and see the growth and recession of the inundated area. Users can also “mouse over” the stages shown to the left of the map to display the flood inundation associated with that stage.



The inundation maps are an excellent tool to visualize the evolving flood hazard. The maps are important to emergency managers in planning flood response by visualizing when and where vital infrastructure is impacted by the developing flood event. The maps promote proactive response to flood threats.

To fully realize the goal of improved flood threat communication in the Chehalis Basin, the Flood Authority adopted a practice of “Relentless Public Outreach.” A wide range of communication channels and methods are employed to encourage active engagement with the flood warning system.

A program of distributing “High Water Alerts” via email has been very effective in maintaining a high-level of flood threat awareness in the basin. Email alerts at ten stream gage locations are sent out to users who subscribe to the service. Stream stages are monitored continuously when the water level at a river gage of interest rises to a predefined high-water threshold, typically 1-2 feet below flood stage. This provides a direct early alert to impending high water. Users have subscribed to more than 1,000 unique alerts. Below is an example high-water alert email, including a link to the NWS forecast flood hydrograph.

In 2015, a survey of high-water alert subscribers was conducted. The survey found that users ranged from their 20s to 80s. All types of devices including desktop, laptop, tablet, smart phone devices are used. News agencies, schools, employers, emergency managers, and local and tribal government offices

The Chehalis River at Porter is nearing flood stage of 21 ft.  
The Alert stage at Chehalis River at Porter is experimentally set at 20 ft.  
Click on link below for NWS River Forecast  
<http://goo.gl/ED2dQa>  
Be aware, be prepared.  
You are receiving this email because you are signed up to receive alerts from the Chehalis River Basin Flood Warning System ([www.chehalisriverflood.com](http://www.chehalisriverflood.com)).

have all signed on. In one case, adult children of elderly parents living in the Chehalis floodplain, receive alerts to keep abreast of developing flood threats that may affect their parents. The reach of the alerts is even larger as organizations that have signed up distribute the notices to their employees or members.

Additional channels employed for flood warning system outreach include, but are not limited to:

- Frequently Asked Questions flyers,
- Website announcements,
- Webinar describing the purpose and use of the system,
- News articles,
- Radio and TV interviews,
- Public briefings and events, and
- Social media.

Three webcams are currently being deployed in the basin as a pilot project. These will provide additional visual context for river stage data at target locations and another channel to encourage active engagement with the community. If successful, additional webcams may be strategically deployed at other basin locations.

Today, communities in the Chehalis River Basin are substantially more aware and better prepared for catastrophic flooding than ever before. Since 2007, the basin has moved from reactive to proactive in 2019 with respect to flood awareness. Citizens, property owners, emergency managers, first responders, and the communities of the basin all gain:

- No surprises,
- Better awareness and preparedness,
- More time to respond to developing flood events, and
- More structured and orderly response.