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PROBABILISTIC HYDROLOGIC OUTLOOK

NATIONAL WEATHER SERVICE EASTERN NORTH DAKOTA/GRAND FORKS ND

957 AM CDT Fri Mar 15 2019

...SPRING FLOOD AND WATER RESOURCES OUTLOOK...

...RED RIVER BASIN OUTLOOK FOR RIVER FLOOD POTENTIAL...

This outlook covers the Red River of the North  
and its Minnesota and North Dakota tributaries.

...HIGH RISK OF MAJOR FLOODING ALONG THE MAINSTEM RED RIVER CONTINUES  
WITH MODERATE TO ISOLATED MAJOR ALONG THE TRIBUTARIES...

.OUTLOOK SUMMARY...

\* Probabilities for exceeding Major, Moderate, Minor Flood Stage...

Major Flooding...

There is a high risk (greater than 65 percent) of major flooding at Wahpeton/Breckenridge, Fargo/Moorhead, Halstad, Grand Forks/East Grand Forks, Oslo, Drayton, and Pembina on the Red River. In North Dakota, there is a high risk of major flooding at Valley City, Lisbon, Kindred, the West Fargo Diversion, and Harwood on the Sheyenne River and at Abercrombie on the Wild Rice River. In Minnesota, there is a high risk of major flooding at Hendrum on the Wild Rice River, Climax on the Sand Hill River, and at High Landing and Crookston on the Red Lake River.

There is a medium risk (35 to 65 percent) of major flooding at Mapleton on the Maple River and at Grafton on the Park River in North Dakota. In Minnesota, there is a medium risk of major flooding at Twin Valley on the Wild Rice River.

There is a low risk (less than 35 percent) of major flooding throughout the remainder of the basin.

Moderate Flooding...

There is a high risk (greater than 65 percent) of moderate flooding at Hickson on the Red River. In North Dakota, there is a high risk of moderate flooding at Enderlin on the Maple River and Minto on the Forest River. In Minnesota, there is a high risk of moderate flooding at Sabin on the South Branch Buffalo River, Hawley and Dilworth on the Buffalo River, Shelly on the Marsh River, and Hallock on the Two Rivers River.

There is a medium risk (35 to 65 percent) of moderate flooding at

Hillsboro on the Goose River. In Minnesota, there is a medium risk of moderate flooding at Alvarado on the Snake River.

Minor Flooding...

In Minnesota, there is a high risk (greater than 65 percent) of minor flooding at Roseau on the Roseau River and a medium risk (35 to 65 percent) of minor flooding near Warren on the Snake River. In North Dakota, there is a low risk (less than 35 percent) of minor flooding at Walhalla and Neche on the Pembina River.

\* This 90-day outlook covers the period from March 18, 2019 to June 16, 2019.

.OUTLOOK DISCUSSION...

Hydrologic and climate conditions which affect each of the several factors that significantly determine the timing and magnitude of spring snowmelt flooding within the Red River of the North are discussed below:

\* SNOWPACK CONDITIONS...

The current snowpack remains above to much above normal. The deepest snowpack remains across the central and southern Red River Valley and into northwestern Minnesota. Due to the recent rain and snow event, the water content of the snowpack across these locations now ranges from roughly 1.5 to 3.5 inches above normal.

\* SOIL MOISTURE...

At the time of freeze-up, soil moisture was above normal across southern portions of the basin, decreasing northward up the valley to below normal near the International border. Note that soil moisture is much below that which preceded the record flood years of 1997, 2009, 2010, and 2011.

\* FROST DEPTHS...

Frost depths continue to be much deeper than normal across the basin. These deeper frost depths are likely to lead to greater potential for significant runoff if the spring warmup/snowmelt occurs quickly and/or is accompanied by rainfall and/or additional snowfall.

\* RIVER FLOWS...

Base streamflows range from near normal across the north to above normal in southern portions of the basin. Note that base streamflows remain much below that which preceded the record flood years of 1997, 2009, 2010, and 2011.

\* RIVER ICE...

River ice and lake ice thicknesses are now above seasonal normals. Note that since most ice is in the lower channels, ice jams are likely to be more of a risk on the tributaries than on the mainstem Red (although not out of the question).

\* FACTORS YET TO BE DETERMINED...

- Further snowpack growth
- Rate of snowmelt/thaw
- Heavy rain on snow or frozen ground during thaw or peak flood

- Heavy rain on ice-covered rivers causing short-term ice jams

\* SHORT TERM FORECAST...

The next two weeks will see a slight warm up with temperatures trending towards more normal values (highs above freezing and lows below freezing). These temperatures coupled with a quieter precipitation pattern will lead to a favorable melt cycle in the short term.

\* LONG TERM OUTLOOK...

Climate outlooks indicate the potential for another cold period to start April with a more uncertain weather pattern.

.NEXT SPRING FLOOD OUTLOOK...

This will be the last probabilistic outlook for the season as we transition into the spring melt and deterministic river forecasts will become available.

.FLOOD OUTLOOK PROBABILITIES TABLES...

The following message has two sections: the first gives the current and normal/historical chances of river locations reaching their minor, moderate, and major flood categories; the second gives the current chances of river locations rising above the river stages listed.

...Red River Long-Range Probabilistic Outlook...

In Table 1 below, the current (CS) and historical (HS), or normal, probabilities of exceeding minor, moderate, and major flood stages are listed for the valid time period.

- CS values indicate the probability of reaching a flood category based on current conditions.
- HS values indicate the probability of reaching a flood category based on historical, or normal, conditions.
- When the value of CS is greater than HS, the probability of exceeding that level is higher than normal. When the value of CS is less than HS, the probability of exceeding that level is lower than normal.

...Table 1--Probabilities for Minor, Moderate, and Major Flooding  
Valid Period: 03/18/2019 - 06/16/2019

Location	Categorical Flood Stages (ft)			: Current and Historical Chances of Exceeding Flood Categories as a Percentage (%)					
	Minor	Mod	Major	: Minor		: Moderate		: Major	
				CS	HS	CS	HS	CS	HS
Red River of the North.....									
WAHPETON	11.0	13.0	15.0	>95	63	>95	32	70	15

HICKSON	30.0	34.0	38.0	:	>95	28	72	14	6	<5
FARGO	18.0	25.0	30.0	:	>95	82	>95	42	>95	27
HALSTAD	26.0	32.0	37.5	:	>95	35	>95	20	>95	11
GRAND FORKS	28.0	40.0	46.0	:	>95	62	>95	32	94	11
OSLO	26.0	30.0	36.0	:	>95	66	>95	59	>95	28
DRAYTON	32.0	38.0	42.0	:	>95	51	>95	37	94	14
PEMBINA	39.0	44.0	49.0	:	>95	56	>95	43	>95	23

: Current and Historical  
: Chances of Exceeding  
: Flood Categories  
: as a Percentage (%)

	Categorical			:						
	Flood Stages (ft)			:	Minor	Moderate	Major			
Location	Minor	Mod	Major	:	CS HS	CS HS	CS HS			
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Minnesota Tributaries.....

SABIN	13.0	15.0	19.0	:	>95	53	91	17	23	<5
HAWLEY	8.0	9.0	11.0	:	>95	36	>95	23	28	<5
DILWORTH	13.0	20.0	26.0	:	>95	67	>95	20	15	<5
TWIN VALLEY	10.0	12.0	14.0	:	>95	17	90	6	49	<5
HENDRUM	20.0	28.0	32.0	:	>95	56	>95	23	91	6
SHELLY	14.0	20.0	23.0	:	>95	30	76	11	33	<5
CLIMAX	20.0	25.0	30.0	:	>95	26	>95	12	65	7
HIGH LANDING	12.0	12.5	13.0	:	>95	21	93	18	84	16
CROOKSTON	15.0	23.0	25.0	:	>95	53	88	13	65	8
ABOVE WARREN	67.0	71.0	75.0	:	41	13	11	<5	<5	<5
ALVARADO	106.0	108.0	110.0	:	77	21	49	15	11	<5
HALLOCK	802.0	806.0	810.0	:	>95	61	>95	45	23	11
ROSEAU	16.0	18.0	19.0	:	68	20	17	8	6	<5

Note: The Roseau numbers consider the flow thru its diversion

: Current and Historical  
: Chances of Exceeding  
: Flood Categories  
: as a Percentage (%)

	Categorical			:						
	Flood Stages (ft)			:	Minor	Moderate	Major			
Location	Minor	Mod	Major	:	CS HS	CS HS	CS HS			
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Note: The Roseau numbers consider the flow thru its diversion

North Dakota Tributaries.....

ABERCROMBIE	10.0	12.0	18.0	:	>95	39	>95	36	>95	20
VALLEY CITY	15.0	16.0	17.0	:	93	10	78	9	71	<5
LISBON	15.0	17.0	19.0	:	>95	10	84	8	68	6
KINDRED	16.0	19.0	20.5	:	>95	19	>95	10	90	9
WEST FARGO DVRSN	18.0	20.0	21.0	:	>95	11	>95	10	>95	9
HARWOOD	84.0	86.0	91.0	:	>95	24	>95	22	>95	10
ENDERLIN	9.5	12.0	14.0	:	>95	21	93	10	19	<5
MAPLETON	18.0	21.0	23.0	:	>95	37	>95	16	38	<5
HILLSBORO	10.0	13.0	16.0	:	89	15	54	9	19	<5
MINTO	6.0	8.0	11.0	:	>95	32	77	11	<5	<5
GRAFTON	12.0	13.5	14.5	:	78	22	57	8	49	6
WALHALLA	11.0	16.0	18.0	:	17	19	<5	<5	<5	<5
NECHE	18.0	19.0	20.5	:	21	30	20	28	11	19

LEGEND:

CS = Conditional Simulation (Outlook for current conditions)  
 HS = Historical Simulation ( " " normal conditions)  
 ft = Feet (above gage zero datum)

...Table 2--Long-Range Probabilistic Outlook by River Stage...  
 Valid from March 18, 2019 to June 16, 2019

LOCATION	95%	90%	75%	50%	25%	10%	05%
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Red River of the North.....							
WAHPETON	13.9	14.1	14.8	15.7	17.0	18.2	19.0
HICKSON	32.1	32.8	33.9	35.1	36.1	37.6	38.6
FARGO	33.8	34.9	36.5	37.9	38.9	40.3	41.4
HALSTAD	38.0	38.5	39.0	39.5	40.0	40.6	41.2
GRAND FORKS	45.8	47.5	49.0	50.6	52.7	54.6	56.7
OSLO	37.2	37.5	37.8	37.9	38.0	38.1	38.1
DRAYTON	41.8	42.4	43.0	43.7	44.6	45.3	46.0
PEMBINA	51.0	51.7	52.2	53.0	53.7	54.5	54.7
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Minnesota Tribs:	95%	90%	75%	50%	25%	10%	05%
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South Fork Buffalo River.....							
SABIN	14.6	15.0	15.8	17.2	18.6	20.3	21.7
Buffalo River.....							
HAWLEY	9.5	9.8	10.0	10.4	11.2	11.9	13.0
DILWORTH	21.2	21.8	22.7	23.9	25.1	26.7	28.1
Wild Rice River.....							
TWIN VALLEY	10.9	12.0	12.8	13.9	15.6	17.1	18.0
HENDRUM	31.6	32.0	32.6	33.3	34.0	35.0	35.6
Marsh River.....							
SHELLY	17.0	18.0	20.3	22.0	23.9	24.7	25.7
Sand Hill River.....							
CLIMAX	26.6	27.9	29.4	31.2	34.4	37.0	39.1
Red Lake river.....							
HIGH LANDING	12.4	12.7	13.1	13.3	13.5	13.6	13.7
CROOKSTON	21.6	22.5	24.3	26.9	28.5	30.4	32.9
Snake River.....							
ABOVE WARREN	65.0	65.2	65.7	66.8	68.3	72.0	73.1
ALVARADO	104.5	105.0	106.1	108.0	109.1	110.3	110.7
Two Rivers River.....							
HALLOCK	807.4	807.7	808.4	809.5	809.9	811.5	812.0
Roseau River..... considering the flow thru the Roseau diversion.							
ROSEAU	14.1	14.8	15.6	16.4	17.7	18.8	19.4
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North Dakota Tribs:	95%	90%	75%	50%	25%	10%	05%
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Wild Rice River.....							
ABERCROMBIE	21.0	21.9	23.4	24.5	25.6	26.9	27.5
Sheyenne River.....							
VALLEY CITY	13.1	15.2	16.6	18.0	19.8	21.7	22.7

LISBON	15.6	16.4	18.3	20.5	22.4	25.0	28.2
KINDRED	20.2	20.5	21.1	21.2	21.2	21.2	21.2
WEST FARGO DVRSN	21.2	21.2	21.3	21.3	21.3	21.3	21.3
HARWOOD	91.8	91.9	92.1	92.1	92.2	92.3	92.4
Maple River.....							
ENDERLIN	11.8	12.1	12.8	13.3	13.6	14.4	15.0
MAPLETON	22.0	22.2	22.5	22.8	23.2	24.0	24.1
Goose River.....							
HILLSBORO	9.3	9.8	12.1	13.3	14.6	16.5	17.9
Forest River.....							
MINTO	7.3	7.5	8.0	8.5	9.6	9.9	10.2
Park River.....							
GRAFTON	10.5	11.0	12.1	14.1	16.1	17.9	19.4
Pembina River.....							
WALHALLA	5.9	6.1	6.8	7.5	8.7	11.8	12.9
NECHE	10.3	10.6	11.7	13.6	16.6	20.5	21.2

#### .THE OUTLOOK PRODUCTION PROCESS...

This long-range probabilistic outlook is based on a series of peak river levels or crests taken from the forecast hydrograph results of the NWS Community Hydrologic Prediction System (CHPS). The model is run for multiple scenarios starting at current river, snow, and soil conditions using over 60 years of past precipitation and temperature conditions that were experienced for those past years during the timeframe of the outlook period. These crests can then be ranked from lowest to highest and assigned an exceedance probability. For example, for a series of 50 years, the lowest ranked crest has 49 crests above it. Since 95 percent of the crests are above it, it is assigned a 95 percent probability of exceedance (POE).

A YouTube video on "How to Interpret River Outlook Products" is at:

[www.youtube.com/watch?v=pSoEgvsnpv4](http://www.youtube.com/watch?v=pSoEgvsnpv4)

The probabilities can be used for risk management by using them as an indication of the range of crests that may be expected during the valid period of the outlook.

By providing a range of peak river level probabilities, the NWS is contributing to the area's Impact-Based Decision Support Services that help with long-range flood planning and response readiness. This outlook is a part of NOAA'S National Weather Service's Advanced Hydrologic Prediction Services (AHPS).

This outlook was produced using precipitation and temperatures for the years 1949 through 2012.

#### .ADDITIONAL INFORMATION SOURCES...

This outlook is also presented as graphs of the probability of stage exceedance for the full period and for weekly intervals during the period. These graphs, together with explanations that help in interpreting them, are available from the NWS Grand Forks AHPS web page at:

[www.weather.gov/grandforks](http://www.weather.gov/grandforks) or [weather.gov/fgf](http://weather.gov/fgf)

then click on "Rivers and Lakes" above the map.

Current river conditions for all river forecast points in the Red River of the North and Devils/Stump Lake basins are available on our web site. Also, 7-day deterministic forecasts will be issued at least once a day when river forecast locations will be at or above flood during that period.

If you have any questions, contact the NWS at 701-772-0720.

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