DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
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17 JUL 2015

CENWP-EC

20150712 Approved as requested

MEMORANDUM FOR Jose L. Aguilar, Colonel, EN, Commanding (CENWP-DE)

SUBJECT: Implementation of Environmental Flows in the Willamette Valley

1. Attached herein is a Memorandum for Record (MFR) that provides detailed guidance for implementation of environmental flows in the Willamette Valley. This document demonstrates our compliance with Corps guidance to implement environmental flows where feasible at Corps projects and meets Corps commitments in agreements signed with The Nature Conservancy (NWP, NWD, National agreements). Environmental flows are part of the Sustainable Rivers Project (SRP) that these agreements created.

2. The MFR discusses the analyses, evaluations, and determination of low risk associated with implementation of environmental flows and identifies the conditions and constraints reservoir regulators should follow during implementation of SRP environmental flows in the Willamette Valley.

3. With your concurrence, this guidance will be added to several Willamette Valley water control manuals for future implementation. For additional information regarding the MFR, please contact Chris Budai, project manager, at extension 4725 or Keith Duffy, technical lead, at extension 4969.

Signature redacted

Signed

Lance A. Helwig, P.E.
Chief, Engineering & Construction Division
Portland District

2 Encls
1. E-Flow Implementation Guidance
2. REC

CENWP-EC-HY 7 July 2015

MEMORANDUM FOR RECORD

SUBJECT: Implementation of Environmental Flows in the Willamette Valley

1. Purpose. This memorandum summarizes guidance for implementing environmental flows (e-flows) in the Willamette River Basin reaches; specifically the Middle Fork, McKenzie and the North and South Fork Santiam Rivers.

The U.S. Army Corps of Engineers Portland District (Corps) with the Nature Conservancy (TNC) developed an implementation plan for environmental flows at multiple projects within the basin. The SRP's goal is to 'operationalize' the environmental flow recommendations into acceptable guidance and recommendations for Willamette reservoir regulators and project operators for implementation. In order to achieve the project goal, this project's objectives were twofold:

1) Identify biological criteria and priorities (e.g., e-flow targets and benefits).
2) Given biological understanding and priority of different biological goals, outline the relevant items important to regulators tasked with implementing e flows.

The proposed environmental flow implementation described in this MFR has been found to conform to operational constraints as outlined in the Water Control Manuals. This has been verified through previous studies and analyses described in greater detail below.

Environmental flow implementation falls under the range of flood reduction operations outlined in the Water Control Manuals. Flood reduction operations occur primarily in the wintertime period (December through February). E-flow releases are not to be performed if they contradict NWP flood operation constraints. Flood operation considerations applicable to the e-flow implementation are summarized in Tables 1 through 4 below.

Upon acceptance of this Memorandum for the Record (MFR), the Water Control Manuals will be updated to incorporate operations for environmental flows.

2. Background. The Sustainable Rivers Program (SRP) began in 2002 as a partnership between TNC and the Corps with the objective of developing, implementing and refining a framework for beneficial flows downstream of dams. TNC and the Corps have signed memorandums of agreements (MOAs) at the national level as well as the district level to study current hydro regulation operations. SRP efforts in the Willamette River Basin focus on identifying opportunities to improve overall downstream ecosystem health and resiliency by modifying dam releases within the existing operational constraints. The releases that benefit downstream ecosystem health are termed environmental flows (e-flows). The e-flows targets were developed through a process of collecting and synthesizing relevant hydrologic and ecological information and expert knowledge into a set of e-flow recommendations.

a. Purpose of E-flows. Flow recommendations focused on fall flows (October-November), winter high flows (November-February) and smaller spring bankfull flows (flows at Action Stage, as identified by the National Weather Service) (March-June). Each seasonal flow is important to some aspect of ecosystem health. Fall flows enhance channel habitat and provide flows for outmigration. Winter high flows provide benefits to habitat by modifying channel features and recruiting large woody debris. Spring time flows are important for providing out-migration flows as well as scouring and flushing during bank full events.

b. Environmental Flow Recommendations. Environmental flow recommendations have been developed for the Middle Fork Willamette River, McKenzie River and the North, South and mainstem Santiam Rivers. The flow recommendations were defined by 1) event duration; 2) number of events per year; 3) range of flow magnitude; and 4) frequency. Summary reports were completed for each river system (also see References):

- Santiam Basin: *Summary Report: Environmental Flows Workshop for the Santiam River Basin, 2013.*
- Middle Fork and Coast Fork: *Summary Report Environmental Flows Workshop for the Middle Fork and Coast Fork of the Willamette River, 2007.*
- McKenzie River: *Environmental Flow Recommendations Workshop for the McKenzie River, Oregon, 2010.*

c. Constraints. The e-flow operations are constrained by Water Control Manual operational requirements for each project and the system as well as the Willamette Biological Opinions (BiOp) (National Marine Fisheries Service and U.S. Fish and Wildlife Service) implementation.

d. Forecast Uncertainty Analysis. The forecast uncertainty analysis performed by the Corps in 2011suggests that maximizing the number of e-flow discharges is feasible; however, evaluations of forecast error indicate that the release of e-flows should not be taken lightly. If anything, the modeling exercise emphasized the intricacy of the hydrologic and operational complexities of the Willamette system.

e. HEC-ResSim Analysis. HEC-ResSim was used to model potential operational changes to provide e-flows. The resulting report prepared in 2013, *Evaluation of E-Flow Implementation and Effects in the Willamette Basin using ResSim Modeling,* addressed concerns about potential increased flood risk and other adverse impacts from e-flow operations and provided recommendations on potential operational approaches. Two approaches were evaluated to determine how Willamette Valley Project operations could be modified to realize e-flow benefits within the constraints of the WCM: 1) Release More and 2) Store More. Both approaches modified the maximum evacuation release rule, as a function of elevation, from the baseline condition at the three projects, Lookout Point/Dexter on the Middle Fork Willamette, Cougar on the South Fork McKenzie River, and Detroit/Big Cliff on the North Santiam River.

The Release More scenario was recommended as a starting point for a strategy to implement e-flow releases in the Willamette River basin. The Release More scenario provided an overall increase in e-flow events (benefits) while affecting minimal change to flood risk reduction, water quality, hydropower and meeting BiOp targets. An unforeseen benefit from implementing the

Release More option was that flood storage availability increased under this alternative. The Store More option did not produce significant changes to total e-flows compared to the baseline. Further, the Store More option potentially increases flood risk by holding water longer and reducing the flood storage space during the wetter times of the year.

3. Implementation. The general intent is to maximize opportunities for achieving e-flows at the Willamette Valley projects considering operational constraints and forecast uncertainty. The following discussion of implementation provides guidance for reservoir regulators and project operators; however, implementation of e-flows is based on regulator/operator judgment and is not a highly prescriptive process.

E-flow operations require use of stored water to achieve environmental goals. The e-flow operation absorbs the incoming event then releases post event to minimize downstream flood risk. Once downstream gages have peaked and are receding below action stage (bankfull) levels, e-flow operations can commence. All intentional e-flow operations must operate below flood stage and within action stage (bankfull) constraints. That is, it is ok to release to bankfull, with some allowance for exceedance, but not to release to flood stage for e-flow purposes.

Just as for any high flow release scenario, error in forecasts should be considered when implementing e-flow operations. Release of large volumes of water combined with an error in the forecast can unintentionally result in reaching flood stage downstream. Previous SRP work has more fully quantified forecast uncertainty in the Middle Fork/Coast Fork Willamette and ReSim modeling has shown that e-flow releases are feasible within the uncertainty of forecasts without exceeding project water management constraints.

There may be high flow events where a sufficiently high volume will have to be passed with the result that the project release 'naturally' exceeds action stage (bank full)/flood stage. Although this could result in e-flows benefits, it is not the intent of e-flow operations to realize benefits in this manner (i.e., to purposely exceed action or flood stages). Rather e-flow operation seeks to obtain benefits while operating under the WCM and other operational constraints.

Flow recommendations focus on winter high flows (15-November through 15-February) and spring bankfull flows (15-March though 30 June). It is cautioned that e-flows cannot be guaranteed every year. The e-flow operations are 'opportunity driven' and would first be indicated by a forecast of a substantial weather system headed for the Willamette Valley and the three sub-basins of interest.

Overall, the e-flow benefit expected from the preferred e-flow operation is an increased number of wintertime events. Spring time e-flow events are expected to be minimally increased. Table 1 lists the range of e-flow operation goals downstream.

Maximizing e-flows is important to effectively manage aquatic habitat. The higher flows provide the mechanism for creating and managing fish spawning/incubation and other aquatic habitat needs over time. Salmon populations and other aquatic organisms are adapted to these variable flow conditions. Active management by fisheries and other technical experts should be part of the protocol.

Table 1. MF WILLAMETTE AT JASPER Maximum Flow and Duration E-Flow Objectives below Projects

Middle Fork Willamette River at Jasper USGS 14152000		
Winter E-Flow Target 1		
(15-Nov through 15-Feb)		**Operational Considerations**
Flow Above (cfs)	17,000	Releases from Fall Creek and Dexter may be combined to achieve these flows at Jasper.
Duration (days)	1	
Winter E-Flow Target 2:		
Min Flow (cfs)	15,000	
Max Flow (cfs)	17,000	
Duration (days)	3	
Winter E-Flow Target 3:		
Min Flow (cfs)	12,000	
Max Flow (cfs)	15,000	
Duration (days)	4	
Spring E-Flow Target A		
(15-Mar through 30 June)		**Operational Considerations**
Flow Above (cfs)	15,000	Releases from Fall Creek and Dexter may be combined to achieve these flows at Jasper.
Duration (days)	1	
Spring E-Flow Target B		
Min Flow (cfs)	12,000	
Max Flow (cfs)	15,000	
Duration (days)	3	
Spring E-Flow Target C		
Min Flow (cfs)	10,000	
Max Flow (cfs)	12,000	
Duration (days)	4	

Table 2. SF MCKENZIE AT COUGAR DAM Maximum Flow and Duration E-Flow Objectives below Projects

South Fork McKenzie River below Cougar Dam USGS 14159500		
Winter E-Flow Target 1		
(15-Nov through 15-Feb)		**Operational Considerations**
Flow Above (cfs)	6,000	Outflow above 5,000 cfs will inundate the adult fish collection facility's facility water system (FWS) intake structure which includes electrical gear and air burst system equipment. Outflow above 5,000 cfs may scour redds (October – January).
Duration (days)	1	
Winter E-Flow Target 2:		
Min Flow (cfs)	4,000	
Max Flow (cfs)	6,000	
Duration (days)	3	
Winter E-Flow Target 3:		
Min Flow (cfs)	3,000	
Max Flow (cfs)	4,000	
Duration (days)	4	
Spring E-Flow Target A		
(15-Mar through 30 June)		**Operational Considerations**
Flow Above (cfs)	4,000	
Duration (days)	1	
Spring E-Flow Target B		
Min Flow (cfs)	2,500	
Max Flow (cfs)	4,000	
Duration (days)	3	
Spring E-Flow Target C		
Min Flow (cfs)	1,500	
Max Flow (cfs)	2,500	
Duration (days)	4	

Table 3. NO SANTIAM AT MEHAMA Maximum Flow and Duration E-Flow Objectives below Projects

North Santiam River at Mehama USGS 14183000		
Winter E-Flow Target 1		
(15-Nov through 15-Feb)		**Operational Considerations**
Flow Above (cfs)	15,000	Fishermen's Bend resident owners should be notified by the shift operator via phone when Big Cliff (BCL) outflow will exceed 10,000 cfs. E-flow operations necessitating releases at BCL greater than 10,000 cfs should not be undertaken because this MAY cause adverse flooding downstream at Fishermen's Bend. It should be noted that BCL outflow may exceed 10,000 cfs as part of normal flood operations. Operational Considerations for Fishermen's Bend may be amended pending future analyses to quantify potential impacts. High flows may impact the Minto Facility. Notify ODFW prior to increasing outflow.
Duration (days)	1	
Winter E-Flow Target 2:		
Min Flow (cfs)	12,000	
Max Flow (cfs)	15,000	
Duration (days)	3	
Winter E-Flow Target 3:		
Min Flow (cfs)	10,000	
Max Flow (cfs)	12,000	
Duration (days)	4	
Spring E-Flow Target A		
(15-Mar through 30 June)		**Operational Considerations**
Flow Above (cfs)	12,000	From March 15 – May 15 flows above 3,000 cfs will require a higher incubation release during the summer which would impact keeping the lake full for recreation and operational temperature control. E-flow operations necessitating releases at BCL greater than 10,000 cfs should not be undertaken because this MAY cause adverse flooding downstream at Fishermen's Bend. It should be noted that BCL outflow may exceed 10,000 cfs as part of normal flood operations. Releases higher than 3,000 cfs are allowed in the BiOp only if the lake elevation is above rule curve
Duration (days)	1	
Spring E-Flow Target B		
Min Flow (cfs)	10,000	
Max Flow (cfs)	12,000	
Duration (days)	3	
Spring E-Flow Target C		
Min Flow (cfs)	8,000	
Max Flow (cfs)	10,000	
Duration (days)	4	

a. Operational Details. Implementation of e-flows is event driven, based on regulator/operator judgment and is not a highly prescriptive process. The preferred e-flow operation is to release stored flood water during the high water months (usually the winter and early spring). Under this operation, stored flood waters are released earlier by allowing the maximum outflows to go higher when the lake elevation is lower than current practice. This e-

flow operation does not change project operating rules, in terms of release rate and normal operations during flood control season as identified in the Water Control Manuals.

Ramp rates must also be monitored to not exceed those identified in the Water Control Manuals and the Biological Opinions. If ramp rates are excessive, there may are adverse biological impacts.

The regulator should always exercise discretion. For example, it may be that the start of release be at an elevation above the secondary flood control pool. For example, Lookout Point elevation would be 856 feet and at Detroit reservoir, 1484.5 feet. Releases below these elevations should be capped at powerhouse capacity. Also, when scheduling releases one has to assure that there is enough stored water to ramp flows back down to inflow without drafting into the power pool and without violating ramp rates.

4. Communication. Normal coordination and communication procedures shall be followed as outlined in the *Standard Procedures for Regulation of the Willamette Basin Projects.*

a. Internal Communication. EC-H will pre-coordinate e-flow operations similar to how it coordinates operations related to BiOp implementation. Notification of pending opportunities for e-flow releases will be included in the normal Corps communication channels such as the Corps Weather and River Updates which indicate expected increases in river flows, such as bankfull or flood levels.

Each year, hydrologic conditions and information on fish spawning activity should be reviewed prior to initiating a high e-flow by consulting technical experts (hydrologists, biologists and operating engineers) in order to balance mission needs within and across years. This could be accomplished in a meeting at the start of each hydrologic year.

During e-flow releases, Corps staff may be directed to monitor downstream conditions to minimize any potential adverse impacts such as bank erosion. It is assumed that notifications may be updated frequently due to changing weather and river conditions.

b. External Communication. Additional external parties may desire to be notified of pending e-flow releases. For example the environmental flow representative at the TNC should be contacted when e-flow releases are likely, in order to monitor potentially beneficial downstream impacts. Other interested parties may be added upon request.

5. Monitoring. Monitoring of ecological benefits is part of the adaptive management process to help inform and refine e-flow targets over time. The SRP team is in the process of developing a monitoring plan for the Middle Fork, McKenzie and Santiam Rivers that focuses on geomorphic and vegetative responses to e-flow implementation. This includes development of a geodatabase and evaluation of indicators (e.g., channel bar formation, side channel inundation, vegetation changes, etc.) using aerial photos, ground survey and LiDAR. In order to maximize the monitoring process, it is foreseen that the Corps/stakeholder interaction should be more collaborative and informative. To this end, Corps reservoir regulators will provide early

indication when e-flow operations are pending in sufficient time for others to set up monitoring of specific indicators of interest.

6. Environmental Considerations. In a memorandum dated 2 June 2015, the implementation of the Sustainable Rivers Project Environmental Flows in the Willamette River was reviewed by PM-E.

7. References.

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b. Gregory, Stan, Ashkenas, Linda and Nygaard, Chris, 2007a. Summary Report to Assist Development of Ecosystem Flow Recommendations for the Coast Fork and Middle Fork of the Willamette River, Oregon. Oregon State University, Corvallis, OR.

c. Gregory, Stan, Ashkenas, Linda and Nygaard, Chris 2007b. Summary Report Environmental Flows Workshop for the Middle Fork and Coast Fork of the Willamette River, Oregon. Oregon State University

d. Risley, John, Wallick, J.R., Waite, Ian and Stonewall, Adam. 2010a. Development of an environmental flow framework for the McKenzie River basin, Oregon. U.S. Geological Survey Scientific Investigations Report 2010-5016, 94 p.

e. Risley, John C., Bach, Leslie and Wallick, J. Rose 2010b. Environmental Flow Recommendations Workshop for the McKenzie River, Oregon. The Nature Conservancy, Portland, OR.

f. Risley, J.C., Wallick, J.R., Mangano, J. F.,and Jones, K. L. An Environmental Streamflow Assessment for the Santiam River Basin, Oregon. U.S. Geological Survey Open File Report 2012-1133, 60 p. plus appendixes.

g. Risley, John., Wallick, Rose, Waite, Ian and Stonewall, Adam, 2010. Development of an environmental flow framework for the McKenzie River basin, Oregon. U.S. Geological Survey Open File Report 2010-5016, 94 p.

h. U.S. Army Corps of Engineers. 2013. Final Report Sustainable River Project Evaluation of E-Flow Implementation and Effects in the Willamette Basin using ResSim Modeling. Portland District, Portland, OR

i. U.S. Army Corps of Engineers. 2012. Standard Procedures for Regulation of the Willamette Basin Projects. Portland District, Portland, OR

j. U.S. Army Corps of Engineers. 2013. SRP Meeting Minutes 12-05-2013, Portland District, Portland, OR.

k. U.S. Army Corps of Engineers. 2011. Technical Memorandum. Middle Fork/Coast Fork Willamette Uncertainty Forecast Analysis Portland District, Portland, OR.

l. U.S. Army Corps of Engineers. 2012. Willamette River Basin Operational Measures Evaluation Report. Portland District, Portland, OR.

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Signed

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