In the United States Court of Federal Claims

No. 14-183L
(Filed: March 13, 2018)*
***Opinion originally filed under seal on February 23, 2018**

IDEKER FARMS, INC., et al., Plaintiffs, v. THE UNITED STATES, Defendant.	)	Fifth Amendment Taking; Missouri River; Flooding; Liability; Causation; Foreseeability; and Severity.

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Terry M. Petrie, Environment and Natural Resources Division, U.S. Department of Justice, Washington, D.C., with whom was *Jeffrey H. Wood*, Acting Assistant Attorney General, for defendant. *Jacqueline C. Brown*, *Laura W. Duncan*, *Carter F. Thurman*, and *Daniela A.* Arregui, Washington, D.C., of counsel.

TRIAL OPINION

FIRESTONE, *Senior Judge*

The pending action was brought by farmers, landowners, and business owners from six states who claim a taking without just compensation in contravention of the Fifth Amendment based on actions by the United States Army Corps of Engineers ("Corps") on the Missouri River. U.S. Const. amend. V. The plaintiffs claim that the

Corps has changed its management of the Missouri River and that these changes have caused more flooding of their properties.

In order to manage the litigation, 44 plaintiffs were selected as representative or "Bellwether" plaintiffs ("plaintiffs"). These plaintiffs own or farm properties that extend from Bismarck, North Dakota to Leavenworth, Kansas. Various plaintiffs claim a taking for flooding in 2007, 2008, 2010, 2011, 2013, and 2014. Together, these plaintiffs assert takings claims based on over 100 flood events.

The litigation was also divided into two phases. Phase I was focused on the issue of the United States' liability. Each of the individual plaintiffs was called to testify or present evidence to establish their property interest and the timing and approximate duration of flooding on the relevant parcel of land. The court also heard testimony from numerous expert witnesses and many federal government employees. These individuals testified as to the changes the Corps has made to its management of the Missouri River, whether the Corps' changes have caused flooding or made flooding more severe for each of the years at issue, and whether the flooding for the years at issue was a foreseeable result of the Corps' changes.

In Phase II of the litigation, the court will decide whether the United States has any defenses to these plaintiffs' claims and other legal and factual issues associated with proving entitlement to just compensation. For those entitled to just compensation, the court will also decide the appropriate amount of compensation.

Phase I of the trial began in Kansas City, Missouri on March 6, 2017 and was moved to Washington, D.C. on April 24, 2017. The trial concluded on June 23, 2017 and

was resumed after post-trial briefing[1] on November 13, 2017 for eight days of closing arguments. During the 55 days of witness presentations, the court heard testimony from over 95 witnesses and received over 3,250 exhibits into evidence.

Set forth below are the court's findings of fact and conclusions of law for Phase I of the trial. The opinion is organized into the following sections: I. Background Facts; II. Legal Standards; III. Liability Findings (Expert Testimony); IV. Individual Plaintiffs; and V. Conclusions.

I. Background Facts

1. The Missouri River Prior to Regulation

The Missouri River ("River") travels 2,341 miles from its source in Three Forks, Montana to its mouth near St. Louis, Missouri.[2] PX16 at PLTF-00003114.[3] The Missouri River Basin includes most of the Great Plains and extends over 530,000 square miles in ten states: Montana, Wyoming, North Dakota, South Dakota, Minnesota, Iowa, Colorado, Nebraska, Kansas, and Missouri. PX99 at USACE0291936. Historically, the River was largely "wide and shallow," meandering across "a wide, unconstrained

[1] The plaintiffs' motion (ECF No. 396) to strike exhibit 1 to the United States' response (ECF No. 382-1) to plaintiffs' post-trial brief is **GRANTED**. The court agrees with the plaintiffs that the exhibit was in effect "briefing" and as such exceeded the page limit set by the court in its July 21, 2017 post-trial order (ECF No. 370).

[2] The Missouri River, which originally measured 2,546 miles in length, lost approximately 200 miles due to the intensive damming, straightening, and channelization that took place in the last century. PX16 at PLTF-00003114.

[3] Many of the background facts have been taken from the 2002 and 2011 reports of the National Research Council whose members are taken from the National Academy of Science. PX16 and PX17. In addition, many facts come from the Environmental Impact Statements that were prepared in connection with various Corps activities on the River. *See*, *e.g.*, PX99; PX110.

floodplain" resulting from constant bank erosion and deposition of sediment. PX390 at USACE0465781; PX99 at USACE0291936-7. The River had "diverse wildlife habitats within the meander belt and formed a natural Missouri River floodplain ecosystem that included open shallow and deep waters, sandbars, wetlands, willow thickets, and riparian woodlands."[4] PX99 at USACE0291936-7. This biodiversity was ensured by the River's transport and distribution of vast amounts of nutrient-rich sediment, which led to it being known as the "Big Muddy." PX16 at PLTF-00003159.

The River was known for its spring and summer rises due to snowmelt and rainfall in the Plains (spring flooding) and in the Rocky Mountains (summer flooding). *Id.* Historically, flooding was common and widespread on the Missouri River, drastically impacting the appearance and functionality of the River, with "water spread[ing] across its floodplain [thus] hydrologically connecting the channel[] to its floodplain and backwaters[]" and creating new channels. PX16 at PLTF-00003158-9, PLTF-00003161-5. Spring flooding tended to last "one to two weeks and was relatively localized," whereas summer flooding "lasted longer and inundated larger portions of the floodplain." *Id.* at PLTF-00003159. Although the River's main channel was 1,000 to 10,000 feet

[4] At the time of Lewis and Clark's "Corps of Discovery" expedition, the Missouri River was highly diverse, with a wide array of morphologies found in different parts of the River. In many areas, the River "was a multichannel system, with a primary channel and often multiple secondary channels . . . widespread bars, islands, and shallow sloughs[,]" while in others, it comprised "natural levees, backwater lakes, large meander loops, oxbow lakes, and sandbars and dunes[.]" PX17 at PLTF-00007916 (citing Hallberg et al. and Moody et al.). In addition, various shallower channels and backwater habitats created "slower-moving waters [that were] critical for the reproduction, shelter, and feeding of fish species[,]" while higher lands encompassed "rich forests, prairie grasses, and thick underbrush that contained a myriad of plant species." PX16 at PLTF-00003165.

wide during normal flow periods, the width increased to 25,000 to 35,000 feet during flooding, with the River "flow[ing] bluff-to-bluff and cover[ing] a width up to 17 miles" in certain areas during heavy flooding. PX17 at PLTF-00007916.

2. Regulation of the Missouri River by the Federal Government

In the early twentieth century, the federal government determined that it was in the national interest for the "wild, free-flowing" Missouri River "to be controlled for purposes of human settlement and as a resource to support economic development." PX16 at PLTF-00003157, PLTF-00003098. To meet the demands of settlers and minimize flooding, Congress adopted a series of laws starting with the Rivers and Harbors Act in 1927, which regulated navigation, and the Flood Control Act ("FCA") in 1917, "which placed flood control on equal footing with navigation within the Corps[.]"[5] PX390 at USACE0465778; PX16 at PLTF-00003130.

As discussed in detail *infra*, flood control was to be achieved in part by controlling flow into the River by constructing a series of interlocking dams and reservoirs with controlled releases of water from Gavins Point Dam, the lowest of the six dams constructed. PX99 at USACE0291944-5. In addition, the Corps would eventually construct a series of federal levees to help contain flooding in sections of the River below Gavins Point Dam. PX555 at USACE3590059, USACE3590183. The Corps also constructed a series of structures within the River that were designed to stabilize the

[5] Following the Great Mississippi River Flood of 1927, Congress passed the 1936 Flood Control Act which made flooding a "federal responsibility" and created a national flood-control policy. PX16 at PLTF-00003130.

River's banks, limit erosion, and ensure that a deeper, self-scouring channel existed in the center of the River to move flood waters more quickly through the River and allow for navigation. PX16 at PLTF-00003129-30.

a. The Missouri River Mainstem Reservoir System

Construction of most of the dams and reservoirs by the Corps was authorized by the 1944 FCA.[6] The 1944 FCA identified six purposes that the construction and operation of the Missouri River Mainstem Reservoir System ("System") would serve: flood risk reduction; enhanced navigation; generation of hydroelectric power; irrigation and water quality; recreation; and fish and wildlife. *Id.* at PLTF-00003132-51. *See also* PX390 at USACE0465778. The 1944 FCA also required the Corps to follow the broad outlines of what is known as the "Pick–Sloan Plan." PX17 at PLTF-00007903. Under the Pick–Sloan Plan, the Corps was to operate the System to "reduce the river's natural hydrologic variability in order to provide a steady and reliable 9-foot deep navigation channel[,]" making use of regulated storage of water in and releases from the reservoirs. PX16 at PLTF-00003109. Congress strengthened the purpose of the Pick–Sloan Plan by authorizing the Missouri River Bank Stabilization and Navigation Project ("BSNP") in the 1945 Rivers and Harbors Act so as to "facilitate navigation, control flooding, provide water supplies, and meet other social and economic needs." PX17 at PLTF-00007910.

The Corps constructed and operates six mainstem dams on the Missouri River:

[6] The mainstem dams and reservoirs are those on the Missouri River itself as distinguished from the dams and reservoirs that were also constructed on certain tributaries flowing into the River to also assist in flood control and for other purposes. PX16 at PLTF-00003116; PX17 at PLTF-00007891.

Fort Peck in northeastern Montana; Garrison in central North Dakota; Oahe, Big Bend, and Fort Randall in South Dakota; and Gavins Point along the Nebraska and South Dakota border. Tr. 6820:6-12, 6821:1-3. The System became fully operational in 1967 and is the largest reservoir storage system in the United States, with a total storage capacity of 73.1 million acre-feet ("MAF"). PX390 at USACE0465783-4. Each of the System's reservoirs have four primary operating zones: a permanent pool at the bottom; a carryover multiple use zone, which is the largest and is "designed to hold water that can be used during periods of drought[;]" an annual flood control and multiple use zone; and, at the top, an exclusive flood-control zone. Tr. 6832:15-6834:1. A secondary zone is the surcharge zone, which is available in each reservoir in the space between the top of the spillway gates in the closed position and the top of the spillway gates when all are raised and releasing water underneath.[7] Tr. 6836:20-24, 6843:2-24. The surcharge zone has only been used in extreme situations when the reservoirs are filling beyond capacity. Tr. 6844:23-6845:6. To date, the surcharge zone has only been used at Fort Peck and Garrison Dams in 1975, 1997, and 2011. Tr. 6844:23-6845:14.

By design, the System reservoirs today are generally kept 75 percent full in order to serve all of the FCA-authorized purposes. Tr. 6903:18-6905:12. Importantly, the mainstem dams regulate only half of the Missouri River Basin. Tr. 6823:12-25. *See also* DX3001-015. The dams cannot control the runoff from tributaries flowing into the

[7] Each dam, depending on design, can release water from the hydropower facilities through outlet tunnels or through a spillway when there are extreme releases. Tr. 6829:18-6831:1. On dams that have spillways, the gates are raised and water passes underneath the gates, down the spillway structure, and past the dam. Tr. 6841:15-6842:11.

River below the dams.[8] *Id.* When heavy rainfall occurs in the downstream tributary watersheds, the Corps can adjust releases from the mainstem dams to mitigate flooding. Tr. 6825:10-24, 6826:22-6827:6.

The Corps' operation of the six mainstem dams is formalized in a Master Manual which contains "the Corps' interpretation of its statutory responsibilities and operating approaches developed in coordination with state agencies and other federal agencies." PX16 at PLTF-00003143-4. The Master Manual sets out the Corps' basic objectives and plans for operating the System for optimum fulfillment of the 1944 FCA uses. PX8 at FWS_00000095-7. To supplement the Master Manual, the Corps prepares a more comprehensive Annual Operating Plan ("AOP") every year. PX16 at PLTF-00003143-4. The Master Manual's storage allocations and release procedures are determined from operational studies of historical River flows and historical flood and drought events. PX3 at USACE0004001. With regard to flood control, the Great Flood of 1881 is used for determining the flood control storage and release procedures. *Id.* at USACE0003997-8.

To minimize the effects of flooding along the River, the Master Manual calls for vacant intermediate storage space in each reservoir at the beginning of each annual flood season, "with evacuation scheduled in such a manner that flood conditions will not be significantly aggravated if at all possible[.]" PX3 at USACE0004040. *See also* PX16 at PLTF-00003143 (quoting the 1979 Master Manual). This means that, historically, the

[8] However, tributary dams help to control this flow. *See* PX17 at PLTF-00007894.

Corps has endeavored to have enough space in the reservoirs to store runoff during the early and later spring snowpack melt and the spring rains to prevent upper Basin flooding and to avoid releasing the resulting stored water into the lower Basin during high uncontrolled tributary flows. PX5 at USACE0121591. The Corps' System operational objectives and requirements were set forth in Section IX-A of the 1979 Master Manual. PX3 at USACE0004040. Section IX-A also provided for allocation among the zones. *Id.* The allocations for each of the zones were carried over to the revised 2004/2006 Master Manual (later referred to as the new Master Manual), as discussed *infra*. PX5 at USACE0121594-6.

In operating the System, the Corps takes into account the effects of the BSNP structures in providing flood control due to the "interdependence between components" and because "the overall performance of the infrastructure is critical for [R]iver corridor and conveyance reliability." PX555 at USACE3590139. In fact, the Corps' operation of the System and its operation and maintenance of the BSNP work hand-in-hand to provide flood control. Tr. 3983:5-14, 6661:13-16. *See also* PX390 at USACE0465783.

In the 1979 Master Manual, the Corps expressly provided that flood control was its first priority and that fish and wildlife were the last priority. PX3 at USCE0004040-1. In the 1979 Master Manual, fish and wildlife were only to be given consideration "insofar as possible, without serious interference with the [other] functions[.]" *Id.* at USACE0004041. *See also* PX16 at PLTF-00003144. This order of priorities was identified in a filing by the United States before the United States Supreme Court, in which the United States represented that "[t]he 1979 Master Manual sets forth a 'general

approach' of priorities for the interests served by the Main Stem System. . . . It gives flood control the highest priority[.]" PX34 at PLTF-00000550. As discussed *infra*, this priority approach changed in 2004, when the new Master Manual was issued, and, again, in 2006, when the Master Manual was revised.

b. The Missouri River Bank Stabilization and Navigation Project

The hydrology of the River was not only transformed by the mainstem reservoirs and dams but also by the BSNP. Tr. 40:24-41:12; PX18 at PLTF-00005729-3; PX390 at USACE0465790-804. As noted above, the BSNP is a series of river-control structures the Corps constructed to help with navigation and flood control. PX16 at PLTF-00003129-30. With the BSNP, there is now a nine-foot deep by 300-foot wide navigation channel between Sioux City, Iowa and the mouth of the River near St. Louis, Missouri. PX390 at USACE0465785.

The BSNP achieved channelization and stabilization of the banks by using "an intricate system of dikes and revetments . . . [which] were designed to provide a continuous navigation channel without using locks and dams." PX99 at USACE0291939. The stabilization of the banks also proved to be indispensable in providing flood control. Stable banks protected the River "from meander[ing][,] [thus] promoting floodplain infrastructure." PX390 at USACE0465802. As such, the BSNP is an integral part of the Corps' efforts to provide flood control, with "the BSNP and related structures hav[ing] effectively become components of the flood risk management system[.]" PX555 at USACE3590059. Channelization and bank stabilization, however, have also resulted in disconnecting the Missouri River from its floodplain, altering the

River's natural hydrograph. PX16 at PLTF-00003169; PX99 at USACE0291937. Specifically, by narrowing and deepening the channel into a fixed location, the BSNP structures have resulted in the loss of shallow water habitat ("SWH"). PX17 at PLTF-00007921.

The BSNP structures (dikes and revetments) are commonly constructed of pilings and rocks. PX390 at USACE0465785. Dikes extend from the bank into the River, perpendicular or nearly perpendicular to the water flow. PX17 at PLTF-00007921. The dikes constrict the River channel to a fixed width in order to maintain high-velocity water flows and to protect the banks from erosion. *Id.* at PLTF-00007963-4. Revetments are constructed parallel to the flow of the River, "on and along the channel bank," either to establish and protect a bank or to guide a flow consistent with a desired alignment. *Id.* These structures have resulted in the narrowing of the Missouri River's channel "to as little as one-half to one-third of its original width." PX17 at PLTF-00007921.

The BSNP structures stabilized the banks of the River by providing erosion control and directing the River's flow to the center of the channel. PX16 at PLTF-00003129-30. *See also* DX1089. This promoted scouring of the bottom of the channel, causing it to grow narrower and deeper, thus increasing the River's velocity and resulting in a "self-scouring channel[.]" PX16 at PLTF-00003129-30. The BSNP also led to the accretion of tillable farmland along the River because the sediment began to accumulate on the River's banks, thereby extending the land into what was previously water. PX99 at USACE0291978. Many of the properties involved in this litigation

were created from the above-described accretion.

To further stabilize the River's banks and channelize the River as part of the BSNP, the Corps has also eliminated most of the chutes or side channels that existed naturally in the lower Missouri River.[9] PX17 at PLTF-0007905; PX390 at USACE0465821. The chutes provided some of the channel's natural lateral migration that was vital to maintaining the Missouri River Basin ecosystem, but also contributed to frequent flooding by allowing the River to meander into the floodplain. PX16 at PLTF-00003159-60. The removal of chutes and side channels was necessary because they promoted the River's "braided pattern with no single, distinct river channel," which resulted in frequent flooding. PX17 at PLTF-00007903.

Finally, due to the changes to the River created by the BSNP, the River has lost its natural flood pulses, *i.e.*, "the predictable rising and falling of water in a natural river-floodplain ecosystem as the principal agent controlling the adaptations of most of the biota[,]" which is "essential to the health of river-floodplain ecosystems[.]" PX16 at PLTF-00003162. The BSNP alterations to the fluctuations in the River stages not only lessened the frequency of flooding, but also lessened the severity and shortened the duration of the flooding. PX18 at PLTF-00005729. In this connection, the BSNP led to an alteration in the normal drainage and seepage characteristics of the Missouri River Basin.[10] PX16 at PLTF-00003169-70; PX99 at USACE0291952. As a result, flooding

[9] The lower Missouri River in this opinion refers to the portion of the River below the mainstem dams.

[10] "Degradation of the river channel disconnects the river channel from its floodplain. Channel degradation not only makes it more difficult for the river to overflow its banks, but it also affects

from blocked drainage and seepage that had historically led to property damage was significantly lessened due to "reduced fluctuations in the floodplain [ground]water table." PX16 at PLTF-00003169-70.

c. Fish and Wildlife Impacts from the Corps' Actions Taken Prior to 2004

While the Corps was very successful in transforming the River for flood control and navigation purposes, according to the National Research Council ("NRC") and the United States Fish and Wildlife Service ("FWS"),[11] the Corps' actions resulted in significant hydrological and geomorphological changes, primarily due to the loss of "extreme high and extreme low flows[.]" PX16 at PLTF-00003165. *See also* PX8 at FWS_00000136-7. Specifically, before 1900, the Missouri River used to transport approximately "400 million metric tons per year of sediment from the interior United States to coastal Louisiana." PX17 at PLTF-00007909 (citing Meade and Moody, 2009). The construction and operation of the System and BSNP structures altered the hydrograph of the River, leading to sediment being scoured faster than it could be replaced from upstream, thus causing the River bed to erode, a phenomenon known as "degradation." PX8 at FWS_00000136. This degradation greatly harmed Missouri River

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the floodplain water table. Most importantly, the lack of flooding removes a source of periodic recharge water for infiltration to the groundwater table. In addition, because the water table (an alluvial aquifer) is hydrologically connected to the river channel itself, there is a consequent lowering of this aquifer in association with the lowering (incision) of the river channel." PX16 at PLTF-00003169.

[11] The FWS is responsible for administering the Endangered Species Act ("ESA"). 16 U.S.C. § 1536. As discussed *infra*, under the ESA the FWS prepares biological opinions setting forth an agency's responsibilities to meet its obligations under the ESA. 16 U.S.C. §1538.

Basin wildlife, especially certain species of fish like the pallid sturgeon, because the reduced amount of sediment, together with "the loss of channel chutes, oxbow lakes, and wetlands[,]" destroyed the natural habitat of those species. PX8 at FWS_00000136-7 (citing Corps, 1981). Additionally, sediment was being trapped behind the dams, reservoirs, and BSNP structures, "resulting in sediment imbalances and marked channel incision" that further destroyed Missouri River Basin fish, wildlife, and habitats. PX16 at PLTF-00003188. *See also* PX17 at PLTF-00007894, PLTF-00007905, PLTF-00007932; PX8 at FWS_00000136.

The Corps' actions are estimated to have led to the destruction of vast numbers of acreage of Missouri River Basin fish and wildlife habitat, as well as the interruption of breeding cues. PX16 at PLTF-00003105-6. River channelization, bank stabilization, levee construction, and inundation have transformed roughly "3 million acres of natural riverine and floodplain habitat" and have reduced the production of benthic invertebrates—an important food source for the River's native fishes—by 70 percent. *Id.* Notably, of the 67 fish species native to the Missouri River, "51 are now listed as rare, uncommon, and/or decreasing across all or part of their ranges." *Id.* at PLTF-00003106. The Corps' actions have also interfered with habitat needed for various bird species. Importantly, three species are currently on the federal Endangered Species List—the Interior Least Tern (*Sternula antillarum*), the Piping Plover (*Charadrius melodus*), and the Pallid Sturgeon (*Scaphirhynchus albus*)—due to the elimination of

what was once a rich, abundant ecosystem.[12] *Id.*

When Congress became cognizant of the damage caused by the construction and operation of a vast network of dams and related support structures across the United States, it passed the Water Resources Development Act ("WRDA") in 1986 to address that harm. *See*, *e.g.*, PX390 at USACE0465813; PX17 at PLTF-00007964; PX280 at USACE1207214. Under the 1986 WRDA, Congress authorized the creation of the Bank Stabilization and Navigation Fish and Wildlife Mitigation Project ("BSNFWMP") to address some of the damage that had been done to the Missouri River Basin ecosystem. *See*, *e.g.*, PX17 at PLTF-00007964-5; PX192 at USACE0266545; PX280 at USACE1207214. The BSNFWMP is now part of the Missouri River Recovery Program ("MRRP") which, as discussed *infra*, is the Corps' umbrella program for returning the Missouri River to a more natural state to aid in the recovery of the Missouri River Basin ecosystem. *See*, *e.g.*, PX187 at FWS_00305189-90. *See also* PX110 at USACE0005085. The BSNFWMP was aimed at mitigating the habitat losses caused from construction of the BSNP structures by reconnecting the River to its floodplain through the creation and restoration of habitat areas. The BSNFWMP provided authority and direction to the Corps to complete projects to mitigate BSNP habitat losses by returning the River to a more natural state.[13] *See, e.g.*, PX94 (report to Congress

[12] The 2002 NRC report contains a lengthy description of how the Corps' actions have led to the destruction of habitat and threatened and endangered species. As discussed *infra*, the destruction is also catalogued in the various Biological Opinions prepared by the FWS. *See*, *e.g.*, PX9-B; PX10.

[13] The Corps constructed various projects under the BSNFWMP to create and restore habitat. The Corps also commenced a review of the 1979 Master Manual in 1989 as part of its

presenting the results of a study undertaken by the Corps to analyze the cost of mitigation projects under the WRDAs).

In 1999, the WRDA reauthorized the BSNFWMP and gave the Corps authority to purchase 166,750 acres from willing sellers, including some of the plaintiffs in this case, ("Willing Sellers Program") along the Missouri River in order to replace lost habitat. The area authorized represented approximately one-third of the habitat lost due to the Corps' regulation of the River. PX280 at USACE1207213-5; PX390 at USACE0465813. Land acquired under the Willing Sellers Program was to be converted to habitat for native Missouri River species to compensate for the habitat that had been lost as a result of the BSNP. PX192 at CLMT0304-00000186.

The Willing Sellers Program was the preferred choice for helping to restore the habitat lost, even though the Corps could have used eminent domain to acquire easements over private land in the targeted acreage. *See*, *e.g.,* PX47 at USACE0000222-6; PX192 at USACE0266545; PX280 at USACE1207215. The Willing Sellers Program has had some success. As of September 30, 2009, the Corps has acquired 56,606 acres of the targeted acreage. *See* PX280 at USACE1207215; PX610.

The BSNFWMP was further expanded by Congress in the 2003 WRDA, which was aimed at developing shallow water habitat ("SWH") for native Missouri River

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Endangered Species Act obligations to address the changes that could be made to the System's operation to ameliorate some of the damage caused to the Missouri River Basin ecosystem, in particular in terms of threatened and endangered species.

Basin aquatic species, in particular the pallid sturgeon, and emergent sandbar habitat ("ESH") for native Missouri River Basin bird species. PX277 at USACE0719805; PX17 at PLTF-00007957. The SWH program currently extends from Ponca, Nebraska downstream to the Missouri River's mouth near St. Louis, Missouri and it aims at having "in place 20-30 acres of SWH per river mile by 2024." PX277 at USACE0719805. The ESH program aimed at having ESH along the entire stretch of the Missouri River. Specifically, the ESH program's goal was to have 50 acres of ESH per river mile below Garrison Dam, 20 acres of ESH per river mile below Fort Randall Dam, 80 acres of ESH per river mile at Lewis and Clark Lake, and 80 acres of ESH per river mile below Gavins Point Dam by 2015. PX174 at PLTF-00005901.

3. U.S. Fish and Wildlife Biological Opinions

In addition to responding to the mandates of the WRDA, the Corps was also being pressured by the FWS to address the harm to the Missouri River Basin ecosystem the Corps had caused in operating the Missouri River Mainstem Reservoir and Dam System and in constructing the BSNP. Under Section 7 of the Endangered Species Act ("ESA"), 16 U.S.C. § 1531 *et seq.*, all federal agencies that permit, fund, or carry out activities involving fish and wildlife must consult with the FWS to ensure that their actions will not jeopardize the continued existence of any listed species.[14] PX33 at

[14] "Jeopardize the continued existence of a listed species" is defined as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." 50 C.F.R. § 402.02.

PLTF-00001365. Under Section 7, the Corps may be required to provide a biological assessment ("BA") to the FWS, assessing the impact of its actions on threatened and endangered ("T&E") species. *Id.* After filing a BA, the Corps is required to enter into Section 7 formal consultation with the FWS to determine how best to avoid jeopardy to the T&E species or prevent destruction or adverse modification of their critical habitat. PX33 at PLTF-00001365. Thereafter, the FWS is required to issue a Biological Opinion ("BiOp") that recommends reasonable and prudent alternatives ("RPA") to avoid further jeopardy. *Id. See also* PX8; PX9-B; PX10. The Corps must follow the BiOp or offer some alternative measures to comply with the ESA. PX33 at PLTF-00001365. As part of a BiOp, the FWS will often include an incidental take statement, which allows an agency, like the Corps, to harm (known as "take") a limited number of protected species without triggering the civil or criminal liability provisions of the ESA. 16 U.S.C. § 1539. *See also* PX33 at PLTF-00001365-6.

Through the issuance of a series of BiOps, starting in 1990, the Corps began negotiations with the FWS over the changes it would need to make to its System operations and the BSNP structures in order to prevent further damage to T&E species and to comply with the ESA. *See* PX8; PX9-B; PX10. In the 1990 BiOp, the FWS concluded that the Corps' "operations of the System [were] likely to jeopardize the continued existence of the endangered interior least tern . . . and the threatened piping plover . . . because operations eliminate[d] essential nesting habitat and could result in the loss of at least 12 percent of the . . . interior least tern population and 22 percent of the . . . piping plover population[.]" PX8 at FWS_00000092. The FWS also made six

recommendations to the Corps, which the Corps never adopted. *Id.* at FWS_00000144-8; PX230.

The Corps' failure to accept the recommendations in the 1990 BiOp led to a new ESA Section 7 consultation with the FWS about other possible RPA measures the Corps could take to comply with the ESA. PX230. This consultation gave rise to the 2000 BiOp, which "repeatedly acknowledged that both flow changes and habitat creation [were] necessary to prevent jeopardy to [T&E] species." PX117 at PLTF-00000517. *See also* PX9-B. The 2000 BiOp recommended an elaborate RPA program "involving a combination of reservoir operational changes, structural modifications, and non-structural actions[,]" such as hydrograph and temperature changes, chute restoration, and floodplain acquisition or easements. PX117 at PLTF-00000517; PX9-B at FWS_00029104-6, FWS_00029382.

The Corps was also resistant to adopting the FWS' 2000 BiOp RPAs, believing the RPAs would cause more flooding. PX231. Specifically, the Corps was concerned that under the BiOp, there would be more and different types of flooding. PX645. The Corps was particularly averse to implementing flow modifications recommended by the FWS because it was concerned they would "pose significant effects to the natural and/or human environment." PX15 at USACE0001757. Rather, the Corps proposed a combination of flow and non-flow measures to meet its ESA obligations, PX15 at USACE0001762-74, stating:

> The Corps is committed to reconnecting the river to its floodplain wherever possible; however, several conditions must be met to ensure the goals can be attained. These include: [a]cquisition of necessary real estate

> interests (willing seller requirement and easements); [r]eceipt of appropriate funds; [l]and acquired must allow floodplain reconnection without induced damages to neighboring lands; and [e]xisting project purposes such as navigation and flood control are not adversely impacted. *Id.* at USACE0001854.

The Corp's proposal was set forth in a 2003 BA. In response, the FWS issued its 2003 BiOp, providing for a "multi-faceted approach[]" to attaining the habitat objectives, which included a combination of changes to the System and BSNP. PX118 at PLTF-00008890. *See also* PX10. This back and forth between the Corps and FWS continued into 2004 with the two agencies still not able to reach an agreement as to the System and BSNP changes necessary to meet the Corps' obligations under the ESA.

4. Multi-District Court Litigation

Numerous lawsuits were brought against the Corps by various Missouri River Basin states, environmental groups, and other Missouri River Basin stakeholders to force the Corps to make changes to its management of the Missouri River. In 2002, the Eighth Circuit addressed some of those claims in *South Dakota v. Ubbelohde*, 330 F.3d 1014 (8th Cir. 2003). In the meantime, American Rivers had filed a lawsuit seeking the Corps' compliance with the ESA. *American Rivers v. USACE*, 271 F. Supp.2d 230 (D.D.C. 2003). Ultimately, the pending cases against the Corps, including *American Rivers* and *Ubbelohde*, were consolidated by the Federal Judicial Panel on Multi-District Litigation before the U.S. District Court for the District of Minnesota. *In re Operation of the Mo. River Sys. Litig.*, 363 F. Supp.2d 1145 (D. Minn. 2004) ("MDL case"). The purpose of the consolidation was to determine, *inter alia*, whether the Corps had to comply with the ESA by following the 2003 FWS BiOp. *Id*.

The MDL Court recognized that the Corps' simultaneous compliance with the Flood Control Act ("FCA") and the ESA was problematic on its face because management actions that benefited one would likely and predictably harm the other. *Id*. at 1175. Nevertheless, the Court ultimately denied the Corps an extension to try and reconcile its obligations under both statutes. PX108 (*In re Operation of the Mo. River Sys. Litig.*, 305 F. Supp.2d 1096 (D. Minn. 2004)). As a result, on February 26, 2004, the Court ordered the Corps to revise its 1979 Master Manual by March 19, 2004, to address the 2003 BiOp directives to come into compliance with the ESA. *Id.*

As ordered by the MDL Court, on March 19, 2004, Brigadier General William T. Grisoli, who was the Corps General responsible for the Corps' management of the Missouri River, signed the Record of Decision ("ROD"), which, *inter alia*, adopted a new Master Manual. PX114. Before signing the ROD, General Grisoli reviewed the March 2004 Final Environmental Impact Statement ("FEIS") the Corps had prepared to evaluate the changes to the Master Manual. *Id.* In the ROD, the Corps expressly stated that both the 2004 FEIS and the 1944 FCA did not assume a priority of purposes in the operation of the System, but it recognized that "there may be occasions where conflicts [will] exist between the individual authorized purposes." *Id.* at PLTF-00000537. To ensure compliance with the ESA, the Corps committed to implementing all elements of the 2003 BiOp and agreed to changes in the operation of the System and the operation and maintenance of the BSNP. PX116. *See also* PX799.

5. The Corps System and River Changes After 2004

This litigation arises from the changes the Corps has made to its operation of the

Mainstem Reservoir and Dam System, hereafter "System Changes," and the changes made to the BSNP and under the MRRP, hereafter "River Changes," to meet its ESA obligations under the 2003 BiOp. Together, these changes are referred to as "System and River Changes." Set forth below is a description of those System and River Changes. The court's findings regarding whether these System and River Changes caused flooding or made flooding more severe than would have otherwise occurred without the System and River Changes is discussed in the Liability Findings (Expert Testimony) section of this opinion. The court's findings regarding the impact of flooding on the individual plaintiffs are in the section of the opinion on Individual Plaintiffs.

The System and River Changes that have been made to comply with the ESA are numerous and are constantly evaluated and evolving. The new Master Manual issued on March 19, 2004 provided that "[d]ecisions concerning implementation of additional measures or modification of existing measures, including potential release changes out of Gavins Point Dam, [would] be made through the adaptive management process." PX114 at PLTF-00000540. Importantly, to comply with the ESA, the Corps must always consider the impact of other FCA-authorized purposes on fish and wildlife because "[t]he Endangered Species Act has a higher precedence than other authorized purposes." PX324 at USACE0328103. Thus, adaptive management does not give the Corps unfettered flexibility. Rather, it is an approach that "promotes carefully-designed management actions, assessment of these actions' impacts, and subsequent policy adjustments." PX16 at PLTF-00003210. It aims at "maintain[ing] or restor[ing] ecosystem resilience," *i.e.*, an ecosystem's ability "to persist and adapt over time in the

face of natural and anthropogenic challenges." *Id.* For example, the creation and monitoring of each SWH and ESH project is a component of the adaptive management approach adopted by the Corps.

The Corps' commitment to complying with the ESA is also reflected in the changes made to the Corps' operating budget. PX701. *See also* PX860; PX860-A; PX860-B. Prior to the ROD, the Corps was spending proportionally far more on the other FCA-authorized purposes than on fish and wildlife. However, compliance with the 2003 BiOp under the ROD represented a significant change in the Corps' management of the River as reflected by its spending. PX701. *See also* PX860; PX860-A; PX860-B. For example, the Corps' fish and wildlife mitigation budget increased from $17.5 million in 2003 to $69 million and $82.8 million in 2005 and 2006, respectively. PX860-A. This represents a significant change in the focus of the work the Corps was doing in managing the River—from flood control to River restoration work. PX701. *See also* PX860; PX860-A; PX860-B.

a. System Changes after 2004

The Master Manual issued in 2004 to comply with the ESA had called for greater releases in the Spring ("Spring Pulse") than the Corps was prepared to make and so the Corps instead, with the FWS' approval, embarked on an "unprecedented" SWH construction program in 2004 as an alternative means of promoting ESA compliance. PX123 at USACE0510835. *See also* Tr. 217:5-24, 490:13-491:9, 2374:11-2379:16, 3737:7-25, 4283:3-16, 8272:6-8273:24, 10371:9-16; PX114; PX115. The Master Manual was revised in 2006 to reflect the Corps' approach. Both the 2004 and 2006 Master

Manuals, hereafter the "new Master Manual," struck the language in the 1979 Master Manual providing a sequential priority of the FCA-authorized purposes in operating the System. Instead of giving flood control first priority and fish and wildlife last priority, the new Section VII.7-01 of the Master Manual provides that, in operating the System, the Corps will "balance [the FCA] functions in order to obtain the optimum development and utilization of the water resources of the Missouri River basin to best serve the needs of the people." PX4 at USACE0002644; PX196.

The new Master Manual also contains two significant operational guidelines that are at issue in this litigation. First, the new Master Manual authorizes the Corps to keep a larger amount of water in the reservoirs for the benefit of other purposes, including fish and wildlife. PX117-A at PLTF-00008836; PX756. In this connection, the Corps acknowledges that during years of high early runoff from rain and snowpack melt above the System dams, if the System does not have enough storage to impound all of the runoff, the Corps may have to choose between making higher early releases, even if that would likely wash away nesting birds and contribute to early flooding downstream, or holding more water in the reservoirs and hope that spring rains are below normal. *See*, *e.g.,* PX10; Tr. 4620:5-4626:22.

Second, the new Master Manual addresses the need to return the River to having more varied river stages for the benefit of T&E species. Under the new Master Manual, water is released from the dams when needed to prevent the least tern and piping plover from nesting on low-lying areas, which can be later washed away, and to provide spawning cues for the pallid sturgeon, hereinafter referred to as "T&E

releases." Tr. 6959:11-16, 6964:24-6965:5. Although the Corps is not required to conduct the once-proposed Spring Pulse, the Corps consults with the FWS throughout the nesting season to determine the extent of releases necessary to comply with the BiOp.

As discussed *infra*, for each of the years of flooding, except for 2011, the Corps made T&E releases during periods of high River flows with the knowledge that flooding was taking place or likely to soon occur.[15] In 2010, for example, the Corps made releases for T&E species despite receiving direct communications from Corps personnel regarding flooding already in progress in the lower River. PX967. The response from Corps personnel responsible for the System was that the releases were needed for the benefit of the least tern and piping plover. *Id.* This happened again in 2015. PX2308.

b. River Changes After 2004

To coordinate the various Corps projects needed to restore the River to a more natural state, *i.e.*, before it was so highly engineered, the Corps established the Missouri River Recovery Program ("MRRP"). PX110 at USACE0005085. In carrying out the objectives of the MRRP, the Corps, as it does with its T&E release decisions, has partnered closely with the FWS. *See*, *e.g.*, PX187; PX911 at PLTF-00018455; DX576 at USACE0089347. The MRRP coordinates the Corps' authority under: (1) the 1986

[15] The government presented expert testimony from Mr. Woodbury who calculated the percentage of flow attributable to releases from Gavins Point Dam during the relevant periods of flooding in 2007, 2008, 2010, 2013, and 2014 at key gages below Gavins Point Dam. In 2007 and 2008, contributions from Gavins Point Dam ranged along the River from five to fifteen percent. In 2010, the range was from 15 to 20 percent. For 2013 and 2014, the contributions ranged from 10 to 30 percent. *See* Def.'s Br. at 99-100; DX3015.

and 1999 WRDAs; (2) the 2003 BiOp; and (3) the 2007 WRDA. PX390 at USACE0465813. As part of the 2007 WRDA, Congress authorized the Missouri River Recovery Implementation Committee ("MRRIC") to provide guidance to the Corps from the affected community on its MRRP activities and projects. PX17 at PLTF-00007956.

To accomplish the MRRP objective of restoring the Missouri River to a more natural state, the Corps has modified BSNP structures and has reopened previously closed chutes to create shallow water habitat ("SWH"). As explained *infra*, Corps studies explain that as of 2014, the Corps had undertaken 1,697 dike notching actions, 354 major modification actions, 63 dike lowering actions, 36 dike extension actions, 39 side-channel chute actions, 20 revetment chute actions, 14 backwater actions, and 3 channel widening actions. PX277 at USACE0719815.

The Corps has also undertaken work to reopen the natural chutes it had removed years ago. PX169. The Corps has acknowledged that in undertaking these BSNP modifications, it is destabilizing the banks of the River, allowing it to meander into the floodplain, as it had been allowed to do in its natural state.[16] *See*, *e.g.*, PX98 at USACE0090827; PX390; PX911. The Corps has also recognized that in reopening chutes, there are potential flooding impacts. *See*, *e.g.*, PX911 at PLTF-00018460-1. *See also* Tr. 9243:7-9245:20, 9499:7-9501:4, 9538:8-9540:23, 10872:16-10873:1. In the

[16] "To achieve significant amounts of SWH, it will be necessary to erode real estate to increase the river's top-width." PX98 at USACE0090827.

environmental reviews for reopening chutes, however, the Corps has clearly stated the need for minimizing flooding impacts. *See, e.g.*, DX0286 at USACE5031174, USACE5031192.

As discussed in greater detail *infra*, the creation of SWH "involves reclaiming areas that were historically part of the active [R]iver channel but were converted to land by the sediments trapped by the BSNP." PX390 at USACE0465814. Because these endangered species "depend on bare sandbars for successful nesting and fledgling[,]" which are limited along the Missouri River, the Corps has been increasing the amount of ESH "by creating new sandbars largely from dredged material and by clearing vegetation from existing sandbars." PX17 at PLTF-00007965-6.

As also discussed in detail *infra*, the evidence has established that River Changes by the Corps, such as the aggradation of sediment from notching and the degradation of dikes and revetments, have had the effect of raising the Missouri River's water surface elevations ("WSEs") in periods of high flows. *See*, *e.g.*, PX2089-A; Tr. 4754:22-4777:14, 4793:23-4794:23, 4838:9-4839:19, 10544:19-10545:18. In 2011, the NRC reported that both SWH and ESH programs affect the amount of sediment transported and thus have repercussions "for sediment loadings and transport and therefore for channel morphology and habitat maintenance." PX17 at PLTF-00007979. More specifically, the NRC reported that although sediment transported across the Missouri River Basin "has value for habitat formation[,] [it] has both positive and negative influences on infrastructure." *Id.* The NRC explained that the BSNP "structures make it difficult to establish and maintain complex channel and floodplain habitats that depend

on the temporary storage and frequent alteration of sediment accumulations in the form of channel bars and off-channel water bodies." *Id.* at PLTF-00007981-2. This is because these structures are aimed at facilitating "a narrower and more rapid flow that scours a deeper and less complex channel[,]" resulting in greater flood control. *Id.* at PLTF-00007982. As such, the NRC reported that changing the River to create SWH and ESH will likely lead to increased flooding of homes, farms, and infrastructure (transportation, telecommunications, power) within the floodplain. *Id.* at PLTF-00007982. The NRC recognized that the impacts on homes and farms would likely be greatest during high-water events. *Id.* *See also* PX911. The NRC concluded that "a reversal of tradeoffs that would favor ecosystem restoration may . . . [result in] *winners and losers* in a new operations scheme who will need to be carefully considered and perhaps compensated." PX16 at PLTF-00003209 (emphasis added).

6. Flooding on the Missouri River After 2004

As discussed above, in its pre-regulated state, the Missouri River regularly flooded. The periods of flooding after the System and BSNP structures were constructed have been less frequent and less severe. Between 1967, when the System was completed, and 2004, there was some limited flooding in the 1980s and one significant flood in 1993. The period from 2000 to 2006 was largely a period of drought on the River. Flooding on the River returned, starting in 2007. In fact, 2007, 2008, 2010, 2011, 2013, and 2014 have been among the worst flooding years in the River's history. PX2008. The evidence established that 2009 and 2012 were drought years. The plaintiffs' takings claims are based on flooding in 2007, 2008, 2010, 2011, 2013,

and 2014. The year 2014 was selected as the cut-off year for purposes of proving flooding by the Corps' System and River Changes; however, some plaintiffs have continued to experience flooding. The plaintiffs claim that there is now a pattern of increased flooding caused by the Corps' System and River Changes. The court allowed testimony regarding flooding in 2015 and 2016 for purposes of establishing a pattern.

Set forth below is a brief description of the flooding on the Missouri River for the years in question. There is no dispute that the flooding at issue in this litigation has occurred in the context of high River flows that were naturally occurring during periods of high precipitation or high tributary inflows, except for the flood in 2011. The United States concedes that none of these higher flows and the associated weather that caused them are an intervening cause that breaks the chain of causation presented by the plaintiffs regarding the System and River Changes. Tr. 14293:16-24. The government contends that none of the Corps' actions have caused higher WSEs on the River than would have existed without these actions. The plaintiffs contend that the System and River Changes have caused higher WSEs on the River than would have existed had the System and River Changes not been made. The plaintiffs also contend that the higher WSEs were a foreseeable consequence of the System and River Changes and led to the flooding and takings claims at issue in this case.

a. Flooding in 2007

Out of the 113 year historical record the May 2007 regional precipitation in South Dakota ranked 104 wettest and in North Dakota ranked 108 wettest. DX3015-28. However, the System storage on March 1st was 22.7 million acre feet ("MAF") below

the base of the annual flood control zone, and the upper three reservoirs were 31 to 34 feet below normal. Tr. 7157:3-8; DX0480. That year, the Corps conducted System releases for the benefit of T&E species, which added flow to the River during a period when the River was lower.[17] Tr. 4557:24-4558:1, 7160:4-20; DX3001-243.

b. Flooding in 2008

In April through June 2008, Iowa experienced very heavy rainfall leading to the wettest record in 114 years. Tr. 10796:20-10797:5; DX3015-29. Heavy and unprecedented rains were also recorded in Montana, South Dakota, Nebraska, and Missouri. Tr. 10797:6-13, 13500:12-14; DX3015-29; DX0094. System storage on March 1st was up from 2007, but still below the normal start of the runoff season, and the upper three reservoirs were 26 to 35 feet below normal levels. Tr. 7161:15-20; DX0481. The Corps conducted System releases for the benefit of T&E species that were higher than those in 2007. Tr. 4574:9-16, 7163:18-7164:5; DX3001-247. These releases also added flow during a period of lower Basin flooding.[18]

c. Flooding in 2010

During the spring and summer of 2010, the Missouri River and its tributaries experienced extensive flooding caused by heavy spring rainfall and heavy plains snowpack. Tr. 1292:7-12, 1561: 21-23, 2845:22-2846:2, 2967:15-19, 3505:15-20, 3452:5-7, 7187:9-7189:16. There was very heavy rainfall in Iowa, Nebraska, and South

[17] *See* fn. 15. In 2007, the releases from Gavins Point Dam contributed five to ten percent of the flow.
[18] *See* fn. 15. In 2008, the releases from Gavins Point Dam contributed five to fifteen percent of the flow.

Dakota from May through July 2010. Tr. 10797:14-10798:2; DX3015-30. As a result, runoff during 2010 was 156 percent above normal, generating the third highest runoff at that time in the last 65 years in St. Joseph. Tr. 10806:14-15; DX0483 at USACE0014563. Nevertheless, the Corps conducted T&E releases which contributed to the flooding.[19]

d. Flooding in 2011

In 2011, runoff and rainfall in the upper Basin was unprecedented in magnitude and duration. The untimely combination of events caused record WSEs and extensive flooding in the upper and lower Basin from June through August. Tr. 13858:16-13859:2. During the winter and spring of 2011, record snow fell across a large portion of the northern Rocky Mountains and eastward into the Northern Plains. *Id.* *See also* Tr. 10798:14-10799:9; DX3015-32. A cool spring held snowpack in place later than usual, and a rapid snowmelt coincided with record-setting rains in May and early June over Montana and western North Dakota. Tr. 13843:1-13848:2, 13853:1-6; DX3007-07. Despite summer drought conditions in the lower Basin, it was extremely wet in portions of Montana, Wyoming, Colorado, and the Dakotas. Tr. 13500:20-13501:2; DX0094. In addition to record highs in mountain snow water equivalent, May precipitation was 400 percent above average in the Basin, while runoff was 320 percent above average above Sioux City. Tr. 13843:1-13844:4, 13847:13-13849:14; DX3007-07; DX0192 at DX0192-0044. The high snowpack and delayed snowmelt contributed

[19] *See* fn. 15. In 2010, the releases from Gavins Point Dam contributed 15 to 20 percent of the flow.

to a May to July runoff in the upper Basin that was twenty percent higher than the previously highest runoff ever recorded in 1997. Tr. 13853:1-6; DX0192 at DX0192-0054, DX0192-0060, DX0192-0067. The runoff in 2011, totaling 61 MAF, was the highest in the upper Basin since 1898, at 247 percent above normal levels. Tr. 7115:25-7116:5; DX0484 at USACE0014651. Upper Basin runoff was 25 percent greater than the next highest runoff year, *i.e.*, 1997. Tr. 7117:16-7117:25.

Although the System storage on March 1st was 57.6 MAF, all 2010 runoff had been released and the runoff season was at the base of the annual flood control zone by January 27th. Tr. 7098:8-17, 7137:13-7138:17; DX0484. In 2011, there were no T&E releases because the Corps had downstream flood control concerns. Tr. 7122:8-22. The massive releases in 2011 starting in May were taken when Corps personnel determined that the record runoff levels in the upper Basin were putting the entire mainstem System in jeopardy. In response, the Corps released a record 160,000 cubic feet per second ("cfs") from Gavins Point Dam for 65 days with higher than normal releases continuing until October. DX0192 at DX0192-0047-8. Previously, the record had been 70,000 cfs released in 1997. Tr. 7392:13-15.

e. Flooding in 2013

A drought developed in 2012 that remained over much of the Missouri River Basin in early 2013. Tr. 7202:1-4. System storage on March 1st was 8.3 MAF below the normal start of the runoff season, and the upper three reservoirs were 10 to 12 feet below normal levels. Tr. 7202:11-17; DX0484. Heavy localized rainfall later in the year in Nebraska, Missouri, Kansas, and Iowa resulted in high flows downstream of

Nebraska City.[20] Tr. 7203:8-20. Despite these higher downstream flows in late May and early June, the Corps continued to make T&E releases which contributed to the flow during the highest flow periods. DX3015-227; DX3015-308; DX3015-406; DX3015-561.[21]

f. Flooding in 2014

In 2014, there was high runoff in the upper Basin and low runoff in the reach between Sioux City and St. Louis. Tr. 7205:2-18; DX3001-276. June, however, saw heavy rainfall in the lower Basin, with the Sioux City runoff being 140 percent above normal levels. Tr. 7205:14-15, 7206:22-7207:9; DX0536 at USACE7739484; DX0094. The System storage on March 1st was 5.4 MAF below the normal start of the runoff season, and the upper three reservoirs were five to 12 feet below normal levels. Tr. 7205:20-24; DX0536. Although the Corps reduced Gavins Point Dam releases to a minimum 10,000 cfs in response to the June rainfall, it maintained its T&E releases, which coincided with the highest downstream flows. Tr. 4649:22-4651:1.[22]

II. Legal Standards

1. Causation

[20] For instance, the Big Nehama River had the second highest flows of record. Tr. 7203:8-14; DX3001-275. May rainfall in the lower Basin was also above normal. Tr. 10799:12-14; DX3015-33; DX0094.

[21] *See* fn. 15. In 2013, the releases from Gavins Point Dam contributed 20 to 30 percent of the flow.

[22] *See* fn. 15. In 2014, the releases from Gavins Point Dam contributed 10 to 20 percent of the flow.

The threshold issue to be decided in this case is whether plaintiffs can establish that the Corps caused the flooding upon which plaintiffs base their takings claims. Plaintiffs assert that they may prove causation based on the cumulative and combined effects of the Corps' System and River Changes. Specifically, they argue that if they can prove that "but for" the Corps' System and River Changes, the flooding in the years identified would not have occurred or been as severe, they will have met their causation burden. Plaintiffs argue that they are entitled to prove causation by demonstrating that the numerous actions the Corps has taken to "retransform" the Missouri River from a highly engineered river to a more natural state for the benefit of T&E species has led to increased and more severe flooding. In support of their approach to causation, the plaintiffs point to the numerous System and River Changes discussed above in the Background Facts section which were taken to meet the Corps' ESA obligations under the 2003 BiOp. The plaintiffs cite to evidence, largely taken from government documents and testimony, which catalogues the Corps' River Changes after 2004, including the reopening of chutes, the creation of ESH, and the construction of SWH. They also rely on evidence, again primarily from government documents and testimony, which shows how the Corps has made System Changes to meet its ESA obligations by releasing water from the dams during periods of high River flows to protect and promote T&E species.

The plaintiffs contend that their reliance on the cumulative and combined effects of the Corps' System and River Changes to establish causation is consistent with the "single-purpose analysis" that the Federal Circuit approved in *Arkansas Game & Fish*.

Pls.' Br. at 96 (citing *Ark. Game & Fish Comm'n v. United States* ("*Ark. Game & Fish III*"), 736 F.3d 1364, 1370 (Fed. Cir. 2013) (determining that because the Corps' yearly deviations from its water-management plan "were directed to a single purpose" (benefiting agricultural interests) and "had a consistent overall impact on the Management Area[,]" it is appropriate to view the flooding as lasting for seven years). The plaintiffs assert that in *Ark. Game & Fish III*, the Federal Circuit "recognized that flooding that is alleged to have occurred because of [the] Corps['] actions done for a single purpose are to be analyzed as one continuous flood or on a macro basis, not as individual floods." Pls.' Resp. at 3 (citing *Ark. Game & Fish III*, 736 F.3d at 1370). The plaintiffs argue that in cases where "there is a 'single purpose' for the Corps' actions that are alleged to have caused the flooding, in determining whether there has been appropriation of property, the Court must assess the collective effects of *all* the MRRP flooding resulting from that single purpose[.]" Pls.' Br. at 95-6 (citing *Ark. Game & Fish III*, 736 F.3d at 1370).

The plaintiffs contend that the government's assertion that to prove causation the plaintiffs had to isolate each individual Corps action and connect that action to each separate flooding event on an individual property is not supported. The plaintiffs explain that this court has long recognized that a taking can be established based on a series of different government actions taken for a single purpose. The plaintiffs point to *Cotton Land Co. v. United States,* where the plaintiffs maintain that the court held that "a sequence of events acting in concert" and which result in the physical occupation of property can establish a taking. Pls.' Resp. at 22 n.10 (relying on *Cotton Land*, 75 F.

Supp. 232, 233 (Ct. Cl. 1948) (finding that a taking had occurred, although the injury occurred years after the initial act of constructing the dam, when a dam caused sediment to deposit in the riverbed upstream of the dam, and over time, the sediment raised the riverbed and water level until the river overflowed its banks and flooded the plaintiff's property. The court rejected the government's defense that the erection of the dam was too remote a cause on which to base liability because the flooding did not occur directly from the erection of the dam but through a chain of events). The plaintiffs also rely on *Avery v. United States*, 330 F.2d 640, 644-45 (Ct. Cl. 1964) and *Cary v. United States*, 552 F.3d 1373, 1379 (Fed. Cir. 2009). Finally, plaintiffs argue that if the government's theory of causation is adopted and plaintiffs are required to prove how each individual action of the Corps caused or increased flooding on each individual property for each separate flooding event, no plaintiff could muster the evidence to prove a case because it would be impossible to separate out each action and pinpoint the precise cause of flooding.

The government argues that the plaintiffs' reliance on the cumulative and combined effects of the Corps' System and River Changes to prove causation should be rejected on the grounds that "[p]roving causation in a takings claim requires a detailed analysis of the property in question including quantifying the alleged harm directly attributable to a precise government action." Def.'s Resp. at 4. The government asserts that "'several distinct actions viewed in concert' are 'too broad' to properly allege a takings claim." *Id.* (quoting *Acceptance Ins. Cos. Inc. v. United States*, 584 F.3d 849, 855 (Fed. Cir. 2009)). According to the government, plaintiffs bear the burden to

pinpoint "the precise step in a sequence of events that constitutes conduct the government cannot engage in without paying compensation." *Id.* The government also argues that the plaintiffs' reliance on *Cotton Land* is misplaced, on the grounds that the case involved only one governmental action, *i.e.*, the impoundment of water behind the dam, whereas here the Corps has taken numerous actions.

The government further argues that a single-purpose flood theory is inapplicable here, on the grounds that, unlike *Arkansas Game & Fish*, "this case does not involve a single set of discrete water control manual deviations proactively made to serve a single purpose and affect[ing] a single parcel for a multi-year period, and even [p]laintiffs do not contend that the Corps' actions are the sole cause of the various flood events" at issue. Def.'s Resp. at 7. The government argues that here "the various actions the Corps has undertaken pursuant to the [new] Master Manual . . . and MRRP have varied each year and served multiple purposes." *Id.* (citing Def.'s Post Trial Brief ("Def.'s Br."). at 8, 14-6, 35-44). The government also asserts that the plaintiffs allege different amounts of flooding in different years. *Id.* at n.9 (citing Def.'s Br. at Tables 3-7, Columns A, I (flooding at different properties); Pls.' Br. at Table A (varying amounts of flooding on the properties)). For all of these reasons, the government argues that plaintiffs are required to prove how individual actions of the Corps caused or increased flooding at each plaintiffs' property for each separate flooding event.

The court has considered the parties' arguments regarding the proper law to apply and concludes for the reasons that follow that the plaintiffs' causation theory is supported and is the appropriate theory to apply in this case. Specifically, the court agrees with

plaintiffs that an individual plaintiff can meet the causation burden if that plaintiff can prove that: (1) the Corps' System and River Changes were made for a single purpose; (2) the cumulative and combined effects of the System and River Changes made for that single purpose led to higher WSEs than would have existed without the System and River Changes; and (3) the higher WSEs led to flooding, or more severe flooding on the property owned or farmed by that individual plaintiff than the flooding the plaintiff would have experienced without the Corps' System and River Changes.

First, the court finds, contrary to the government's contentions, that this case is similar to *Arkansas Game and Fish*. The Federal Circuit found that "[t]he government cannot obtain an exemption from takings liability on the ground that the series of interim deviations were adopted on a year-by-year basis, rather than as part of a single multi-year plan, when the deviations were designed to serve a single purpose and *collectively* caused repeated flooding and timber loss on the Commission's property." *Ark. Game & Fish III*, 736 F.3d at 1370 (emphasis added). Based on the reasoning in *Ark. Game & Fish III*, the court finds that it is proper to consider the *series* of changes made by the Corps for a single purpose—here, meeting the Corps' ESA obligations—to determine whether those System and River Changes have caused flooding that would not have occurred without those System and River Changes.

Second, the court's conclusion is consistent with other cases in this court involving flooding. For example, in *Turner v. United States*, the United States Claims Court held that the "plaintiffs have demonstrated that authorized actions of the Government resulted in the taking of an easement on their property for periodic

inundation through flooding." *Turner v. United States*, 23 Cl. Ct. 447, 460 (1991). The court found that "there is a causal connection between the Corps' activities and the damage to plaintiffs' land." *Id.* at 455 (emphasis added) (footnote omitted). In that case, the court concluded that channelization had resulted in higher flow velocity and flood stages, which had subsequently led to the transfer of greater amounts of sediment that "raised the river stage along the channel adjacent to plaintiffs' land." *Id.* The court explained that "[o]ver time, the process had occurred to such an extent that the tremendous flows captured in the upper reaches of the creek could no longer be contained in the now shallower lower reaches. This was exacerbated by the damming effect of the sediment deposits at the East Fork." *Id.* (footnote omitted). The court analyzed multiple Corps actions, and the plaintiffs did not have to pinpoint the specific Corps' action(s) that caused the flooding on their property. It was, as these plaintiffs would say, the "combined and cumulative" impacts of the Corps' actions over time that constituted a taking.

Third, the court also finds, as plaintiffs contend, that the government's reliance on *Acceptance* is misplaced. *Acceptance* is a regulatory takings case and the United States Supreme Court has made clear that the "longstanding distinction between acquisitions of property for public use, on the one hand, and regulations prohibiting private uses, on the other, makes it inappropriate to treat cases involving physical takings as controlling precedents for the evaluation of a claim that there has been a 'regulatory taking,' and vice versa." *Tahoe-Sierra Pres. Council, Inc. v. Tahoe Reg'l Planning Agency*, 535 U.S. 302, 323 (2002) (footnote omitted).

Finally, the court also agrees with plaintiffs that if the court were to require each plaintiff to prove causation with evidence of how each of thousands of Corps' System and River Changes individually led to flooding or increased flooding on their property for each flooding event, no plaintiff would be able to prove causation.

2. Foreseeability

The standards for proving foreseeability in a takings case are well settled. In this case, to prove foreseeability, the plaintiffs must show either (1) that the Corps intended to take plaintiffs' property interests by its actions in making the System and River Changes it instituted to comply with the ESA or (2) that the invasion of the plaintiffs' property interests was the '"foreseeable or predictable result"' of the Corps' System and River Changes. *Ark. Game & Fish III*, 736 F.3d at 1372 (quoting *Moden v. United States*, 404 F.3d 1335, 1343 (Fed. Cir. 2005) (determining that an injury is "the direct, natural, or probable result" when the injury was "the foreseeable and predictable result of the authorized [government act]."")). *See also Ridge Line, Inc. v. United States*, 346 F.3d 1346, 1355 (Fed. Cir. 2003); *Cary v. United States*, 552 F.3d 1373, 1377 (Fed. Cir. 2009).

Here, the plaintiffs acknowledge that the Corps did not intend to invade each plaintiff's property interest. Rather, the plaintiffs argue that they can establish their takings claims by proving that the flooding which invaded their properties was the "direct, natural and probable result" of the Corps' System and River Changes. Pls.' Br. at 85 (citing *Moden*, 404 F.3d at 1343; *Cary*, 552 F.3d at 1377). The plaintiffs also assert that in meeting their burden, it is not necessary for plaintiffs to establish that flooding was

the direct, natural, and probable result of each individual System and River Change taken by the Corps. Pls.' Br. at 87-9. Rather, plaintiffs argue, as they did with regard to causation, that so long as the Corps' actions have a '"single purpose[,]"' foreseeability should be judged taking all of the Corps' System and River Changes into account. *Id.* at 87 (quoting *Ark. Game & Fish III*, 736 F.3d at 1370). In this regard, the plaintiffs maintain that by endeavoring to restore the River and by making System releases to benefit T&E species, the Corps knew or should have known that the River's flooding pattern would change and that more flooding would occur. *Id.* at 4, 52-3, 90-1.

The plaintiffs assert that foreseeability, or determining whether flooding was the direct, natural, and probable result of the Corps' System and River Changes, is determined based on an objective, not subjective, test. *Id.* at 86-7 (citing *Ark. Game & Fish III*, 736 F.3d at 1372-3). Plaintiffs point to "extensive evidence" in the form of government reports, records, and studies, as well as the testimony of government witnesses before Congress that, at the time the Corps was considering the System and River Changes it needed to make to comply with the ESA, the Corps knew or should have known that additional flooding would likely result. Pls.' Br. at 91; PX16 at PLTF-00003207-9 ("There will be potential for flood damage on properties that are near the channel. … There may be drainage problems on some floodplains that have been converted to agricultural, industrial, or domestic uses."). *See also* PX96 at USACE0070654; PX99 at USACE0291869 ("Based on input from public scoping, the following issues will be addressed either generally or through a specific evaluation in the SEIS. . . . Increased flooding on adjacent private lands[;]. … Impacts to levees and flood

control structures[.]"); PX324 at USACE0328101 ("Any changes in the management of the [R]iver will result in a wide variety of impacts to authorized purposes. Meeting the requirements of the [ESA] will require some sacrifice by other purposes that have benefited in the past to the detriment of listed species.").[23]

The plaintiffs also contend the fact that the Corps did not undertake a comprehensive study to determine the cumulative and combined impacts of its proposed System and River Changes on raising WSEs in the River argues in favor of finding foreseeability under *Arkansas Game & Fish III*, because foreseeability, according to the plaintiffs, "encompass[es] not only what the Corps knew at the time it authorized the MRRP about the flooding impacts of the MRRP, but what it could have known *had it conducted a reasonable investigation* concerning those impacts."[24] Pls.' Br. at 86 (citing *Ark. Game & Fish III*, 736 F.3d at 1372-3 (upholding the Federal Court of Claim's finding that the flooding was foreseeable because "a reasonable investigation by the Corps of Engineers prior to implementing the deviations during the 1993–2000 period would have revealed that the deviations would result in a significant increase in the number of days of flooding in the Management Area during the growing season."); *Ridge Line*, 346 F.3d at 1357 (citing *Cotton Land Co*., 75 F. Supp. at 233-4 (mentioning that

[23] *See* PX566; PX911; Tr. 217:25-219:8, 223:5-20, 227:24-228:9, 1114:6-9, 1117:14-1118:6, 1145:4-1149:2, 13140:1-8, 13169:25-1370:11, 13261:2-22, 3042:22-3044:20, 3191:11-3192:10, 5741:19-5742:17.

[24] The government acknowledges that "[a]n agency's reasonable investigation into the results of a complained-of action before it takes that action can bear on whether a result was foreseeable." Def.'s Br. at 79 (citing *Ark. Game & Fish III*, 736 F.3d at 1373).

"[i]f engineers had studied the question in advance they would, we suppose, have predicted what occurred.")).

The government agrees that to prove foreseeability plaintiffs do not have to prove that the government intended to flood their properties but only that that flooding was the "direct, natural, or probable result of authorized [g]overnment activity."[25] Def.'s Br. at 5. The government contends, however, that "[t]he United States is only liable for a taking for damages 'directly attributable to government action,' not secondary or contributory factors that caused damage." *Id.* at 77 (quoting *Bartz v. United States*, 633 F.2d 571, 593 (Ct. Cl. 1980)). According to the government, "[t]his 'direct attribution' occurs if the injury is the 'direct, natural, or probable result of an authorized activity and not the incidental or consequential injury inflicted by the action,' as incidental and consequential injuries of an action lie in tort." *Id.* (quoting *Ridge Line*, 346 F.3d at 1355). The government also argued that foreseeability must be determined as of the time of the governmental action alleged to have taken the property and thus the government argues that plaintiffs' failure to pinpoint individual Corps' actions means that the court does not have a concrete point in time to determine foreseeability.

The government asserts that if the Corps' System and River changes have only increased the "risk" of flooding, the plaintiffs cannot show foreseeability. Def.'s Br. at 78-9. The government argues that plaintiffs must show that the Corps should have

[25] The government, as discussed *infra*, contends, for example, that the 2011 flood was not foreseeable because it was caused by excessive snowmelt and rainfall in the upper basin above Gavins Point Dam and that the 2011 flood was not a direct, natural, or probable result of keeping water in the reservoirs during March and April 2011.

known that the System and River Changes would in fact cause additional flooding and not merely the risk of additional flooding. Relying on *Cary*, the government argues that taking a risk or an action that "increases the risk of a detrimental result 'does not equate to making the detrimental result direct, natural, or probable.'" Def.'s Br. at 78 (quoting *Cary*, 552 F.3d at 1378). The critical question, the government contends, is what set the chain of events in motion and then whether each event inevitably followed to cause the result. *Id.* (citing *Cary*, 552 F.3d at 1379).

The government contends "[t]he Corps did not intend, nor did it expect, that any increased flooding would likely occur as the result of either changes to the [Master] Manual or the construction of habitat projects[.]" *Id.* at 6. The government describes how multiple engineers discussed the Corps' efforts to analyze possible changes from the Master Manual revision and to model, design, and construct habitat projects to minimize and avoid adverse effects on flood control.[26] *Id.* at 5-6, 143-5. Relying on its experts and Corps witnesses, the government contends that the "effects [of the Corps' actions] on water levels from project construction are minor and localized." *Id.* at 146.

Having considered the parties' arguments, the court concludes with regard to plaintiffs' burden to establish foreseeability as follows. First, plaintiffs must prove that the flooding at issue was the "direct, natural, or probable result" of the Corps' authorized

[26] The government's reliance on its efforts to minimize flooding is misplaced. As this court in *Bettini* explained, "[t]he inquiry is not whether the result was intended nor whether it occurred despite the efforts of the Government to prevent the damage, but whether it was the probable or foreseeable consequence of a deliberate governmental act." *Bettini v. United States*, 4 Cl. Ct. 755, 760 (1984) (citing *Berenholz v. United States,* 1 Cl. Ct. 620, 628 (1982)).

actions. *Ridge Line*, 346 F.3d at 1355 (internal quotations and citations omitted). The Federal Circuit has explained that to prove a direct, natural, or probable result, a "property owner must prove that the asserted government invasion of property interests allegedly effecting a taking 'was the predictable result of the government action,'. . . because it was 'the direct or necessary result' of the act." *Vaizburd v. United States*, 384 F.3d 1278, 1282-3 (Fed. Cir. 2004) (quoting *Ridge Line*, 346 F.3d at 1356) (other citations omitted). This court in *Baird v. United States* explained that "it is the 'likelihood of the outcome' of the government's action that distinguishes its takings from its torts." *Baird v. United States*, 5 Cl. Ct. 324, 330 (1984) (quoting *Bettini v. United States*, 4 Cl. Ct. 755, 760 (1984)); *Berenholz v. United States,* 1 Cl. Ct. 620, 628 (1982) ("The likelihood of the outcome serves to distinguish conduct which is taking from that which is tortious."), *aff'd*, 723 F.2d 68 (Fed. Cir. 1983)). In other words, "the probability and foreseeability of the damage is a primary determinative element in whether a taking or tort occurred." *Baird v. United States*, 5 Cl. Ct. 324, 330 (1984).

In this regard, the court finds that *Cary* is plainly distinguishable from the present case. *Cary* involved a forest fire started by a hunter where the government was sued for a taking because it had left dead wood in the forest which made the forest fire worse than it would have been without the dead timber. The government has focused on the portions of *Cary* finding that there was only a long sequence of decisions, some of which increased risk, and others which decreased risk, which was insufficient to demonstrate that the loss of the plaintiffs' property was the direct, natural, or probable result of the Forest Service's timber removal policies. The plaintiffs, on the other hand, rely upon

Cary's recognition that a series of events can give rise to a taking. *Cary*, 552 F.3d at 1379. In *Cary*, the Federal Circuit discussed and distinguished flooding cases, including *Cotton Land*, holding that "[t]he key difference between the flood cases and the instant controversy is that the policy of suppressing fires did not set the [fire] in motion as the dams did the floods." *Id.* Thus, in flooding cases, foreseeability has been found where the Corps removal and subsequent repair of a section of a dike protecting the plaintiffs' property from Lake Erie caused the dike to weaken and erode, because "the washout of the dike and flooding of the farm were the natural and probable consequences of defendant's conduct in creating the breach." *Berenholz*, 1 Cl. Ct. at 627. The court in *Cotton Land* held that a taking had occurred because "[t]he events which occurred, although they took some time, were only the natural consequences of the collision of sediment-bearing flowing water with still water, and the progress upstream, of the deposit begun by that collision." *Cotton Land*, 75 F. Supp. at 233. The court found that "a succession of events was initiated which, when the events had all occurred in their natural order, deprived the company of the beneficial use of its land." *Id.*

Similarly, in *Barnes v. United States*, the Court of Claims determined that the government's control of the Missouri River through its construction and operation of the Fort Randall and Gavins Point Dams on the Missouri River had the "natural consequence" of producing a sediment delta on the Niobrara River, a tributary, resulting in the intermittent and inevitably recurring flooding of the plaintiffs' lands. *Barnes v. United States*, 538 F.2d 865, 872 (Ct. Cl. 1976). The court found that "the delta's unprecedented size and tenacity were natural consequences of the closing of the dams in

the area, and that the flooding [of the plaintiffs' properties] was a natural consequence of delta growth." *Id.* The court also held that "[t]he flooding has been occasioned by authorized Government action for public use–construction and operation of the Fort Randall and Gavins Point Dams." *Id.* The court mentioned that "[t]he stipulation shows that defendant anticipated the creation of a delta and a rise in the groundwater elevations in the area." *Id.* at 873.

The Federal Circuit in *Ark. Game & Fish III* affirmed the Court of Federal Claim's finding that the flooding was foreseeable because "the Corps of Engineers could have foreseen that the series of deviations approved during the 1990s would lead to substantially increased flooding of the Management Area and, ultimately, to the loss of large numbers of trees there." *Ark. Game & Fish III*, 736 F.3d at 1372-3. The Federal Circuit additionally noted that the Court of Federal Claims also "found that during the deviation period[,] the Commission put the Corps of Engineers on notice of the impact the deviations were having." *Id.* at 1373. Although Commission representatives had complained that the long flooding periods caused by the Corps' deviation policies were damaging timber resources, the Corps had continued to approve said deviations during the growing season of 2000. *Id.* In view of the foregoing precedents, the court finds that the plaintiffs will be able to satisfy their burden if they can show that higher WSEs are a direct and natural consequence of the cumulative and combined effects of the System and River Changes taken by the Corps to meet its ESA obligations.

Second, the court also finds that foreseeability is judged on an objective basis. *See Moden*, 404 F.3d at 1344 n.3. Thus, the Corps' subjective foresight of injury is not

required. *Cotton Land*, 75 F. Supp. at 235 ("it is not necessary, in order to take jurisdiction of a suit for compensation for property taken, to find that the Government's agents were aware that their acts would result in its taking, so that their performance of the acts can be regarded as a somewhat tenuous promise to pay.").

Finally, as will be discussed in the Liability Findings (Expert Testimony) section, the issue of causation and foreseeability is different for the flooding in 2011 than the other years. Plaintiffs are relying on a single purpose theory to prove that the Corps' System and River Changes together, caused foreseeable flooding in each year. A distinction must be drawn from the flooding in 2011, which was tied directly to System releases aimed at protecting the integrity of the dams and reservoirs, and the flooding in 2007, 2008, 2010, 2013, and 2014. The Corps made System releases in 2007, 2008, 2010, 2013, and 2014 for T&E species which, plaintiffs argue, together with the River Changes had the direct, natural, and probable effect of causing flooding or more severe flooding in 2007, 2008, 2010, 2013, and 2014. The Corps' System releases in 2011 were not part of the single purpose of meeting the Corps' obligations to protect T&E species.[27] As such, the plaintiffs will need to separately prove causation and foreseeability for flooding in 2011.

3. Severity

[27] Plaintiffs argue that the 2011 flood was a consequence of the Corps changing its priorities and deciding that flood control would no longer be considered the Corps' first priority. The plaintiffs, through their expert, Dr. Christensen, conceded that the System releases in 2011 were not related to the Corps' ESA obligations under the 2003 BiOp.

To prove liability for a taking, plaintiffs must not only establish that the flooding was caused by authorized government action and was the intended or natural, direct, and probable consequence of the government's actions, but also that "the injury constituted a sufficiently severe invasion that interfered with the landowner's reasonable expectations as to the use of the land." *Ark. Game & Fish III,* 736 F.3d at 1370 (citation omitted). In this phase of the litigation the court did not require plaintiffs to establish the full extent of the injury to their property interests. Issues regarding the full extent of the injury and of valuing the interest taken have been reserved for the second phase of the litigation.

The plaintiffs argue that for the purpose of proving severity, they need only show that the injuries to their properties have been more than *de minimis* and have "interfered with the landowner's reasonable expectations as to the use of the land." Pls.' Br. at 99 (citing *Ark. Game & Fish III*, 736 F.3d at 1370). The plaintiffs also argue that in evaluating the severity of the flooding, this court should again consider "the collective effects of *all* the MRRP flooding resulting from [the] single purpose[.]" *Id.* at 96 (citing *Ark. Game & Fish III*, 736 F.3d at 1370).

The plaintiffs maintain that because flooding involves a physical occupation of land, "[t]he damage can be substantial even if the flooding does not take the whole of the property." *Id.* at 97 (citing *United States v. Cress*, 243 U.S. 316, 328 (1917) ("[I]t is the character of the invasion, not the amount of damage resulting from it, so long as the damage is substantial, that determines the question whether it is a taking.")). In this connection, plaintiffs explain that only a few inches of surface flooding or an increase of several inches in the groundwater table can cause drainage and/or seepage flooding that

interferes with planting for an entire year. *Id.* at 97-8. Plaintiffs assert that, for many plaintiffs, where there have been repeated years of flooding, the Corps' System and River Changes "threaten[] to wipe out an entire way of life." *Id.* at 98.

The government argues that plaintiffs can only establish a taking if the flooding they prove "exceeded 'a range that the property owner could have reasonably expected to experience in the natural course of things,' or the government action 'impaired the use of the lands for agricultural purposes.'" Def.'s Resp. at 45 (quoting *Ark. Game & Fish* III, 736 F.3d at 1374-5 (citation omitted)). The government insists, contrary to plaintiffs' contentions, that "the question is not simply whether [p]laintiffs experience—for example—longer, or more severe flooding now compared to before the agency action that changes the character of the use of the land, but rather, how much—if any—of the increase is caused by the agency action, and whether that amount, relative to the other causes, results in a taking." Def.'s Br. at 80 (citing *Alost v. United States*, 73 Fed. Cl. 480, 494 (Fed. Cl. 2006)). The government explains that "when natural flooding will last a large number of days and at depths that would already cause damage—such as destroying crops—the addition of an incremental length of days of flooding or depth due to government action is unlikely to 'materially enhance' the damage caused by the flood and result in a taking." *Id.* at 81 (quoting *Leeth v. United States*, 22 Cl. Ct. 467, 487 (1991)). The government contends that in establishing the severity necessary to prove a taking, courts consider the character of the land, such as the flood-prone nature of the property, historical flooding events, and historical weather patterns, when assessing causation and severity. In addition, the government argues based on *Keystone*

Bituminous Coal Ass'n v. DeBenedictis, that the court should also consider the "parcel as a whole" because plaintiffs "have not alleged, nor can they show, that there has been a permanent physical occupation of their property or a complete seizure of a portion of their properties." Def.'s Br. at 81 (citing 480 U.S. 470, 500 (1987)).

The court finds that at this stage of the litigation, for purposes of establishing severity, it is sufficient for plaintiffs to show that government-induced flooding has interfered with plaintiffs' ability to use their land for its intended purposes. The court heard uncontroverted testimony from each plaintiff as to how the flooding interfered with their use of their property and the nature of the damages suffered. In *Ark. Game & Fish III*, the Federal Circuit rejected the government's argument that "the marginal increase in flooding did not constitute a sufficiently severe invasion of the Commission's property rights to support a takings claim." *Ark. Game & Fish III*, 736 F.3d at 1374. The court further explained that "[t]he point is not that there was flooding before the deviations; the point is that after the deviations began the flooding lasted for significantly longer periods of time and had much more serious consequences than the flooding of the pre-deviation period." *Id.* The Federal Circuit explained that it is not "unreasonable to measure the severity of the interference with a property owner's rights by looking to the effects of the interference[;] [the] interference with the Commission's property rights [is considered to be] as depriving the Commission 'of the customary use of the Management Area as a forest and wildlife preserve.'" *Id.* at 1375 (citing *Ark. Game & Fish*, 568 U.S. at 37-8). The Federal Circuit mentioned that "[i]ndeed, it may often be difficult to say, in the abstract, whether a particular intrusion is severe or only incremental in nature;

consideration of the effects of the intrusion on the property owner will often make that distinction easier to draw." *Id.*

In this connection, the court finds that the government's reliance on *Keystone Bituminous Coal* and its related arguments regarding the "parcel as a whole test" are misplaced and unpersuasive. *Keystone Bituminous Coal* is a regulatory takings case and thus is not applicable here. *See Tahoe-Sierra Pres. Council, Inc.,* 535 U.S. at 326-7. Nor is the "parcel as a whole" test applicable or appropriate for determining the severity of government-induced flooding in a physical takings case. *See id.* In *Tahoe-Sierra*, the Supreme Court made clear that "[w]hen the government physically takes possession of an interest in property for some public purpose, it has a categorical duty to compensate the former owner, regardless of whether the interest that is taken constitutes an entire parcel or merely a part thereof." *Id.* at 322 (citing *United States v. Pewee Coal Co.*, 341 U.S. 114, 115 (1951)).

At this stage of the litigation, plaintiffs who are able to prove an invasion by government flooding that interfered with that plaintiff's use and enjoyment of the property for some period of time (which can be established by combining the impacts of flood events over multiple years) will be allowed to proceed to the next phase of the litigation.

III. Liability Findings (Expert Testimony)

The plaintiffs retained three experts to support their takings claims based on flooding in 2007, 2008, 2010, 2011, 2013, and 2014. In keeping with their theory that that the flooding was caused by the cumulative and combined effects of the Corps'

System and River Changes,[28] the plaintiffs focused their experts' testimony on how the Corps' System and River Changes together caused higher water surface elevations ("WSEs") in the River, which led to atypical flooding, namely flooding that would not have occurred or was more severe.[29] The plaintiffs retained Dr. Ronald Kurt Christensen, Ph.D., P.E., J.D., Dr. Ted Hromadka II, Ph.D., Ph.D., Ph.D., D.WRE, P.E., P.G., P.H., and Mr. Glenn Tofani, P.E., G.E.

Dr. Christensen's opinion testimony focused on a "but for" analysis to show WSEs in a world without the Corps' System and River Changes, as compared to WSEs in the "actual" world with the Corps' System and River Changes for each year of flooding. Dr. Christensen opined that the difference in WSEs between the "but for" and "actual" world was explained by the Corps' System and River Changes, and that together the Corps' System and River Changes caused flooding that would not have occurred or would not have been as severe.

Dr. Hromadka's opinion testimony focused on the hydrological reasons for how and why the Corps' River Changes caused a rise in WSEs, and thus why the Corps' River Changes, together with the System Changes, caused plaintiffs to experience more flooding or more severe flooding than before the System and River Changes were undertaken by the Corps. He also opined as to why the flooding caused by the Corps'

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[28] Throughout the trial, the plaintiffs argued that the Corps' System and River Changes were made to meet the Corps' ESA obligations. They also argued that by virtue of the Corps' ESA obligations, flood control was no longer the Corps' first priority and that this shift in priorities also led to increased flooding. *See, e.g.*, Tr. 4517:23-4525:11 (Christensen).

[29] The plaintiffs relied on the testimony of each individual plaintiff to establish the severity of flooding for the years in question.

System and River Changes was foreseeable as a natural, direct, and probable consequence of the System and River Changes. Finally, he testified regarding the flooding claimed by each plaintiff and offered his opinion as to whether the Corps' System and River Changes were a foreseeable cause of the flooding on each plaintiff's property. In this connection, Dr. Hromadka explained that there were different reasons for flooding on various plaintiffs' properties. For the properties adjacent to the River, there was overbank flooding, blocked drainage, and seepage. For properties further away from the River, including properties behind levee systems, there was flooding associated with levee overtopping and with blocked drainage and seepage. Dr. Hromadka did not testify as a levee expert, but was qualified to testify regarding blocked drainage and seepage, which are effects from higher WSEs. In formulating his opinions regarding flooding from levee failures, Dr. Hromadka relied on the testimony of Mr. Tofani, an expert in levee construction who was retained by plaintiffs to opine on the effect of higher WSEs on levees in the vicinity of plaintiffs' properties, including the effects of levee overtopping, blocked drainage, and seepage.

Mr. Tofani offered his analyses and opinions regarding the effect of WSEs on levees and on the failure of various levees during the years in question. There are many levees protecting properties from flooding along the lower River. As discussed *infra*, many of the levees at issue are private levees or levees that are part of the federal government's Public Law 84-99 ("PL 84-99") program that failed and caused flooding in some of the years at issue. In addition, several properties were flooded when a few federally owned and operated levees failed in 2011. Mr. Tofani opined as to each

plaintiff claiming flooding based on levee overtopping and/or levee failure. He relied, as did Dr. Hromadka, on the WSE analysis of Dr. Christensen and testified as to how those higher WSEs translated to higher water levels on affected levees, which caused them to overtop with some then failing. Mr. Tofani offered his opinions as to whether any of the levees would have overtopped or failed in the "but for" world modeled by Dr. Christensen. Mr. Tofani also prepared a separate analysis in connection with one of the federal levees that failed in 2011 because it was adjacent to a re-opened chute. Finally, Mr. Tofani offered his opinions regarding the effects of blocked drainage and seepage that he determined were caused by the Corps' System and River Changes.

The government, in response to the plaintiffs' experts, presented the testimony of experts of its own, as well as the testimony of many professional government employees from several agencies, including the Corps, who challenged the analyses and opinions of the plaintiffs' experts with their own opinions. The government retained Dr. Robert Mussetter, Ph.D., P.E., Mr. Mark Woodbury, M.S., Dr. Jeffrey Schaefer, Ph.D., P.E., P.G., and Dr. Andrew Kopania, D.Env., P.G.

The government presented Dr. Mussetter, who offered his analyses and opinions to show, based on modeling he had conducted, that the Corps' changes to the River he modeled did not cause flooding, but in fact had a positive effect on lowering WSEs in many situations by allowing more water to spread across the floodplain.

The government also relied on Mr. Woodbury, a civil engineer, who, based on his modeling and Dr. Mussetter's calculations, opined that the changes to the System and River that he modeled, which were not the same as those modeled by plaintiffs' experts,

did not have a significant impact on WSEs in the River and thus did not cause flooding or make flooding significantly more severe in the years in question. Importantly, the LIDAR imagery[30] presented by Mr. Woodbury, as part of his analysis, confirmed that virtually all of the flooding complained of by plaintiffs in fact occurred and was almost always attributable, at least in part, to elevated WSEs in the Missouri River. Based on his modeling, Mr. Woodbury presented his opinion as to each plaintiff's flooding claim and opined as to whether, based on the changes he modeled, the Corps' actions caused more or fewer days of flooding than would have occurred without the changes he modeled.

The government also presented the expert testimony of two witnesses to respond to Mr. Tofani's opinions regarding levee failure, blocked drainage, and seepage. Dr. Schaefer was called as the government's levee expert. He focused his testimony on the 2011 levee failures. Dr. Schaefer opined that the 2011 levee failures were caused by the extraordinary high flows in the River and that Mr. Tofani's contention that a re-opened chute contributed to one of the federal levee failures was not supported. Dr. Schaefer also examined whether the Corps' changes, as modeled by Mr. Woodbury, caused increased seepage and concluded they did not. Relying upon the same modeling, Dr. Schaefer concluded that none of the Corps' actions could have led to any erosion on plaintiffs' properties either. The government also offered the testimony of Dr. Kopania, who relying on Mr. Woodbury's modeling, offered his opinion that he did not find

[30] LIDAR is a remote-sensing surveying method produced by the government that creates three-dimensional pictures of particular points on the Earth's surface on specific dates.

evidence to show that groundwater levels rose due to increases in WSEs, and thus the Corps was not responsible for causing additional seepage.

The government further relied on the testimony of several professional Corps employees who work on the Missouri River, who offered their opinions as to whether the increased WSEs measured on the River could be instead explained by the plaintiffs' actions. Specifically, these Corps employees testified that by building private levees, the plaintiffs had constricted river flows and caused higher WSEs. These government witnesses did not, however, present any analysis or data to support their assertions. The government also presented the testimony of other government witnesses, most particularly Jody Farhart, who was responsible for System operations during the relevant time period and who explained that the Corps did not ignore flood control when it made releases, most especially in 2011.

Finally, the government presented witnesses from other government agencies, including FWS, Federal Emergency Management Agency ("FEMA"), and National Oceanic and Atmospheric Administration ("NOAA"), who testified to various facts associated with the Corps' ESA compliance history, weather patterns during the flood years in question, and where plaintiffs' properties were located on FEMA maps within the Missouri River floodplain.

In the sections that follow, the court will review the plaintiffs' experts' testimony, the government's experts' testimony, and the government's witness testimony in detail, with the understanding, as discussed in the Legal Standards section, that the court agrees with the plaintiffs that where, as here, the Corps made systemic changes to its

management of the System and to the River in order to meet its ESA obligations, it is not necessary for the plaintiffs to pinpoint the precise Corps actions at each property to establish "but for" causation and foreseeability. The plaintiffs' "but for" causation burden rises and falls on their ability to show for each year of flooding that the cumulative and combined effects of the Corps' System and River Changes resulted in foreseeable flooding that was either greater than what would have occurred without these Changes or would have been prevented altogether. In this connection, as also discussed above, the plaintiffs can only meet their foreseeability burden by establishing that the flooding was either the intended result of the Corps' actions or the direct, natural, and probable consequence of the Corps' actions.

1. Causation and Foreseeability

a. Dr. Christensen

Dr. Ronald Kurt Christensen, Ph.D., P.E., J.D., is a professional engineer with 36 years of experience in civil, reservoir, and river environmental engineering. Tr. 4461:22-4462:1; PX2050. He holds a B.S. in Watershed Science from Utah State University, College of Natural Resources (1978). Tr. 4464:5-18; PX2050. He received his M.S. in Civil Engineering in 1980 from Utah State University, where he studied Water Hydrology and River and Reservoir Management. Tr. 4463:20-4464:3; PX2050. He received a Ph.D. in Civil and Environmental Engineering from Utah State University in 1996. Tr. 4463:7-19; PX2050. He also holds a J.D. from the University of Utah College of Law (1999). Tr. 4462:4-6; PX2050. He is a licensed Professional Engineer in Alabama, New Mexico, and Utah and is a member of the American Society of Civil

Engineers. Tr. 4464:19-24; PX2050. Dr. Christensen was an adjunct professor of Civil and Environmental Engineering from 1998 to 2002 at Utah State University. Tr. 4465:11-14; PX2050. In 2007, he was an adjunct Hydrology instructor at Utah Valley State College. Tr. 4465:9-11; PX2050.

Dr. Christensen has had extensive experience studying the hydrology and operations of rivers, dams, and reservoirs. Tr. 4465:15-22; PX2050. As the owner of Water and Environmental Services, LLC, a consulting firm, he has worked specifically on issues of reservoir and river operations, including work studying the Flathead Lake and Reservoir in Montana between 2015 and 2016, where he did an analysis of flooding, hydropower, and erosion. Tr. 4464:22-4467:4, 4472:12-16; PX2050. He also studied flood operations and hydrology for the R.L. Harris Dam on the Tallapoosa River in Alabama. Tr. 4468:15-23; PX2050. In conducting his work, Dr. Christensen explained that he has applied various modeling techniques, including the Corps' HEC-RAS computer model on several occasions.[31] Tr. 4470:4-4472:20, 4482:12-4485:20; PX2050. He explained the circumstances in which he determined that the Corps' HEC-RAS model is helpful and, as discussed *infra*, why he did not use the HEC-RAS model in his work

[31] HEC-RAS is a modeling system that is used by the Corps and others to determine the effects of individual changes to a river, such as the construction of a bridge across a river which will likely lead to constricting the river. *See*, *e.g.*, Tr. 4470:4-4471:2 (Christensen). Dr. Christensen testified that most recently he had used HEC-RAS to analyze the levee breach on the Missouri River at the Iatan Power Plant in Missouri. Tr. 4471:15-4472:4. He has also used the computer program for single-event analysis and floodplain mapping. Tr. 4471:1-2. Dr. Christensen explained that it is not used to model an entire complex river. Tr. 5026:7-11. *See also* Tr. 11605:12-15, 11611:13-16 (Woodbury; admitting that one-dimensional models such as HEC-RAS cannot effectively capture "three-dimensional effects" or "the hydrodynamic complexities" of a flooding river.); PX2229 at 3 ("there is concern over the ability of 1D [hydraulic] models [such as HEC-RAS] to effectively capture the hydrodynamic complexities of a river in flood[.]").

for this case. Tr. 4702:10-4712:18. The court finds Dr. Christensen to be a highly reliable and credible witness with both impressive credentials and extensive relevant experience on the issues of causation and foreseeability in connection with reservoir operations and river hydrology.

Dr. Christensen testified that he was engaged by plaintiffs to evaluate, analyze, and assess the changes the Corps has made to its policies and procedures regarding the operation and management of the mainstem reservoir System ("System Changes").[32] Tr. 4487:5-25. In this context he explained the new Master Manual "made changes to navigation releases for conservation" and "made changes to releases for T&E species protection." Tr. 4537:10-27, 4539:3-4. He further explained "[t]he BiOp requires two distinct types of releases to benefit T&E species. First, variable flows to benefit the pallid sturgeon . . . [a]nd second, releases designed to aid the nesting of and avoid the taking of least terns and piping plovers." Tr. 4539:5-7, 21-23. He testified that he was also engaged by plaintiffs to evaluate, analyze, and assess the changes the Corps has made and is continuing to make to the Missouri River channel ("River Changes").[33] Tr. 4487:5-25.

[32] Dr. Christensen identified six significant System Changes: (1) the Corps "deprioritized flood control" by balancing all System authorized purposes equally (Tr. 4517:23-4524:11); (2) the Corps reduced the amount of System flood control storage (Tr. 4525:4-4529:7); (3) the Corps modified its navigation releases for conservation, resulting in less reservoir storage capacity (Tr. 4529:25-4530:4, 4535:15-4539:2); (4) the Corps replaced Plate 44 in the 1979 Master Manual with Plate VI-1 in the new Master Manual, which meant that release minimums were replaced by advisory guidance (Tr. 4529:20-24, 4530:5-4535:7); (5) the Corps increased the frequency of T&E releases (Tr. 4539:3-4547:16); and (6) the Corps adopted an "adaptive management" approach to meet its ESA obligations, which gave it more operational flexibility to protect T&E species (Tr. 4513:13-16, 4514:17-24, 4524:15-4525:3).

[33] Dr. Christensen identified four significant River Changes: (1) the Corps modified, removed, and failed to maintain dikes and revetments (Tr. 4662:16-23, 4667:13-23); (2) the Corps created chevrons, chutes, and backwater areas (Tr. 4662:16-23, 4667:13-23, 4674:6-4675:3); (3) the

He explained that the "2003 amended BiOp . . . ordered that and directed that the Corps needed to restore the connectivity of the floodplain to the river." Tr. 4661:7-10. Specifically, he testified that the 2003 amended BiOp "ordered that shallow-water habitat be constructed or be created some way or another for [the] endangered pallid sturgeon." Tr. 4661:20-22. Additionally, he explained that "[i]n 2004 as required by the ROD, the Corps deprioritized flood control and accelerated . . . its modification of river control structures[,] . . . the reintroduction of chutes and, . . . the construction of various habitat projects[.]" Tr. 4662:18-23. He testified that he was asked by plaintiffs to offer opinions based on his assessments and analyses as to whether and to what extent the Corps' System and River Changes have contributed to the increased incidents of flooding and to the severity, frequency, and duration of flooding on the Missouri River since those System and River Changes have been implemented by the Corps. Tr. 4487:15-18.

Although, as discussed below, Dr. Christensen analyzed each of the flood years separately, Dr. Christensen offered the following generalized opinions. First, he opined that "[t]he Corps' changes to its operation and management of the [S]ystem post-2004 contributed to cause higher water surface elevations downstream of the [S]ystem and flooding of greater frequency, severity and/or duration than would have otherwise occurred." Tr. 4488:6-11. Second, he opined that "[t]he Corps' changes to its operation and management of the [R]iver channel had the cumulative effect of reducing the flood

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Corps constructed SWH and ESH projects for T&E species (Tr. 4662:16-23, 4663:23-4665:14, 4676:12-4677:15); and (4) the Corps added sediment to the River (Tr. 4673:22-4674:5, 4680:11-16, 4691:18-19).

carrying capacity of the [R]iver, allowing the lateral migration of water to the floodplain during high-water events, sloughing and eroding the riverbanks, and contributing to cause high water surface elevations and flooding . . . of greater frequency, severity, and/or duration than would have otherwise occurred." Tr. 4488:12-21. Third, Dr. Christensen opined that "[b]ut for the Corps' changes to its policies and procedures for the operation and management of the [S]ystem and . . . the [R]iver, the flooding of [p]laintiffs' properties either would not have occurred or would have been of lesser frequency, severity and duration." Tr. 4488:22-4489:2. Finally, he opined that "[u]nless the Corps reverts to its prior policies and procedures for the operation and management of the [S]ystem and the [R]iver, the increased levels of flooding will continue." Tr. 4489:3-6.

Dr. Christensen distinguished the flooding in 2011 from the other years of flooding at issue in the case. Specifically, he acknowledged that not all of the flooding experienced by all plaintiffs "could have or would have been avoided[]" in 2011. Tr. 4489:18-4490:1. In contrast to the other years of flooding, Dr. Christensen also opined that the System releases in 2011 were made solely because of inadequate System storage in the reservoirs due to high mountain snowpack and heavy plain snowpack. Tr. 4590:11-23, 4591:21-4592:3. He explained that the "[s]ummary of results are that the lack of system storage forced the Corps to make releases of unprecedented duration and volume throughout the summer of 2011, contributing to and exacerbating catastrophic flooding throughout the basin." 4591:24-4592:3. According to Dr. Christensen, the extensive flooding in 2011 was caused by the Corps' failure to release water from the

reservoirs early enough in the year and in sufficient quantities to minimize flooding. Tr. 4591:24-4594:8.

In contrast to the System releases in 2011, Dr. Christensen explained that the System releases in 2007, 2008, 2010, 2013, and 2014 were made to meet the Corps' obligations under the ESA. Tr. 4539:3-4540:2, 4546:6-4547:16. Dr. Christensen testified that releases from the System for years other than 2011 were sometimes needed to prevent protected bird species from nesting in low-lying areas.[34] Tr. 4539:21-4541:14. Other times, releases were needed to cue the pallid sturgeon to spawn. Tr. 4539:8-20. Dr. Christensen acknowledged that some flooding would still have occurred at points downstream of Gavins Point during 2010, but unlike in 2011, he testified that the Corps in 2010 made T&E releases that made flooding more severe in extent and duration. Tr. 4581:22-4582:18; PX2094-A at 1-3.

The court finds that the releases and the reasons for the releases in 2011 and in 2007, 2008, 2010, 2013, and 2014 are sufficiently different from each other that the 2011 flood needs to be analyzed separately for both causation and foreseeability. Thus, the court will first review Dr. Christensen's analysis and opinions regarding the System Changes for the 2007, 2008, 2010, 2013, and 2014 flooding, and then the court will turn to Dr. Christensen's analysis and opinions regarding the System Changes in 2011. The court will thereafter examine Dr. Christensen's opinions regarding causation and

[34] Under the terms of the 2003 BiOp, the Corps now operates under an incidental take statement which allows the Corps to kill a limited number of birds or eggs without triggering the liability provisions of the ESA.

foreseeability with respect to the River Changes and his analysis of the cumulative and combined effects of the Corps' System and River Changes.

i) System-Related Flooding in 2007, 2008, 2010, 2013, and 2014

Dr. Christensen began his opinion testimony by briefly reviewing the history of the Missouri River and how it has changed over time. Dr. Christensen explained that historically the River was "a braided, multi-channel river . . . [which] flooded regularly[.]" Tr. 4491:14-16. He explained that the River's original connection to its floodplain had allowed native species to flourish. Tr. 4491:16-19. He then explained, as discussed above, that in the 1940s in order to encourage economic development in the Missouri River Basin, "the Government began, through the Corps, to actively regulate and manage all aspects of the [R]iver to provide, amongst other things, flood control and downstream navigation." Tr. 4491:23-4492:4. He testified that under the 1944 Flood Control Act ("FCA"), the six large dams and reservoirs, Fort Peck, Garrison, Oahe, Big Bend, Fort Randall, and Gavins Point, were built by the Corps to provide flood control. Tr. 4494:13-19. He explained that each reservoir in the System has five storage zones: (1) the inactive zone, which is the lowest zone where water is stored continuously; (2) the carryover storage zone, where water can be stored over multiple years and which is emptied and filled for System water uses, including, in order of priority under the 1944 FCA vc(flood control; navigation; hydropower; irrigation, municipal and industrial water supply, and water quality; recreation; and fish and wildlife habitat); (3) the flood control and multiple use zone, which needs to be emptied by March each year, so there is enough

room in the System to capture the snowmelt and hold it to protect against downstream flooding; (4) the exclusive flood-control zone, which is for flood control only and is kept empty except for when there are large floods; and (5) the surcharge zone, which is the uppermost zone and is empty to accommodate large floods that exceed the exclusive flood control zone. Tr. 4495:24-4499:20.

Dr. Christensen testified that flood control is allocated among the reservoirs. Tr. 4499:22-4500:14. *See also* PX2200. He explained that the upper Basin runoff captured by the System includes: (1) plains snowmelt, which usually occurs during March and April; (2) mountain snowmelt, which usually begins in late April and can go through July; and (3) rainfall, which is random but occurs during these melting periods. Tr. 4501:3-4502:17.

Dr. Christensen described his understanding of the Corps' System operations under the 1979 Master Manual and later contrasted that understanding with his understanding of the changes made by the Corps to the Master Manual after 2004, which included changes to meet the Corps' obligations under the ESA to comply with the 2003 BiOp. Tr. 4502:23-4547:16. Under the 1979 Master Manual, Dr. Christensen testified, flood control was the highest priority and fish and wildlife protection had the lowest priority. Tr. 4503:12-23. *See also* PX3 at USACE0004040-1. Dr. Christensen explained that under the 1979 Master Manual, releases from Gavins Point Dam were significantly reduced during periods of high downstream inflows from the tributaries into the Missouri River. Tr. 4503:24-4505:7.

Dr. Christensen testified that in order to implement the BiOp, the Corps changed the Master Manual in 2004 and further revised it in 2006, hereafter the "new Master Manual."[35] Tr. 4513:4-12. According to Dr. Christensen, under the new Master Manual, flood control is no longer the Corps' first priority except when risks to health and safety are imminent. Tr. 4517:23-4524:11. *See also* PX4 at USACE0002644; PX5 at USACE0121577-8, USACE0121590; PX2201. Whereas the 1979 Master Manual clearly identified flood control as the first priority, the new Master Manual states that "Congress did not assign a priority" to any of the 1944 FCA-authorized purposes and "it was contemplated that the Corps . . . would balance these functions in order to obtain the optimum development and utilization of the water resources of the Missouri River [B]asin to best serve the needs of the people." PX5 at USACE0121590. The new Master Manual further states that the Corps would now abide by four objectives: "first, to serve the contemporary needs of the [B]asin and the Nation; second, to serve the Congressionally authorized project purposes; third to comply with other applicable statutory and regulatory requirements including environmental laws such as the Endangered Species Act (ESA); and fourth, to fulfill the Corps' responsibilities to Federally recognized Tribes." *Id.* *See also* PX2201.

[35] Dr. Christensen explained that in addition to operating reservoirs and dams, the Corps' pre-2004 actions over the years had served to disconnect the Missouri River from its floodplain by channelizing the previously shallow and braided river. Tr. 4492:5-14. In so doing, he testified, "[t]housands of acres of habitat of native fish and wildlife were destroyed, including the habitat of what are now considered threatened and endangered species . . . under the ESA[.]" Tr. 4492:15-19. As discussed previously, concerns over these environmental consequences led to litigation forcing the Corps to make changes to its policies and practices to better protect and promote T&E species. Ultimately, this litigation resulted in a court order requiring the Corps to implement the 2003 BiOp of the FWS.

Dr. Christensen explained that to comply with the 2003 BiOp, the Corps began to make very specific releases downstream to benefit T&E species ("T&E releases").[36] Tr. 4539:3-4540:2. First, to benefit the interior least tern and piping plover, he testified that the Corps began making releases using cycled or heavy steady spring flows to prevent the least terns and plovers from building low-lying nests for fear these nests would wash away, and then the Corps would lower the releases downstream to prevent flooding once the nests were made. Tr. 4539:21-4541:4. Second, to benefit the pallid sturgeon, Dr. Christensen explained that the Corps began making additional releases downstream. Tr. 4539:8-20. These releases involved increasing flows in the spring in order to provide spawning cues to the sturgeon. *Id.* The court understands that the Corps also lowered releases in the summer in order to protect the SWH the Corps had created for the sturgeon.[37]

Dr. Christensen opined that the T&E releases needed to meet the Corps' ESA obligations compromised flood control because cycled releases were made by the Corps at the same time that the lower River was facing large tributary inflows or rain. Tr. 4541:8-14. According to Dr. Christensen, the Corps' releases made to comply with the ESA added to downstream flooding in 2007, 2008, 2010, 2013, and 2014.[38] Tr. 4546:22-

[36] Dr. Christensen acknowledged that the Corps had periodically made releases for species protection starting in 1986, but explained that under the new Master Manual, these T&E releases are now mandatory to comply with the ESA. Tr. 4541:5-14.
[37] Dr. Christensen explained that reductions in releases for T&E protection can interfere with flood protection whenever higher releases are needed to empty the reservoirs to provide space for upper Basin runoff the next year. Tr. 4541:8-14, 4546:6-21.
[38] The benefits to the least terns and plovers, as well as to the pallid sturgeon, from flooding were acknowledged by both Corps and FWS witnesses at trial. Mr. Casey Kruse, the Missouri River coordinator for the FWS, testified that big floods benefit the bird species by improving habitat.

4547:16. He reached that conclusion based upon a model he created to compare River water levels in a "but for" world where the Corps did not have to make releases for ESA compliance with those in the "actual world" with the T&E releases needed for ESA compliance. Tr. 4547:24-4549:11.

Dr. Christensen characterized his model as "simple, because it [was] based on measured data, actual Corps past practices, and the applicable criteria, rather than elaborate computer simulation." Tr. 4549:12-15. Dr. Christensen treated the six reservoirs of the System as a single reservoir for modeling purposes, and thus he only modeled releases from Gavins Point, the last reservoir in the System. Tr. 4552:22-4553:2. He claimed that he accounted for differences in available storage in individual reservoirs in his calculations of a single release from Gavins Point Dam, stating that at "the end of the month [S]ystem storage [for all reservoirs was] equal to the previous month storage, plus net inflow minus net outflow[.]" Tr. 4553:3-6. Regarding assumptions, Dr. Christensen explained that in his "but for" world, flood control remained the number one priority and that the Corps would have continued to make releases that benefited flood control. Tr. 4551:7-20. He further explained that he modeled the years 1993 through 1999, as well as the period from 2000 to 2015, in order to capture two high flow years before the Corps implemented the new Master Manual. Tr. 4553:8-15. He used 1993 through 1999 to model actual System releases and the

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Tr. 1155:7-12. Mr. Bitner, from the Corps, testified that overbank flooding also helped the pallid sturgeon by washing biota and nutrients into the River. Tr. 1740:14-23.

period from 2000 to 2015 to model old policy operations under the 1979 Master Manual. *Id.* He then explained his modeling results for each year of flooding.

For 2007, Dr. Christensen testified that "the Corps' actual releases in 2007 were higher than they would have been under the [1979 Master Manual] and policies. The primary reason for the difference was the changes the Corps made to its release schedule for T&E low nesting prevention and conservation." Tr. 4557:13-23. Specifically, he explained that the Corps in 2007 made higher T&E releases in the spring despite high downstream inflows and that because these higher releases coincided with the highest downstream flows, there was increased flooding. Tr. 4556:22-4558:1. Under Dr. Christensen's "but for" model, the Corps would have limited its releases to 6,000 cubic feet per second ("cfs") during critical periods, instead of making T&E releases. Tr. 4559:5-9, 4567:5-9; PX2060-A at 2; PX2091-A at 1-2. Dr. Christensen acknowledged that the additional releases for T&E species in the actual world in 2007, as compared to overall flows downstream, were not necessarily large. Tr. 4558:12-4559:23. He opined, however, that because they added flow, these T&E releases contributed to higher WSEs, thus causing greater flooding in 2007 than would have occurred without these T&E releases. Tr. 4557:16-4567:25. For example, he explained that on May 2nd, the Corps began higher T&E releases, which, due to travel time, coincided with the May 7th and 8th critical high flows. Tr. 4573:9-13. Evidence presented by the government showed that, during periods of peak flow, releases from Gavins Point made up approximately five to ten percent of downstream flows in 2007. DX3015-207; DX3015-220; DX3015-221; DX3015-300; DX3015-301; DX3015-394; DX3015-395; DX3015-552; DX3015-553.

Dr. Christensen presented his model results for 2008 and offered the same opinion as he had for 2007, to the effect that releases in 2008 were higher to prevent low T&E bird nesting, despite higher downstream inflows, and that because they coincided with periods of higher downstream flows, these T&E releases caused more severe flooding than would have occurred without these releases. Tr. 4573:23-4575:9. Dr. Christensen explained that in the "but for" world, the Corps would have reduced releases in 2008 when the Corps had some reason to anticipate higher tributary flows. Tr. 4574:3-8, 4576:3-7; PX2060-A at 3; PX2091-A at 3-4. According to Dr. Christensen, the differences between his models under the "but for" world and the actual world for May and June were greater for 2008 than for 2007. Tr. 4576:21-24. Evidence presented by the government showed that during periods of peak flow, releases from Gavins Point made up approximately five to fifteen percent of the downstream flow in 2008. DX3015-207; DX3015-220; DX3015-222; DX3015-300; DX3015-302; DX3015-394; DX3015-397; DX3015-552; DX3015-554.

Dr. Christensen explained that System storage was a factor in the flooding that occurred in 2010 because "reduced storage capacity . . . led to higher releases" from the System. Tr. 4578:13-19. According to Dr. Christenson, "[c]arryover storage [in 2010] was more full than it would have been pre-2004 due to the Corps' new policies and practices of reduced releases for conservation and reduced capacity due to sedimentation." Tr. 4578:23-4579:2. Specifically, Dr. Christensen testified that, due to high plains snowpack melt and precipitation, the three largest downstream reservoirs were filled into the exclusive flood control zone early: Oahe by the end of May; Fort

Randall by the end of June; and Garrison by the end of July. Tr. 4579: 3-6, 4580:5-13. During June, July, and most of August, considerable downstream flooding occurred, which, Dr. Christensen opined, was exacerbated by the high releases from the System, including T&E releases that "coincided with the highest downstream peak flows[.]" Tr. 4582:4-25. Dr. Christensen conceded that this was one of the years of flooding in which all flooding could not have been avoided in the "but for" world. PX2094-A at 1-3. Dr. Christensen explained that under the 1979 Master Manual, the Corps would have had more capacity in the reservoirs because it would not have retained as much water in the reservoirs from the prior drought year, and when there was downstream flooding, the Corps would not have conducted T&E releases. Tr. 4578:24-4579:2, 4583:2-5. Dr. Christensen testified that in the "but for" world, the Corps would have kept releases lower during June and July when the highest downstream flows occurred, and the lower releases would therefore have reduced the flooding in 2010. Tr. 4588:21-4589:5; PX2060-A at 4; PX2094-A at 1-3. Evidence presented by the government showed that during periods of peak flows in 2010, releases from Gavins Point made up fifteen to twenty percent of the flow. DX3015-207; DX3015-220; DX3015-223; DX3015-300; DX3015-303; DX3015-394; DX3015-398; DX3015-552; DX3015-555.

Dr. Christensen testified that T&E releases in 2013 caused increased flooding. Tr. 4647:10-17. He explained that despite higher downstream inflows during late May and early June, the Corps maintained higher T&E releases, which "coincided with the highest downstream flows and increased the flooding." Tr. 4647:4-17. Dr. Christensen testified that in the "but for" world, the Corps would have reduced releases when there were high

downstream flows. Tr. 4647:6-12, 4648:18-23; PX2091-A at 5-6. Evidence from the government showed that during periods of peak flows, releases from Gavins Point made up twenty to thirty percent of the flow in 2013. DX3015-207; DX3015-220; DX3015-227; DX3015-300; DX3015-308; DX3015-394; DX3015-406; DX3015-552; DX3015-561.

Dr. Christensen testified that T&E releases increased flooding in 2014. Tr. 4650:4-4651:1. He testified that while the Corps reduced releases in June 2014 to accommodate downstream flooding, the Corps maintained higher flows for T&E species purposes, which "coincided with the highest downstream flows and increased the flooding." Tr. 4650:4-19. He explained that the Corps' actions thus "caused higher and longer duration flood flows." Tr. 4650:4-7. Dr. Christensen testified that in the "but for" world, the Corps would not have made T&E releases and would have reduced its releases, reducing the flooding in 2014. Tr. 4650:4-12; PX2091-A at 7-8. Evidence from the government showed that during periods of peak flows, releases from Gavins Point made up ten to twenty percent of the flow in 2014. DX3015-207; DX3015-220; DX3015-229; DX3015-300; DX3015-310; DX3015-394; DX3015-408; DX3015-552; DX3015-563.

The government took issue with Dr. Christensen's System model and his opinions regarding the Corps' System Changes for the years in question. The court has considered those criticisms and has determined that the government's criticisms do not undermine the basic logic and factual support behind Dr. Christensen's opinions. Set forth below are some of the most repeated criticisms for each flood year and the reasons the court finds

that these criticisms do not undercut Dr. Christensen's conclusions. First, the government criticized Dr. Christensen by suggesting that his model required omniscience because it assumed extremely low releases to avoid the highest downstream flows, which the government contends could not be known.[39] *See* Tr. 4572:20-4573:22, 4577:15-4578:11, 4589:6-4590:10, 4648:24-4649:21, 4651:2-22 (Christensen). The court disagrees. The 1979 Master Manual did not require releases for the benefit of fish and wildlife and, based on the priorities articulated in that Master Manual, no releases for fish and wildlife would have been undertaken unless the Corps was assured that there would be no flooding in the lower Basin. PX3 at USACE0004040-1. *See also* Tr. 4503:12-23, 4530:19-22, 4586:12-21 (Christensen), 6611:2-23 (Ponganis). For example, in 2007, just before it increased T&E releases, the Corps had reduced its releases for a brief period because of flooding concerns but then raised T&E releases right at the time of greater downstream inflows. Tr. 4573:1-22. *See also* DX3001-243. In the "but for" world, Dr. Christensen correctly assumes that if flooding was already occurring in the lower River, the Corps would not have resumed releases. The same was true for T&E releases in 2008. *See*, *e.g.*, Tr. 4577:19-4578:11; DX3001-247. Similarly, in 2010, the Corps continued T&E releases after flooding downstream was brought to the Corps' attention. Tr. 4581:22-4584:8. *See also* DX3001-263. After receiving notice that 14 or 18 Missouri River gages were above the flood stage downstream of Gavins Point, the Corps continued to make T&E releases in 2010 because, as Ms. Farhart explained at the time in

[39] The criticism was made by Mr. Woodbury. Mr. Woodbury's background is described at length *infra* in connection with Dr. Hromadka's testimony.

an e-mail to a colleague, "[t]his is the peak of the tern and plover nesting season and if we cut now it may be difficult to go back up if the birds come in and nest low." PX967 at USACE5569989. On June 11, 2010, Ms. Farhart explained to her fellow Corps colleague, Colonel Roger Wilson, that she would continue to cycle releases for the least terns and plovers, stating,

> [a]s you may know, we have been cycling releases from 26,500 cfs to 28,000 cfs for 8 hours every other day to prevent terns and plovers from nesting on low elevation sandbar habitat. As a result of the flooding downstream, Gavins Point releases on the low part of the cycle will be reduced from 26,500 to 22,000 cfs while continuing the 8 hours of 28,000 cfs every other day. This is the peak of the tern and plover nesting season, so maintain[ing] the cycle is critical to prevent large numbers of nest[s] from being established on newly exposed habitat. Once the bulk of the nests are established we will have more flexibility to reduce or eliminate the cycling." *Id.* at USACE5569988.

The Corps continued T&E releases in 2013 and 2014 in the face of increased downstream flows and higher WSEs. Tr. 4647:10-17, 4649:14-18 (2013), 4650:10-19, 4651:22-4652:1 (2014). In fact, in 2015 the Corps continued to make T&E releases after learning that the lower 500 miles of the Missouri River from Nebraska City to St. Louis were three to six feet above flood stage. PX2308 at USACE0356497. At that time, the Corps acknowledged that reduction in releases

would "reduce stages downstream about 1 to 1.5 feet[.]"[40] *Id.* In view of the foregoing facts, the court finds that the government's criticism of Dr. Christensen's testimony based on Mr. Woodbury's claim that Dr. Christensen's modeling requires "omniscience" is not persuasive.

Second, the government criticized Dr. Christensen's model because he did not present modeling or other evidence to show with specificity how he accounted for releases between the individual reservoirs in the System, but instead presented modeled releases from only Gavins Point. Tr. 11355:25-11356:9, 11367:25-11371:20 (Woodbury). The court acknowledges that Dr. Christensen presented modeling only for releases from Gavins Point. However, for flooding in 2007, 2008, 2010, 2013, and 2014, the court finds that the criticism is not well founded. For purposes of modeling downstream flood control, the court is persuaded that releases from Gavins Point were the only relevant releases to consider. The government did not present any evidence to show how releases among the upper reservoirs would have been relevant in modeling a "but for" world, where the flooding for the years in question was all below Gavins Point.[41]

[40] The court recognizes that the 2015 flooding is not at issue in this phase of the litigation, but finds that this evidence confirms the plaintiffs' position that in the actual world ESA compliance has taken precedence over flood reduction and that in the "but for" world the additional releases mandated by the ESA would not been made and thus would not have contributed to River flows and flooding.

[41] Dr. Christensen noted that the flooding in 2010 involved some System storage concerns, but explained that the main contributions to additional flooding were the T&E releases made in the face of downstream flooding. Tr. 4579:25-4582:21.

Third, the government also took issue with Dr. Christensen's use of 6,000 cfs as the minimum daily release in the "but for" world on the grounds that in more recent years, the Corps has had to make higher releases to meet water supply needs below Gavins Point. Tr. 11366:5-11367:23, 11698:1-11700:16 (Woodbury); DX3015-648. The court again finds that the criticism is not well founded. To begin, the 1979 Master Manual explicitly uses 6,000 cfs as the minimum release in order to meet water supply requirements and Dr. Christensen was modeling the "but for" world using the 1979 Master Manual. Tr. 4570:20-4572:19; PX3 at USACE0004043, USACE0004057-8. Moreover, to the extent that the minimum release number should have been 8,000 cfs, as suggested by the government's evidence, the court accepts the government's concession from Mr. Woodbury that an increase of 2,000 cfs would not "drastically change flooding levels[,]" meaning that the minimum amount under either "but for" scenario would likely be the same. Tr. 11702:12-19 (Woodbury).

Fourth, the government criticized Dr. Christensen for failing to take into account the Corps' actions in reducing its releases at various times when it became aware of flood risks downstream. The court does not find this criticism persuasive. The fact that the Corps knew its actions increased flooding during certain periods and changed its releases for a limited period of time only confirms that the Corps made T&E releases during other downstream high flow periods when it was on notice that additional releases would result in higher WSEs and more flooding.[42]

[42] As discussed later in the context of Dr. Hromadka's testimony, the government's evidence of significant rainfall during periods of flooding does not undermine the credibility or reliability of

Finally, the court did not find any of the government's other criticisms of Dr. Christensen's opinions regarding 2007, 2008, 2010, 2013, and 2014 persuasive. As discussed below in detail in connection with Dr. Hromadka's expert testimony, the court does not find the opinions offered by Dr. Mussetter or Mr. Woodbury sufficiently reliable to cause the court to question Dr. Christensen's opinions that the T&E releases mandated by the 2003 BiOp and reflected in the Corps' new Master Manual would not have been made in the "but for" world during periods where downstream flooding was evident or highly likely.

The court finds that Dr. Christensen's testimony is sufficient to show that the Corps' System Changes, which for the years in questions include T&E releases, caused increased WSEs. The court also finds that Dr. Christensen's testimony is sufficient to show that it was foreseeable that by adding flow to the River, the T&E releases would increase flooding in periods of already high River flows below Gavins Point Dam. The increased flooding was a direct, natural, and probable consequence of making T&E releases at times when there was known or expected increased downstream inflows or flooding.

ii) System Changes and the 2011 Flood

There is no dispute that the 2011 flood was a record-setting flood that involved a record 60.8 million acre-feet ("MAF") runoff, the highest since record-keeping began in

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Dr. Christensen's testimony. Flooding usually occurs because of increased precipitation. The plaintiffs contend that it was the Corps' T&E releases in the face of foreseeable flooding, combined with the River Changes made by the Corps to comply with its ESA obligations, that satisfy plaintiffs' causation and foreseeability burden in this case. The court agrees.

1898. DX0192 at DX0192-0007, DX0192-0016. It is also not disputed that starting in June 2011, the Corps released a record 160,000 cfs from Gavins Point for many months to address the record runoff. *Id.* at DX0192-0026. Prior to that time, 70,100 cfs had been the record released from Gavins Point in 1997.[43] *Id.*

To understand Dr. Christensen's "but for" analysis for System Changes with regard to 2011, the court will first review his testimony as to the differences between the 1979 Master Manual and the new Master Manual. According to Dr. Christensen, the entire mainstem "[S]ystem is designed to control inflows up to 40 million acre-feet, March to July, without outflows ever exceeding 100,000 cfs[.]" Tr. 4600:15-19. Dr. Christensen opined that had the Corps followed the release levels set in the 1979 Master Manual, and specifically the levels set in Plate 44 in that Manual, flooding in 2011 would have been less severe. Tr. 4598:25-4599:15. Dr. Christensen opined that had the Corps followed Plate 44 and the 1979 Master Manual, it would have released more water from the reservoirs earlier, in late March or early April, and that had the Corps done so, the Corps would have limited releases from Gavins Point downstream to 100,000 cfs and thus limited the severity of flooding. Tr. 4592:8-4594:8; PX2060-A at 5, PX2094-A at 4-16. He recognized in his opinion testimony that there still would have been significant flooding at 100,000 cfs, but he explained that flood damage would have been greatly reduced. Tr. 4600:15-4601:12. He explained that "the [2011] flood water levels had

[43] The court understands that the 2011 flood was devastating for the plaintiffs. However, as discussed *infra*, in order to establish liability for a taking, the plaintiffs were required to establish causation and foreseeability with regard to the 2011 flood, which the plaintiffs failed to do.

increased by as much as five to six feet in the worst areas and at the very least more than 1.5 feet in all [p]laintiff areas[.]" Tr. 4794:11-15.

Dr. Christensen opined that the increased flooding in 2011 was also foreseeable or a natural, direct, and probable consequence of the Corps having to use Plate VI-1 in the Corps' new Master Manual, rather than Plate 44 from the 1979 Master Manual. Tr. 4594:20-4600:11. Dr. Christensen based his opinion on a comparison of the Corps' response to upper Basin runoff in 1997 and 2011. Tr. 4597:9-4598:4. Dr. Christensen testified that upper Basin runoff in 1997 and 2011 were similar, but that the record runoff in the upper Basin in 1997 did not lead to downstream flooding because of the proactive measures the Corps took to minimize the flooding risk mandated by Plate 44. Tr. 4597:9-4599:15, 4607:3-4612:3. Dr. Christensen produced a chart which contrasts 1997 releases to 2011 releases to show that before the new Master Manual revisions, the Corps made larger releases in 1997 than even the minimum amounts required by the 1979 Master Manual to avoid flooding. Tr. 4607:3-4612:3; PX2203. He testified that if the Master Manual had not been changed, Corps personnel would have been focused on flood control and would have acted in 2011 as they had in 1997. Tr. 4598:1-16, 4624:8-12. He explained that in the actual world, under the new policy of "balanced" priorities, the Corps was not allowed to make earlier releases for flood control because flood control only becomes the highest priority under the new Master Manual when flooding is deemed imminent. Tr. 4595:5-8, 4598:12-4599:3, 4610:2-4612:3, 4625:17-25; PX5 at USACE0121577 ("Flood Control carries the highest priority during significant runoff events that pose a threat to human health and safety[.]"), USACE0121625 ("The flood

control purpose of the System will be given the highest System priority during periods of significant runoff when loss of life and property could occur."). Dr. Christensen noted that e-mails show that it was not until April 25 that the Corps decided that upper Basin runoff could no longer be contained by the reservoirs and only then did the Corps begin making releases from Gavins Point. Tr. 4618:11-23; PX2206. He also noted that the Corps was still consulting with FWS regarding T&E releases in April and did not begin to evacuate the reservoirs until May 7. Tr. 4618:11-4619:5; PX787; PX2206.

Dr. Christensen testified that while Corps personnel consistently explained that among the reasons for not releasing water from the reservoirs earlier was downstream flooding concerns, the Corps' explanation for not making earlier releases in late March or early April based on concerns over downstream flooding was not consistent with the Corps' approach in 1997. Tr. 4622:16-4624:12. In 1997, he testified, the Corps released water from the reservoirs "despite minor downstream flooding." *Id*.

The court has considered Dr. Christensen's testimony and concludes that plaintiffs' causation theory based on a "but for" world in 2011 fails for two primary reasons. First, and foremost, the plaintiffs have not established how the Corps' System releases in 2011 can be considered part of the "single purpose" it has relied upon to establish causation for the other flood years. The Corps' System releases in 2011 had nothing to do with ESA compliance. The court's conclusion is confirmed by the independent study commissioned by the Corps to evaluate the 2011 flood. In 2011, the Corps commissioned four independent non-Corps experts to evaluate the Corps'

operation prior, during, and after the 2011 flood.[44] The panel provided its findings and recommendations in its report entitled *Review of the Regulation of the Missouri River Mainstem Reservoir System During the Flood of 2011. See* DX0192 at DX0192-0094-9. In the report, the experts concluded that the Corps' "decisions related to storage and evacuation of spring runoff were not influenced or affected by consideration of threatened or endangered species." DX0192 at DX0192-0074.[45] In addition, in his separate report entitled *2011 Missouri River Flood Report: Opinions, Bases, Reasons, Facts and Data,* Dr. Grigg explained that in 2011 "operations for purposes other than flood control (including environmental purposes) were suspended or assigned secondary priority once significant flooding started and that during the flood the Corps did not operate for environmental or other purposes in a way to influence flood risk."[46] PX847 at 5. The plaintiffs have based their takings case on the theory that meeting the Corps' ESA obligations is the "single purpose" that allows the court to consider all of the Corps' System and River Changes for all of the years together to determine whether the plaintiffs have met their causation and foreseeability burden for establishing a taking. As discussed

[44] The experts are Dr. Neil Grigg, professor of Civil and Environmental Engineering at Colorado State University; Mr. Bill Lawrence, Hydrologist in Charge of the Arkansas Red Basin at the River Forecast Center of the National Weather Service; Mr. Darwin Oekerman, Hydrologist at the USGS; and Ms. Cara McCarthy, Senior Forecast Hydrologist at the National Resources Conservation Service at the National Water and Climate Center. DX0192 at DX0192-0094.

[45] The court has considered plaintiffs' argument that the study was biased because Ms. Farhat was involved in the study and because the Corps performed the study. The court has heard the testimony and reviewed the study. The court does not find the study was biased.

[46] The plaintiffs argue that portions of Dr. Grigg's analysis support their position that earlier releases would have led to less flooding. For the reasons stated in the next section of the opinion the court finds that the argument regarding earlier releases is not supported.

in the Legal Standards section of the opinion, the court has accepted plaintiffs' theory that the cumulative and combined effects of the Corps' System and River Changes can give rise to a taking, to the extent the System and River Changes "serve a single purpose." Because the releases in 2011 were not part of the "single purpose" to comply with the ESA, the flooding caused by the System releases in 2011 cannot be considered with the other flood years to establish the plaintiffs' takings claims.

Second, plaintiffs have not established that the 2011 flood by itself meets the causation and foreseeability tests to serve as an independent basis for a takings claim. Plaintiffs' 2011 takings claims turn on their contention that when the Corps began balancing priorities under the new Master Manual, the Corps abandoned flood control as its first priority, and this change in priorities directly, naturally, and probably caused the flooding in 2011. To prove their case, plaintiffs rely on a comparison of conditions in the upper Basin in 1997 with those in 2011. Tr. 4590:11-4625:25; PX2203; PX2208. Dr. Christensen testified that his "but for" model for 2011 was based on the Corps' response to upper Basin conditions in 1997. *See, e.g.*, Tr. 4590:24-25, 4591:17-20. The court finds, however, that the evidence established that there were significant differences between conditions in the upper Basin in 1997 and 2011 and that the premise of plaintiffs' takings claims for flooding in 2011 is not supported.

The two major differences that led to different responses by the Corps to upper Basin runoff in 1997 and 2011 are as follows: first, Basin runoff started earlier in 1997 than in 2011 because the weather was colder in 2011 and, as a result, inflows to the reservoirs in 2011 were lower in March and April than in 1997. DX0192 at DX0192-

0036, DX0192-0050, DX0192-0053, DX0192-0081-2; DX3001-202; DX3015-656; DX3015-660. Second, runoff in 2011 was twenty percent higher than in 1997, meaning the runoff in 1997 was significantly less than in 2011 (49 MAF in 1997 compared to 60.8 MAF in 2011). DX0192 at DX0192-0010, DX0192-0016, DX0192-0061. These differences mean that the Corps' response in 2011 cannot be fairly equated to the Corps' response to upper Basin runoff in 1997. Dr. Christensen's modeling of the "but for" world depended upon finding that upper Basin runoff in 2011 was virtually the same as 1997. The court finds that Dr. Christensen's opinions regarding the "but for" world in 2011 did not take into account the significant differences in the timing and volume of the inflows between 1997 and 2011. As such, the court cannot find that "but for" the new Master Manual, the Corps would have begun to make releases from the dams earlier and could have avoided the 160,000 cfs releases that resulted in devastating flooding in 2011.

For similar reasons, the court finds that the increased flooding in 2011 was not the natural, direct, and probable consequence of the new Master Manual. The plaintiffs argue that the 2011 flood was the foreseeable result of the Corps' policy change, which no longer placed flood control as the Corps' first priority except when there were threats to human health and safety. The new Master Manual requirement to balance priorities did not mean that flood control was ignored by the Corps during March and April 2011, thus making flooding inevitable. To the contrary, the Corps claims that it did not make releases in March and April 2011 because it was in fact concerned with downstream flooding. Tr. 7121:8-7122:6, 7123:11-7132:5 (Farhat); PX691 at USACE1012607 (map showing the potential flooding hotspots). The Corps' concerns in March and April 2011

demonstrate that flood control, particularly downstream of Gavins Point Dam, was considered by the Corps in making its System release decisions in 2011. The court appreciates that when the Corps was faced with downstream flooding in 1997, Corps personnel made a different call than that of Corps personnel in 2011. The evidence established that in 1997, Corps decision-makers elected to increase flooding downstream in March and April because of the large upper Basin inflows the reservoirs were receiving at that time. In 2011, in contrast, upper Basin inflows did not dictate that the Corps should begin to make releases in March and April, which is when large releases could typically cause or increase downstream flooding, because such inflows came later in April and May. In both 1997 and 2011, Corps personnel made System release decisions based on their best judgment in light of the information they had at the time.

The plaintiffs' contention that the government took a flowage easement from plaintiffs during the 2011 flood because the new Master Manual requirement to balance priorities meant at some point the Corps would not have enough room in the reservoirs and would thus need to flood properties in both the upper and lower Basin is not supported. There are situations where the government has obtained flowage easements when it knows it will have to flood an area in order to protect one group of landowners during a flood event at the expense of another group. That is not the case here. Flooding in 2011 occurred in both the upper and lower Basin because inflows exceeded the amount of storage available in the six reservoirs that make up the mainstem System, not because the Corps knew that would happen and then chose to protect one group of landowners

over another. The Corps was forced to flood both upper and lower Basin properties to save the mainstem System.

The court also recognizes that the Corps could have exercised its judgment differently in 2011 and perhaps minimized some of the terrible flooding that took place in 2011, but the plaintiffs cannot base their takings claims on their challenge to the Corps' management of the mainstem System. The court heard testimony from several plaintiffs to the effect that the Corps made the wrong call in failing to recognize the magnitude of the upper Basin runoff leading up to the 2011 flood. Even if this were true, this court does not have jurisdiction to consider whether the Corps made the wrong call in its decision-making in 2011. Objections to the Corps' management of the mainstem System in 2011 sound in tort. This court does not have jurisdiction over claims sounding in tort. *See* 28 U.S.C. § 1491. In addition, Congress, in the 1944 Flood Control Act, has immunized the government from tort liability for flooding in such circumstances. 33 U.S.C. § 702c.

For all of these reasons, the plaintiffs have failed to establish causation in connection with the releases from the System in 2011, and thus will not be able to rely on the System releases in 2011 to support their takings claims.

iii) River Changes

Dr. Christensen also opined on the cumulative and combined effects of the changes the Corps has made to the Missouri River channel in order to comply with its ESA obligations. He testified that to understand the impacts of the River Changes the Corps has made, it is important to understand the history of the Corps' past engineering

efforts to control flooding on the River. Tr. 4653:4-8. He testified that part of those efforts involved the Bank Stabilization and Navigation Project ("BSNP"), which was authorized by the Rivers and Harbor Act of 1945. Tr. 4654:20-25. He explained that the BSNP river-control structures were constructed by the Corps to (1) stabilize the River banks and (2) channelize the River for navigation by removing natural side channels and chutes. *Id.* Through the BSNP, the Corps "constructed thousands of rock dikes perpendicular and parallel to the flow that trapped sediment and resulted in … accreted land and accreted riverbank" that is now farm land. Tr. 4655:1-9. The Corps' actions also narrowed the River channel, concentrating faster flows downriver to create a "self-scouring" channel that improved the flood-carrying capacity of the River. Tr. 4655:10-24, 4657:15-4658:11; PX383-A. In addition to changing the River channel, the Corps also constructed levees, which "prevented high [R]iver flows from escaping the engineered channel and further disconnected the [R]iver from its floodplain." Tr. 4655:25-4656:2.[47]

Dr. Christensen testified that the Corps started to make modifications to the River channel to ameliorate the conditions that led to lost habitat in and adjacent to the River before 2004. Tr. 4660:22-4661:1. After the 2003 BiOp was issued, however, the Corps was required to make very specific changes to the System and the River to meet its ESA obligations. Tr. 4493:7-4494:6, 4660:13-4663:2. Under the terms of the 2003 BiOp, the

[47] As Dr. Hromadka also testified, the straighter and smoother the River, the greater its capacity to carry water and the less prone it is to flooding. As discussed in detail *infra*, actions taken to reduce this capacity by notching dikes and revetments and building up sediment in the channel to make SWH and ESH contribute to increased flooding.

Corps was required to make numerous changes to the River channel in order to restore the River's "connectivity" to the floodplain, including the construction of shallow water habitat ("SWH") and emergent sandbar habitat ("ESH") for T&E species. Tr. 4661:7-4662:23, 4676:22-4677:15.

To create SWH the Corps notched numerous dikes and revetments by cutting the dikes and revetments to allow water to flow through and thereby creating SWH. For example, between March and June of 2004, the Corps made "427 traditional dike notches, 119 type B dike notches, 91 revetment notches, 78 chevron type major dike modifications, 75 bank notches, seven pilot channels, four dredging projects and three chute restorations" for the purpose of creating SWH. Tr. 4663:3-10; PX123 at USACE0510836; PX313 at FWS_000087327. SWH is defined in the 2003 BiOp to mean that in August when there are normal flows, the depth of the SWH will be less than five feet and the velocity will be less than two feet per second. Tr. 4663:23-4664:7. Historically, *i.e.*, before the Corps' construction of the BSNP, the River had more than 100 acres of SWH per river mile. Tr. 4664:8-13; PX545 at USACE0946760. The current average is five to fifteen acres per river mile. *Id.* Under the 2003 BiOp, the Corps is required to ensure that there are 20 to 30 acres of SWH per river mile by 2024. *Id.* *See also* PX17 at PLTF-00007967; PX277 at USACE0719805, USACE0719808. Dr. Christensen discussed the methods used by the Corps to create in-channel SWH and off-channel SWH. Tr. 4665:18-4666:14. *See also* PX545 at USACE0946761. He explained that, to create in-channel SWH, the Corps lowered dikes and revetments, notched dikes and revetments, removed dikes and revetments, allowed dikes and revetments to

deteriorate through lack of maintenance, constructed chevrons, and "mechanically constructed shallow undulating [R]iver bottom in the channel[.]" Tr. 4666:1-4667:24. *See also* PX545 at USACE0946761. As discussed, the purposes of the notching is to erode the bank, which moves sediment into the River and deposits it downstream, creating an undulating River bottom with slow, shallow areas in the River channel. Tr. 4670:2-4671:13. *See also* PX135 at USACE0003073-4. Dr. Christensen explained that there is "a substantial cumulative effect" associated with the large number of dike notches undertaken by the Corps throughout the length of the River, as well as with the revetment modifications. Tr. 4671:6-13, 4673:9-4674:5. Dr. Christensen also explained how chevrons create SWH. Tr. 4674:6-4676:11. Chevrons consist of a pair of short dikes angled closer together so that when water flows through them, as the water spreads out, it slows down and deposits sediment directly downstream of the chevron, creating sandbars and SWH. Tr. 4674:6-4676:11.

Dr. Christensen also testified that the Corps created off-channel SWH by reintroducing chutes and backwater areas adjacent to the River. Tr. 4665:18-22. He explained that after 2004, the Corps constructed new chutes through dredging and reopened natural chutes that had been previously cut off to channelize the River. Tr. 4691:1-15. Dr. Christensen explained that without chutes, the River had deepened and narrowed which increased its flow capacity, thus minimizing flooding. *Id.* He testified that "[b]y design, [chutes] create[] shallow, slow-moving areas within the chute." Tr. 4692:8-20. According to the Corps, "[t]hrough erosion and deposition, the land along constructed chutes should consist of a variety of elevations which create increasing

acreage of flooded vegetation as River stage[s] increase[]. This is the desired progression expected of constructed chutes." PX2209 at EPA0044497. Dr. Christensen explained that chutes are designed to erode over time, which, together with the sand material dredged from the chutes during their construction, introduces additional sediment into the River, leading to aggradation and increasing hydraulic resistance. Tr. 4692:6-4693:5, 4694:25-4695:15. *See also* PX204 at USACE0721635-41. He testified that chutes decrease flood control by "divert[ing] water from the deeper swift main channel into a shallower, slower side channel." Tr. 4697:3-8. This diversion, he explained, results in the water moving "laterally into the floodplain during high flows[,]" and "reduc[ing the] average velocity of channel flows and channel flood carrying capacity." Tr. 4693:3-5, 4697:5-25. He opined that there is "a significant cumulative effect from chutes and other shallow-water habitat modifications throughout the length of the [R]iver." Tr. 4698:1-5.

Dr. Christensen used three analytical methods to determine the impact of the River Changes described above on WSEs and to calculate the increase in flooding caused by these Changes. Tr. 4700:15-4701:21. First, he examined expected WSEs from existing United States Geologic Survey ("USGS") gage curves over time to determine how the River was expected to respond, as compared to how it has in fact changed over time. Tr. 4700:21-23. Second, he compared current flood frequencies against what the Corps had anticipated in the Corps' 2003 Flood Frequency Study, which was completed before the Corps made the River Changes and before this litigation began. Tr. 4700:24-4701:5. Third, he compared the Corps' 2011 Global Positioning System ("GPS") water level measurements with the results of the two other studies as means of verifying his results.

Tr. 4701:6-12. Dr. Christensen testified that each of the results were consistent with each other and, in his opinion, confirmed the soundness of his approach. Tr. 4701:15-4702:9. He explained that his analysis showed that WSEs have increased significantly at higher flows than what had been anticipated by the data before the Corps made any of the River Changes, and that he attributed the higher WSEs to the River Changes. Tr. 4698:25-4700:14, 4744:13-20, 4754:21-4756:13. *See also* PX2089-A at 1-5. Because the results could be verified with actual data, Dr. Christensen said that using a complex model like HEC-RAS was not necessary. Tr. 4702:10-23. As he stated, with the actual data available "there was no need to substitute a less accurate measuring stick, such as HEC-RAS."[48] *Id.*

His conclusions from his analyses can be summarized as follows: first, "the structural changes and sediment dumping have partially reversed the BSNP engineered [R]iver" and have made it "shallower and slower" in places, and thus it "carries less floodwater." Tr. 4698:25-4700:14. Second, "there has been a dramatic increase in flood frequency . . . [and] in floodwater levels" since 2004. *Id.* Third, the changes in WSEs at higher River flows cannot be explained by natural events because there were no natural events before the 2011 flood that could have caused significant changes to the River's flood-carrying capacity. Tr. 4744:13-4745:13. Dr. Christensen noted, for example, that between 2000 and 2006, there had been a drought in the Missouri River Basin, which

[48] Dr. Christensen explained that to use HEC-RAS would require a modeler to specify many thousands of parameters subject to many judgment calls and thus a HEC-RAS model would be very subjective. Tr. 4703:5-8, 4712:14-18.

would not have caused any change in the River to explain the changes in WSEs. Tr. 4745:2-6. He also noted that "there's been no natural events that could cause this increase prior to the Corps' changes to policies and procedures. There was a drought and there was no high flows that could . . . dramatically change the river like that, for 2000 to 2006." Tr. 4700:9-14.

Dr. Christensen explained his gage curve analysis as follows. He testified that there are two types of gage on the River: those which measure water levels at a particular point and those that also measure water flows or discharge, in addition to measuring water levels at a particular point. Tr. 4713:8-4714:14. Those gages that measure river discharge or flow are also converted into gage curves which identify both WSE levels and expected water levels at certain flows. Tr. 4713:20-25, 4714:15-4715:12. Dr. Christensen testified that both types of gage are placed up and down the River both above and below Gavins Point Dam. Tr. 4714:1-14. He explained that when a River channel changes, a new gage curve will be set to reflect those changes, as happened after the 2011 flood when the gages revealed substantial water level increases on the River at higher flows. Tr. 4714:24-4715:16. *See also* PX2065. He testified that he compared the pre-2004 gage curves and modeled releases in the "but for" world with real world average daily water levels measured at the river discharge gages in 2010 and 2011. Tr. 4720:5-22. He testified that when he examined the USGS gages between dams and below Gavins Point, he noted that "particularly at high flows, the actual water levels are substantially higher [post-2004] than pre-2004 water levels at the gages." Tr. 4720:23-4721:4. *See also* PX2060-A at 6-11. He opined that "the [R]iver channel has changed

such that moderate and high flows result in higher WSEs post-2004 than would have resulted from the same flows pre-2004." Tr. 4721:1-4. He explained that he attributed the changes in WSEs to the River Changes made by the Corps because the degree of change was not anticipated by the prior studies. Tr. 4699:14-4700:8. He pointed to the Corps' 2003 Flood Frequency Study, which, before the River Changes had been undertaken, predicted that the River was becoming stable and thus WSEs were not likely to change. *Id.*; PX2211 at USACE4640373. Dr. Christensen then ran simulations showing for each of the gages what would have happened without the Corps' River Changes and without the Corps' System releases for T&E species. He then compared the actual flows with his "but for" simulation to determine the difference in WSEs between the actual and "but for" worlds. Tr. 4735:7-14; PX2060-A at 12-24. Based on his gage curve analysis, Dr. Christensen concluded that the "WSEs at each of the USGS gages on the [R]iver have increased since 2004, for all moderate and high flow levels[,]" and that "[t]he increase in WSEs is particularly stark at high flow levels." Tr. 4738:11-18, 4754:22-4755:10.

Dr. Christensen explained that he extended his gage analysis to each of the plaintiffs' properties by interpolating the results of his analysis between gages to the river miles adjacent or near the plaintiffs' properties, which he verified using the Corps' 2003 Flood Frequency Study. Tr. 4768:16-4773:9; PX2089-A at 1-5. He explained that because none of the Corps' River Changes are located at a specific gage location, his interpolation of water surface levels was probably conservative because it would not reflect higher WSEs at a particular property. Tr. 4770:4-16. As noted, he testified that he

also used the Corps' 2011 GPS study of actual water levels to verify his interpolation analysis and that the results matched his actual world results. Tr. 4779:25-4783:16; PX2060-A at 26-35. Dr. Christensen concluded, based on his analyses, that "the flood carrying capacity of the Missouri River below Gavins Point Dam has [been] dramatically reduced" and that there has been "a marked and significant increase in flood water levels and frequency of flooding" following the Corps' System and River Changes. Tr. 4793:23-4794:17.

The court has considered Dr. Christensen's opinion testimony together with the opinion testimony of Dr. Hromadka, discussed *infra*, and finds that the Corps' River Changes have, together with the Corps' System Changes, caused WSEs to rise higher than they would have risen without these Changes and that this rise in WSEs has led to more flooding or more severe or longer flooding than would have occurred had these Changes not been made by the Corps.

The court has considered the criticisms of Dr. Christensen's gage analysis by government witnesses and the government's experts Mr. Woodbury and Dr. Mussetter and has not found these criticisms persuasive. To begin, it is significant that neither Dr. Mussetter nor Mr. Woodbury acknowledge any impactful change in the River attributable to the Corps' actions to create SWH and ESH in the River channel. *See* Tr. 4825:13-4826:15 (Christensen), 5398:3-6 (Hromadka), 9897:15-24, 9900:5-9901:9 (Mussetter), 10784:14-24; DX3015 (Woodbury). The court agrees with Dr. Christensen and Dr. Hromadka, two well respected and acknowledged experts in the fields of hydrology and hydraulics, that Mr. Woodbury's and Dr. Mussetter's conclusions defy both common

sense and principles of hydrology and hydraulics.[49] Tr. 4826:10-15 (Christensen), 5398:3-21 (Hromadka). There cannot be any serious debate that the type of changes made by the Corps to the River channel, coupled with the T&E releases during periods of higher downstream inflows, would foreseeably cause higher WSEs than would exist without those System and River Changes. The government's fundamental challenge to Dr. Christensen's analysis is that said analysis only shows higher WSEs at higher flows. Tr. 10306:8-10314:20, 10317:9-10318:18 (Mussetter); DX3014-305–DX3014-311; DX3014-313–DX3014-315. The government argues that if Dr. Christensen is correct and the Corps' actions have caused higher WSEs, the WSEs should also be higher at lower flows. Tr. 10274:4-10275:2, 10314:16-20. The plaintiffs respond that the government's assumption that River Changes would result in higher WSEs during periods of low flow is based on the government's misunderstanding of the plaintiffs' experts. The plaintiffs explain that Dr. Christensen and Dr. Hromadka both opined that by changing the River, the Corps has changed the flow and velocity of the River, thus diminishing its flood-carrying capacity, meaning that the same amount of flow in the past would not have caused the River to rise as high as it now does. As Dr. Hromadka explained, the fact that WSEs are not higher at lower flows is not how a river system works. Tr. 8464:23-8465:5. As discussed later in the discussion of Dr. Hromadka's testimony, the Corps' River Changes have created changes in velocity at various points

[49] Mr. Woodbury, the government's expert, admitted on cross-examination that dike notches can change the velocity and depth of a river and, in this way, can cause higher water surface elevations. Tr. 11590:24-11591:9.

along the River causing slower flows, which allows water to back up during periods of high flows, which in turn leads to higher WSEs. The government's criticisms of Dr. Christensen's opinions on this point are not persuasive.

The government's criticisms of Dr. Christensen's reliance on the USGS gage curves are also unpersuasive. The government criticizes Dr. Christensen for interpolating the USGS gage curves for each plaintiff and for using the Corps' 2003 Flood Frequency Study. Tr. 4742:23-4746:16. First, the Corps itself interpolates USGS gage curves for its work. Tr. 8335:10-8336:16 (Remus). Second, the Corps relies on the Corps' 2003 Flood Frequency Study to this day. Tr. 8844:8-11 (Shumate) ("The flow frequencies are still used today." Tr. 8844:11). The Corps' 2003 Flood Frequency Study was considered to be the "gold standard" and "'recommended for all uses related to water surface elevations on the Missouri River[.]'" Tr. 4751:24-4752:18, PX2212 at USACE461090. Dr. Christensen cannot be criticized for relying upon the Corps' 2003 Flood Frequency Study. The fact that neither Dr. Mussetter nor Mr. Woodbury used it in their modeling makes their work suspect.

Finally, as discussed above in the Legal Standards section, the court does not agree with the government that in order to establish causation and foreseeability based on the Corps' System and River Changes, a separate study of the impacts from each individual River Change near each individual property for each year was required. As discussed above, the court is persuaded that Dr. Christensen and Dr. Hromadka have properly evaluated the issues of causation and foreseeability based on the cumulative and

combined impacts associated with the System and River Changes made by the Corps to meet the Corps' ESA obligations.

b. Dr. Hromadka

As discussed above, the plaintiffs retained Dr. Theodore Hromadka II, along with Dr. Christensen, to prove causation, foreseeability, and severity in connection with their takings claims. Dr. Hromadka, Ph.D., Ph.D., Ph.D., D.WRE, P.E., P.G., P.H., is a highly respected and established expert in engineering and modeling with a focus on hydrology and hydraulics. He has almost 45 years of experience working in engineering, planning, flood control, groundwater analysis, transport mechanics, and water resources. Tr. 5051:18-24; PX2001. He has a B.S. and an M.A. in Applied Mathematics and Computer Science from California State University (1972 and 1976, respectively). Tr. 5044:17-25; PX2001. He also holds an M.S.in Water Resources Engineering and a Ph.D. in Water Resources from the University of California at Irvine (1977 and 1980, respectively). Tr. 5045:1-7; PX2001. He has an additional Ph.D. in Applied Mathematics and Systems Modeling from the University of California at Irvine (1985) and a third Ph.D. in Methods in Engineering Mathematics in the theme of Advanced Transport Modeling Analysis from the University of Wales in England (2001). Tr. 5045:8-14; PX2001.

He holds numerous professional licenses. Tr. 5045:18-5046:24; PX2001. He is a Professional Civil Engineer, licensed in Arizona, California, Hawaii, Illinois, Iowa, Nevada, New York, and Ohio. Tr. 5046:6-11; PX2001. He is a licensed Geoscientist (licensed to practice, geology, geophysics, engineering geology, environmental geology, hydrogeology, and soil science); a Professional Geologist; a certified Ground Water

Professional and member of the Association of Ground Water Scientists and Engineers; a board certified Environmental Scientist and member of the American Academy of Environmental Engineering Scientists ("AAEES"); and a certified Professional Hydrologist and member of the American Institute of Hydrology. Tr. 5045:12-5046:24; PX2001.

He has received numerous awards and honors, including the United States Military Academy, West Point, Award for Excellence, and Chair, Mathematical Sciences Center. Tr. 5047:2-5048:7. Dr. Hromadka is currently a professor at West Point. Tr. 5049:11-13. He is also a principal in Hromadka & Associates, a firm located in Rancho Santa Margarita, California. Tr. 5050:11-12; PX2001.

He has testified in dozens of cases, and his accepted areas of expertise and specialization include: hydrologic and hydraulic analysis and modeling; flooding evaluation and floodplain inundation; groundwater assessment; sediment transport; rainfall and atmospheric science; flood protection systems, including levees; statistics and probability; and computational modeling. Tr. 5048:24-5049:9, 5051:1-5052:20; PX2001.

Dr. Hromadka was engaged by the plaintiffs to analyze whether the flooding alleged to have taken plaintiffs' property interests was caused by the Corps' System and River Changes and if so, how the Corps' actions, either alone or in combination with other causation factors, led to the flooding in question. Tr. 5052:22-5053:21. As part of his assignment, he reviewed each of the plaintiffs' flooding claims to determine whether the flooding they identified was caused by the Corps' System and River Changes. Specifically, like Dr. Christensen, Dr. Hromadka explained that the Corps' actions he

reviewed included changes to the Corps' operation of the System, including changes to the Corps' reservoir storage operations and releases from the System ("System Changes"). Tr. 5053:23-5054:15. He also reviewed the Corps' changes to the BSNP, together with the Corps' implementation of the MRRP ("River Changes"). *Id.*

Dr. Hromadka acknowledged that some of the changes to the System and to the River began before 2004. Tr. 5054:23-5055:3, 5100:12-5101:13. He focused his analysis on the acceleration of the Corps' System and River Changes in 2004, which were made to implement the 2003 BiOp, to determine whether these Changes resulted in greater flooding by raising WSEs. Tr. 5054:23-5055:3.

Dr. Hromadka testified as to the work he undertook to formulate his opinions, which included: developing a sedimentation study; preparing a groundwater model; preparing a correlation analysis to isolate causation factors for each plaintiff's property; and conducting statistical investigations to evaluate trends and patterns in flooding. Tr. 5055:25-5056:20. He also testified that he reviewed the computer modeling of the government's experts. Tr. 5056:21-22. Based on his studies, modeling and analysis, he offered the following opinions. First, he opined that "[t]he evidence and analysis results show that the [Corps' System and River Changes] . . . have impacted and changed the Missouri River[,] causing an enhanced flood risk, as well as recurrent flooding in the Missouri River Basin that will continue into the future." Tr. 5056:25-5057:6. Second, he asserted that "the evidence and analysis results show that but for the [Corps' System and River Changes] . . . . the flooding at each [plaintiff's] property either would not have occurred or would have been significantly less severe in scale and/or duration." Tr.

5057:7-15. He examined each property and each claimed flooding event to determine the differences between the actual and "but for" worlds by using the WSEs derived from the work of Dr. Christensen. Tr. 5232:13-5236:12. He prepared tables to show the difference in WSEs with and without the Corps' System and River Changes. Tr. 5232:19-5233:18. Dr. Hromadka presented a chart for each property with dates for each flooding claim, the comparative WSEs for each claim, and average monthly rainfall totals for each claimed period of flooding.[50] *Id*. Third, he opined that the Corps "introduced significant quantities of new sediment into the [R]iver, . . . which led to areas of sedimentation and contributed to increased water surface elevations." Tr. 5057:16-5058:4. Fourth, he testified that the Corps, "through active disassembly or failure to

[50] At closing argument, the plaintiffs asked the court to have Exhibit PX2025-A, which included all of Dr. Hromadka's charts and which the court admitted into evidence as a demonstrative exhibit, to come into the record as substantive evidence. The government has not specifically objected to the plaintiffs' request. The court has considered the plaintiffs' request and has determined that the charts, which the government had been given in advance of Dr. Hromadka's testimony and were available for cross-examination, are properly considered as part of his opinion testimony and thus may be relied upon as opinion evidence by the court in this case. *See United States v. Gardner*, 611 F.2d 770, 776 & n.3 (9th Cir. 1980). In a judge-tried case, the court has substantial discretion to consider all of the evidence admitted. *See Minebea Co. Ltd. v. Papst*, 444 F. Supp. 2d 68, 170 (D.D.C. 2006). Dr. Hromadka opined that the Corps' System and River Changes resulted in higher WSEs than would have occurred without the Corps' System and River Changes. Based on his review of the data and analysis that Dr. Christensen prepared, Dr. Hromadka examined each plaintiff's property and opined that the additional WSEs caused more significant flooding and damage to property than would have occurred without the Corps' System and River Changes. The plaintiffs at this stage of the litigation were not required to quantify the precise damage to their properties, but they were required to establish that the Corps' System and River Changes they identified caused foreseeable flooding to their properties that would not have occurred without those Changes. The charts show the basis for Dr. Hromadka's conclusion that the WSEs were elevated compared with what they would have been "but for" the Corps' System and River Changes and, based on the WSE differences, they support Dr. Hromadka's conclusions regarding greater flooding. The charts are part of Dr. Hromadka's opinion testimony and the WSEs he determined caused greater flooding have been relied upon by the court in deciding liability.

maintain [the BSNP], caused the degradation of BSNP river control structures, which led to the erosion, sedimentation, and increased hydraulic resistance." Tr. 5058:5-13, 5235:12-15, 5492:12-16. Fifth, he opined that "[t]he increased water surface elevations caused by the [Corps' System and River Changes] . . . caused in whole or in part increased groundwater levels, blocked drainage, and seepage on the [plaintiff's] properties." Tr. 5058:14-24. Sixth, he asserted that "weather-related events contributed to cause the flooding in question, [but] those events alone cannot explain the increased frequency, severity and duration of the flooding experienced since 2006." Tr. 5058:25-5059:4. Dr. Hromadka testified at trial that "[t]here obviously cannot be flooding without water." Tr. 5059:5. Seventh, he opined that the government's experts have not directly refuted the plaintiffs' theory of causation, which is "based upon a transformation of the [R]iver and the cumulative effects of the [System and River Changes.]" Tr. 5059:6-10, 5493:4-8. Eighth, he asserted that the government's experts' HEC-RAS models are flawed and "none of [these models] are an accurate representation." Tr. 5059:11-5060:6. Ninth, he opined that the government's experts' opinions "are inconsistent with the credible eyewitness observations of the [p]laintiffs who relate a consistent observation of a changed [R]iver since 2006." Tr. 5060:7-10. Finally, he explained that the government experts' opinions "are not consistent with the actual observations of the . . . [plaintiffs] as [to] the macro . . . and cumulative flooding effects of the [Corps' System and River Changes.]" Tr. 5060:11-15.

Dr. Hromadka explained that for purposes of his expert opinions, he used the word "flooding" to represent four different types of flooding: overbank, levee overtopping,

blocked drainage, and seepage. He explained that: (1) overbank flooding (without levee overtopping) occurs when surface water leaves the River bank and flows directly onto the land; (2) levee overtopping flooding occurs where surface water flooding is so high as to overtop a levee, which can then lead to levee failure; (3) blocked drainage flooding occurs where surface water remains on the land and cannot drain off the land because culverts and/or natural drainage are blocked by a high WSE in the River; and (4) seepage flooding occurs when the land is inundated by rising groundwater or when surface water on low points of the property cannot drain back into the ground due to oversaturation. Tr. 5064:1-19, 5068:20-5069:8, 5234:5-14. In this case, Dr. Hromadka often analyzed blocked drainage flooding and seepage flooding together as a single type of flooding. Tr. 5234:5-14. He noted that not every inundation of property gave rise to a takings claim. Tr. 5063:9-25. He acknowledged that landowners will accept or tolerate a certain amount of flooding that does not interfere with their use of the land, a phenomenon he termed "tolerance." Tr. 5062:18-5063:25. According to Dr. Hromadka, "tolerance" explains why some plaintiffs claimed a taking based on flooding that only interfered with their property at planting times, but not during times when there was flooding on their property but crops had not yet been planted or harvested. *Id.*

Dr. Hromadka testified that in determining causation for the flooding on each of plaintiff's properties, he grouped plaintiffs together according to common flood factors, which resulted in five groups of plaintiffs. Tr. 5078:21-5085:9. He testified to the following groups:

Group 1 is located above Sioux City, Iowa. Tr. 5080:4-21. Dr. Hromadka explained that this portion of the River remained closest to the historical River, meaning the River in this area is still "meandering, winding and shallow with sandbars and side channels." Tr. 5080:4-9. There are no levees in this area. Tr. 5080:10. The Corps has built ESH in this region. Tr. 5080:11-12. Flooding only occurred in 2011 in this region of the River. Tr. 5080:13-15. For the reasons discussed above in connection with Dr. Christensen, the court has determined that the plaintiffs failed to prove that the System Changes were the "but for" cause of flooding in 2011.

Group 2 is located from Sioux City, Iowa to Omaha, Nebraska. Tr. 5081:4-5. Dr. Hromadka testified that this area had been significantly altered from the natural River. The Corps used BSNP structures, including dikes and revetments, to channelize the River and protect banks from erosion. Tr. 5081:7-17. He also testified that to create the self-scouring channel, the Corps removed natural side channels and chutes. Tr. 5081:10. There are no federal or PL 84-99 levees in this area.[51] Tr. 5081:5-6. Dr. Hromadka testified that after 2004, the Corps engaged in a variety of activities to create SWH in this area, including constructing backwaters, chutes, and dike notches. PX2006. As a

[51] The court heard extensive testimony from the government's Corps witnesses and several plaintiffs regarding the levees that were built to protect properties from flooding. There are three types of levees relevant to flooding in this case: federally constructed PL84-99 levees (e.g. L-575, L-550), which were built by the federal government but are maintained by levee districts that receive funding for levee maintenance if the districts comply with certain federal standards; non-federally constructed PL 84-99 levees (e.g. Union Township, Holt County #10), which were built by landowners and are accepted into the PL 84-99 program for maintenance; and private levees that have been constructed by the plaintiffs and are not required to meet federal requirements. While some federal levees in the United States are both built and maintained by the federal government, no such levees are relevant to the claims at issue in this case.

consequence, he explained, this area has suffered flooding largely from overbank flooding. PX2006. He opined that the flooding in this reach of the River is "a result of [a] combination of [System and River Changes]." Tr. 5081:16-17.

Group 3 is located from Council Bluffs, Iowa to Holt County, Missouri. Tr. 5081:24-25. Dr. Hromadka explained that the federal levee system begins north of Council Bluff on the east side and runs continuously for 100 miles to Holt County. Tr. 5082:2-6. He testified that the Corps had channelized this area with dikes and revetments to protect banks from erosion and removed natural side chutes and channels, just as it did in Group 2. Tr. 5082:7. He testified that the Corps undertook the same actions to create SWH in this reach of the River as it did in Group 2. Tr. 5082:8. Dr. Hromadka noted that flooding in this region started in 2007 and continued in 2008, 2010, 2011, 2013, and 2014. Tr. 5082:9-19. He testified that the plaintiffs in this reach of the River have experienced overbank flooding, as well as seepage and/or blocked drainage flooding. *Id.* He opined that the flooding in this area of the river was "the result of a combination of [the Corps' System and River Changes.]" Tr. 5082:17-19.

Group 4 is located in the area of Holt County, Missouri. Tr. 5082:25. Dr. Hromadka testified that, like Groups 2 and 3, this reach of the River was channelized through the BSNP. Tr. 5083:2-3. He testified that this area has a mix of federal, PL 84-99, and private levees. Tr. 5082:25-5083:1. He explained that in this reach of the River, the Corps has undertaken the same actions to create SWH as it has in Groups 2 and 3. Tr. 5083:4-5. He pointed out that this area, and Holt County in particular, has the largest number of government created habitat sites intended to meet the Corps' ESA obligations

of any county on the River.[52] Tr. 5083:6-7. He testified that the properties in this reach have experienced the most devastating and recurrent flooding. Tr. 5083:8-10. The plaintiffs in this area experienced flooding in 2007, 2008, 2010, 2011, 2013, and 2014. PX2006. Dr. Hromadka opined that the flooding in this region was the "result of a combination" of the Corps' System and River Changes. Tr. 5084:9-10.

Group 5 is located south of Holt County, Missouri. Tr. 5084:14-16. Dr. Hromadka testified that this area has also experienced River channelization by the Corps, similar to Groups 2, 3, and 4. Tr. 5084:17-19. He testified that the Corps undertook the same actions to create SWH in this reach of the River as it did in Groups 2, 3, and 4. *Id.* As such, he explained that this area, as in Groups 2, 3, and 4, has had dikes and revetments notched and chutes reconstructed. *Id.* Dr. Hromadka opined that the flooding in this region of the River was a result of a combination of the Corps' System and River Changes. Tr. 5085:3-4.

Similar to Dr. Christensen, Dr. Hromadka began his analysis of plaintiffs' claims by analyzing how the Corps is changing the Missouri River. Dr. Hromadka testified that the Missouri River is "the most highly engineered river in the United States." Tr. 5087:23-5087:25. He testified that the River is being changed with new engineering projects to create SWH for the benefit of pallid sturgeon and to create ESH for the benefit of interior least tern and piping plover. Tr. 5086:9-5090:22. He noted that the 2003

[52] As noted above in the Background Facts section, the government has acquired property along the River and has converted those properties into habitat sites.

BiOp required 20 to 30 acres of SWH per river mile from Ponca, Nebraska to St. Louis, Missouri, which is 15,060 to 22,590 acres of SWH in total. Tr. 5088:8-12; PX158 at USACE0473411; PX277 at USACE0719811. Dr. Hromadka explained how SWH is created by notching dikes and revetments, allowing the same to deteriorate, dredging chutes, and creating backwaters and chevrons.[53] Tr. 5088:13-24. Dr. Hromadka explained that chutes are "secondary channels that naturally occurred on the [R]iver pre-channelization," and he testified as to how the Corps has reconstructed chutes to move the River laterally, thus allowing it to reconnect with its floodplain, with the expectation that the chutes will "erode and expand over time." Tr. 5092:14-5093:9. He explained that chutes can "bring[] water closer to levees in high-water events" and can increase the risk of seepage beneath levees, which can lead to levees collapsing. Tr. 5093:10-5094:5. He explained that creating chutes also changes the River by reintroducing sediment into the River during construction. Tr. 5094:5-5095:8. *See also* PX158 at USACE0473428; PX390 at USACE0465824, USACE465827-8.

[53] Representatives of the Corps testified at trial that BSNP structures are maintained using a "construction reference plane" or CRP, described as "a hypothetical sloping water surface elevation[.]" Tr. 8992:23-8999:25 (Chapman). According to these Corps witnesses, the Corps completes annual inspections and compiles a priority list of structures needing repair. Tr. 9019:1-21 (Chapman), 9212:13-16 (Pridal). The Corps witnesses' testimony suggested that these structures are now maintained at a lower height to minimize the adverse effects these structures may have on flood stages. Tr. 9002:6-9003:21, 9149:3-12 (Chapman), 9214:16-9216:11 (Pridal). The plaintiffs maintain that by virtue of limiting maintenance of these structures, the Corps is allowing for more sediment to enter into the River, which is consistent with the Corps' obligation to build SWH. Various Corps witnesses concurred that by allowing dikes and revetments to deteriorate, the Corps was also increasing the amount of SWH by allowing banks to erode. Tr. 1727:9-12 (Bitner), 9214:16-9216:11 (Pridal).

According to Dr. Hromadka, the Corps has modified thousands of river-control structures to create SWH. Tr. 5097:14-5098:12. As of 2014, the Corps had undertaken 1,697 dike notching actions, 354 major modification actions, 63 dike lowering actions, 36 dike extension actions, 39 side-channel chute actions, 20 revetment chute actions, 14 backwater actions, and 3 channel widening actions. PX277 at USACE0719815. The Corps estimated that in 2014, there were approximately 11,211 acres of SWH in the Missouri River. *Id.* at USACE0719811. Dr. Hromadka testified that dike notching introduces sediment into the River and "leads to expected erosion and/or sloughing of the bank" and, depending on the size and location of the notch, dike notching can create one to six acres of SWH in the River channel. Tr. 5097:20-25; PX158 at USACE0473422-4, USACE0473427; PX169. He further testified that he focused his attention on the River Changes after 2004 because in 2004 the Corps accelerated its SWH creation activities to meet its obligation to create 1,200 acres of new SWH by early summer. Tr. 5100:17-5101:13; PX106 at USACE0282629-30; PX123 at USACE0510833-5. The government admitted in court filings that the Corps' habitat-creation activities in 2004 were "unprecedented." PX123 at USACE0510835 (internal quotation marks and citations omitted). In addition, Dr. Hromadka noted that although the government said notching would only take place next to government-owned property, "[n]otches were constructed along both public and private property . . . [e].g. Blodgett Farms, Ideker Farms, and Harry Larson's farm." .[54] Tr. 5103:23-5105:1; PX513.

[54] These plaintiffs have based their takings claims in part on the erosion of their property.

Dr. Hromadka noted that there were Corps personnel, including Geoffrey Henggeler and Don Moses, Corps geotechnical engineers, who at trial expressed concern that notching and recreating chutes can adversely impact levees because of erosion. Tr. 5093:8-5094:1, 5108:20-5109:17. *See also* Tr. 3986:4-14 (Henggeler), 4030:6-4031:1 (Moses). Dr. Hromadka noted that in one of its post-2011 studies, the Corps suggested that underseepage from dike notching and SWH construction may have led to levee failures in 2011. Tr. 5128:21-5129:25; PX555 at USACE3590194-5. In addition, Dr. Hromadka referenced the 2011 National Research Council Study, which stated that "removing revetments along the navigation channel in the name of ecosystem restoration may threaten farmland and infrastructure, as well as reduce depths of the navigation channel." Tr. 5111:15-5112:15; PX17 at PLTF-00008016.

It was against this backdrop that Dr. Hromadka explained how the Corps' River Changes interfered with the River's equilibrium, which in turn caused more flooding. Tr. 5121:24-5124:9. He explained that "rivers tend to try to reach equilibrium between the various processes that are going on." Tr. 5122:8-10. Dr. Hromadka explained that "[r]ivers tend to equilibrate . . . with regard to channel shape, channel slope, sediment transport, and streamflow velocity[.]" Tr. 5122:13-16 (quoting PX814 at USACE7478345). Dr. Hromadka added that "[w]hen one of these characteristics [of a river] changes, the others also change until the river again is in equilibrium[.]" Tr. 5122:21-24 (quoting PX814 at USACE7478345). Dr. Hromadka explained that by 2007, when the first high water event occurred after the Corps' River Changes began in earnest in 2004, "flooding resulted and then has continued and will continue." Tr. 5123:20-22.

In support, he noted that half of the highest River stages recorded in the length of the River at issue in this case have occurred since 2006 in the counties with the largest number of River Changes. Tr. 5131:22-5135:22; PX2007; PX2008. He testified that this pattern is consistent with a re-engineered River. Tr. 5132:6-8.

As noted above, Dr. Hromadka supported his conclusions with his various studies. First, he testified regarding his sedimentation study. Tr. 5137:3-5158:2. He used bathymetry data[55] he received from the Corps, covering river mile 735 down to river mile 500 at intervals of 0.1 miles on various dates between 1990 and 2012 and covering river miles 498 to 400 at intervals of 0.05 to 0.1 miles on various dates between 1994 and 2014. Tr. 5137:10-16. With these data, he created a model to determine whether sediment in the River was accumulating, which would mean the River was aggrading in certain locations, or decreasing, which would mean that the River was degrading in certain locations. Tr. 5137:22-5141:15. He examined the sources of new sediment added to the River from various SWH projects and noted that, for example, in a seven-week period in 2004, the Corps dredged more than 450,000 cubic yards of sediment during two SWH projects, which the Corps then deposited into the River. Tr. 5141:17-5142:12. He also noted that in one year, 2009, the Corps added more than three million cubic yards of sediment to the River on the 100-mile stretch of the River between river miles 691 and 592, which he explained was equal to having 152,000 super dump trucks full of sediment

[55] Bathymetry data is the measurement of the size, shape, and depth of a body of water.

dumped into the River or an amount of sediment approximately the size of the Great Pyramid of Giza added into the River. Tr. 5142:13-15, 5146:22-5147:13; PX2151.

Dr. Hromadka explained that his sedimentation study showed "significant changes in [R]iver geometry[.]" Tr. 5155:8-9. He testified that "[s]ediment is accreting along banks" and "[a]reas of sediment deposition and sediment erosion are observable[.]" Tr. 5155:11-20. Specifically, he testified that areas of sediment deposition along the banks exhibited low flow velocity. Tr. 5155:21-5156:3. He further explained that the addition of large quantities of heavy sediment into the River has increased hydraulic resistance and has caused an increase in WSEs, which in turn has caused increased incidents of seepage flooding, increased incidents of blocked drainage flooding, increased incidents of overbank flooding, and increased incidents of levee overtopping. Tr. 5168:3-5169:4. Dr. Hromadka testified that his conclusions regarding sedimentation effects have been confirmed by the USGS rating curves examined by Dr. Christensen, which show not only that WSEs are increasing, but also that WSEs have increased at a greater rate for high flows more recently, meaning that the same high flows are now resulting in higher WSEs than before 2004. Tr. 5172:6-5173:23; PX2018-A.

Dr. Hromadka responded to the government's criticisms of his sedimentation study. Tr. 5203:14-5208:14. He explained the fact that his study did not show that there has been a uniform increase in sedimentation in the River is not significant because he did not expect to find a uniform increase in sediment because the Corps did not add sediment uniformly throughout the River. Tr. 5126:1-19, 5140:19-5141:15, 5203:16-5204:1. He also explained the fact that the gages measuring suspended sediment load did

not show sediment increases is not inconsistent with his findings because the gages are located fairly far apart and are not located near SWH sites where sediment was added to the River. Tr. 5204:19-5206:1. He also explained that the nature of the sediment introduced to the River for the purpose of creating SWH would not be reflected in suspended sediment loads, because the SWH sediment is primarily composed of "heavier materials" that remain in the River for a period of time. Tr. 5206:2-8. He acknowledged that the amount of new sediment deposited by the Corps through these SWH projects is small relative to the total amount of sediment in the River, but he explained that the volume of sediment from the Corps' River Changes is not insignificant and that it is the concentrated delivery and the composition of the sediment from SWH construction that are "much more critical." Tr. 5146:14-5147:23, 5206:18-5207:14. *See also* PX2013. He noted that "the concentration, delivery and composition of the sediment is much more critical. And what the evidence shows, and in particularly from Mussetter's own data, is this is heavier sediment, 75 percent sand being introduced over a short time period at point sources." Tr. 5207:4-9. The court finds that these explanations were supported and credible, and thus the court rejects the government's objections to Dr. Hromadka's sedimentation study.

Dr. Hromadka also performed a groundwater study and seepage study to assess the impact of a higher River on seepage and on blocked drainage. Tr. 5208:23-5210:14; 5219:9-5221:24. Dr. Hromadka explained that "the [R]iver normally acts as a sink" and that groundwater generally flows down into the River. Tr. 5210:8-18. He further explained that in order to remove surface runoff from rainfall on properties, drainage

systems are necessary in cases where a levee blocks natural drainage. Tr. 5210:19-25. He testified that culverts, with screw gates or flap gates attached to the side, are cut under or through the levee to allow for water to drain off the properties. Tr. 5210:22-5211:10. When the River is too high, the culverts close off so that water from the higher River does not flood up to the properties. Tr. 5211:5-18. As a result, surface water from rainfall on the properties cannot drain off the properties and water remains on the land. Tr. 5211:5-5212:13. Dr. Hromadka catalogued the testimony of the plaintiffs complaining that their drainage gates are "blocked more often and for longer duration by high water in the [R]iver" and are "blocked at lower flow levels than before" the Corps' actions. Tr. 5212:5-9, 5213:11-12. In these circumstances, the plaintiffs are experiencing blocked drainage flooding. Tr. 5168:17-21, 5212:10-13. In addition, because the groundwater will also rise when the River is higher, the plaintiffs also experience seepage flooding. Tr. 5223:7-5224:2.

Dr. Hromadka explained that the seepage on the plaintiffs' properties could not be explained by rainfall alone, but instead was consistent with the River running higher.[56] Tr. 5223:12-5224:23. Relying on aerial photographs, groundwater gage data, and precipitation records, Dr. Hromadka disputed the government's contention, based on Dr. Kopania's testimony, that "groundwater effects abated as soon as the river levels

[56] As discussed *infra* with regard to individual properties, in his review of satellite imagery of the plaintiffs' properties, Mr. Woodbury acknowledged that in many instances, blocked drainage was apparent, and he opined that in such instances, the blocked drainage was likely caused by rain and a higher River. Mr. Woodbury also acknowledged that seepage also occurred in some of these instances of blocked drainage. *See infra*, Individual Plaintiffs section of this opinion.

dropped." Tr. 5225:2-12. Dr. Hromadka explained that Dr. Kopania, the government's groundwater expert, did not consider the groundwater multiplier effect and the groundwater memory effect. Tr. 5225:13-25. Dr. Hromadka explained that because of these effects, seepage does not drop quickly, which explains why the plaintiffs claimed that seepage lasted on their properties for days and weeks. Tr. 5226:1-21.

Dr. Hromadka also prepared his own causation analysis for each property using the actual and "but for" WSEs prepared by Dr. Christensen. Tr. 5233:5-18. As part of the analysis, he explained that he undertook a "[c]orrelation analysis." Tr. 5233:19-5234:14. He testified that he examined the primary variables at issue for each flooding event: WSEs, rainfall, prior inundation events, antecedent moisture conditions, groundwater modeling results, and sediment deposition. *Id*. He looked at the outcomes for each of the types of flooding at issue: seepage and/or blocked drainage flooding, overbank flooding, and levee overtopping flooding. Tr. 5234:5-14. He concluded that the River changed after 2004 and that the flooding in question would not have occurred or would have been significantly less severe in scale and/or duration "but for" the Corps' System and River Changes.[57] Tr. 5234:15-5235:2. He explained that the significant

[57] Dr. Hromadka testified that for the period in question, there was no evidence that natural sediment aggradation could explain the higher WSEs. Tr. 5126:1-23. He also dismissed the possibility that floodplain development could explain the rising WSEs. Tr. 5484:15-16. He further testified with regard to precipitation that there was no evidence that regional precipitation had significantly changed since 2004. Tr. 5484:20-5485:6. This was confirmed by government records which showed the highest runoff events were before 2004 with only two after. Specifically they occurred in 1975, 1978, 1986, 1993, 1995, 1996, 1997, 2010, and 2011. PX832 at 18. Finally, he testified that tributary inflows alone could not account for the change in WSEs. Tr. 5485:19-22.

quantities of sediment added to the River by the Corps led to geomorphological changes that decreased the River's flood-carrying capacity, velocity and depth in certain areas, and increased hydraulic resistance. Tr. 5126:20-5127:14, 5155:14-5156:3, 5235:3-15. The Corps' River Changes thus caused the River to rise faster and higher more often and for longer periods of time than it did prior to 2004. Tr. 5234:15-5235:6. He further explained that the Corps' System and River Changes together have thus caused higher WSEs, which in turn have "caused in whole or in part increased groundwater levels, blocked drainage, and seepage on the [plaintiffs'] properties." Tr. 5235:21-25. He conceded that "weather-related events contributed to cause the flooding in question," but he testified that those events alone could not explain the increased frequency, severity, and duration of flooding. Tr. 5236:1-6. He concluded that the flooding caused by the Corps' System and River Changes was also a foreseeable consequence of the Corps' System and River Changes to comply with the 2003 BiOp. Tr. 5236:7-11. *See also* Tr. 5193:8-17, 5199:4-23. Put another way, his testimony confirmed that higher WSEs and the attendant flooding were the direct, natural, and probable result of the Corp's System and River Changes.

The court finds that Dr. Hromadka's opinions are consistent with and confirm the opinions of Dr. Christensen and establish that the Corps' System and River Changes caused a rise in WSEs, which in turn has resulted in flooding on some plaintiffs' properties that would not have occurred had the Corps not taken these actions, and that this flooding caused by higher WSEs was a foreseeable consequence of the Corps' actions.

The court has considered the testimony from Corps representatives to the effect that they have been very careful to plan and design their activities to avoid potential flooding impacts and that they have studies to show that before taking certain actions, such as chute construction, they try to minimize any flooding harms. Tr. 8171:16-21, 8173:10-8176:24 (Remus), 9060:14-9063:5 (Chapman), 9216:13-9217:1, 9228:17-9237:20, 9241:18-9248:8, 9261:8-21 (Pridal), 9496:23-9506:10, 9538:8-9540:23 (Bitner), 10872:16-10873:1 (Woodbury). *See also* PX514 ("Our chute projects are designed to not impact flood control project[s] by either water surface changes or velocity concentrations."). There are other Corps studies that show there are flooding concerns with the construction of chutes. *See, e.g.*, DX0286; DX0576; DX1072. The court does not question the Corps' efforts to minimize flooding in constructing and maintaining SWH and ESH. The fact that the Corps did not want to cause flooding and may have taken actions in an effort to mitigate potential flooding when creating SWH and ESH does not mean, however, that higher WSEs have not resulted or that this result was not a natural, direct, and probable consequence of the Corps' actions. The rising WSEs described by Dr. Hromadka and Dr. Christensen are the result of known processes that change the hydrology and hydraulics of a river. When the Corps took combined actions to make the River shallower and slower, rising WSEs were a natural, direct, and probable consequence of the Corps' actions. The River Changes were designed to keep the River from functioning as the deep and fast-flowing River that the BSNP structures were designed to create and maintain. The court does not doubt that the Corps has tried to minimize the flooding impacts of its actions. The fact that the Corps took actions to

minimize flooding impacts only confirms that flooding impacts are foreseeable and need to be minimized. The court finds that the Corps' witness testimony, along with the exhibits presented regarding the Corps' intentions, do not undermine Dr. Christensen's and Dr. Hromadka's opinions that, by its actions, the Corps has caused foreseeable water surface level increases and thus more flooding than would have occurred without the Corps' System and River Changes. The evidence established that the changes to the River along its banks that were designed by the Corps to slow velocity by changing depths and adding more roughness to the River increased WSEs at higher flows by essentially slowing down the water in the River that in the past had flowed more quickly through the channel. The extent to which these elevated WSEs flooded individual plaintiff's properties is discussed in the Individual Plaintiffs section of this opinion.

In addition, the court has carefully considered the government's testimony that the reason WSEs have risen may be solely attributable to levee construction, as suggested by Corps witnesses and Dr. Mussetter. Tr. 8642:4-19, 8659:4-18, 8734:2-12, 8742:21-8744:3 (Shumate), 10631:9-10631:14 (Mussetter). The court does not question that levees can constrict flow in the floodplain during high flow events and that this constriction can also lead to higher WSEs. The government did not, however, present any data to show what impact any increase in levee construction post-2004 has had on WSEs. The government did not present any studies to support its contention that changes to the levees that have existed since before the Corps introduced its System and River Changes are the reason for higher WSEs during periods of high flows on the River. Without any quantitative evidence to show how WSEs have changed based on the limited

improvements made to the levees during the flood years in question, the court has no basis for finding that the higher River WSEs post-2004 are solely attributable to limited levee improvements made after 2004.

In addition to carefully considering the testimony of Corps witnesses, the court has also carefully considered the opinion testimony offered by the government from Dr. Mussetter and Mr. Woodbury,[58] who did their own modeling studies and challenged the opinions of both Dr. Hromadka and Dr. Christensen. For the reasons set forth below, the court finds that the opinions of Dr. Mussetter and Mr. Woodbury, two of government experts, do not undermine Dr. Christensen's or Dr. Hromadka's opinions regarding causation and foreseeability with regard to the System and River Changes causing higher WSEs and attendant flooding.

Dr. Robert Mussetter, Ph.D., P.E., has 35 years of experience in fluvial geomorphology and river engineering. Tr. 9863:5-9866:13. He received his B.S. in civil engineering from Montana State University in 1976, an M.S. in Civil Engineering with a focus on hydraulics from Colorado State University in 1982, and a Ph.D. in Civil Engineering from Colorado State University in 1989. Tr. 9864:10-25. He is a registered Professional Engineer licensed in ten states and is a member of various professional societies, including the American Society of Civil Engineers and the American Academy of Water Resources Engineers. Tr. 9865:1-14.

[58] The court addresses Dr. Kopania's opinion testimony and the issue of seepage in the section of the opinion addressing Mr. Tofani's opinion testimony.

Dr. Mussetter was retained by the government to: (1) analyze whether the Corps "change[d] the physical characteristics and behavior of the Missouri River" and (2) if so, "the likely effects of those [C]hanges . . . on the flooding and the erosion at the [p]laintiffs' properties." Tr. 9874:5-23. In answering these questions, Dr. Mussetter prepared a one-dimensional sediment transport model using HEC-RAS for an approximately 413-mile reach of the River and a two-dimensional hydrodynamic model of "six specific locations" that contain multiple SWH projects. Tr. 9874:24-9881:10, 9882:2-9894:8, 10042:16-10045:25. His goal, he explained, was to isolate the precise effects of the Corps' new Master Manual and SWH construction from the "multitude" of other factors that also affect River hydrology and hydraulics. Tr. 9882:9-9884:17, 10042:16-10043:9. In preparing his models, he relied primarily on hydrology records from the USGS and the simulated flows prepared by Mr. Woodbury. Tr. 9894:9-9896:17. He used Corps surveys for his bathymetric data. Tr. 9938:17-22, 9961:17-9962:16.

Dr. Mussetter concluded that "the Master Manual revision and the SWH [construction] activities had an insignificant effect on the alleged flooding" and there is "no basis for the [p]laintiffs' claims that the physical changes to the [R]iver due to the flow changes associated with the [Master Manual revision and] the shallow-water habitat construction are responsible for the alleged flooding." Tr. 9900:5-9901:18. *See also* Tr. 9897:14-24. He opined that the amount of sediment from SWH construction is small compared to the amount of sediment from other inputs and that there is no basis for plaintiffs to claim that SWH construction is responsible for the plaintiffs'' flooding

claims. Tr. 9966:2-9968:1, 9973:24-9974:8, 10017:3-17, 10019:16-20, 10021:14-10022:21, 10024:2-18, 10058:6-10070:2, 10112:8-14, 10354:11-22.

Based on the data he reviewed, he explained that bed elevations and WSEs for in-bank flows have both been largely stable at low flows. Tr. 9946:25-9947:6, 9951:12-23, 9955:21-9956:11, 9958:21-9960:22, 9961:12-24; DX3014-30; DX3014-31; DX3014-36; DX3014-37; DX3014-42; DX3014-43; DX3014-49 (bed elevations); DX3014-50 (WSEs). Dr. Mussetter explained that his one-dimensional model shows that SWH-related effects on hydraulics and sediment dynamics are "basically insignificant" and that SWH construction increases the River's flood-carrying capacity. Tr. 10353:14-10354:16. While he acknowledged that some small aggradation occurred near the entrances of some chutes, he determined that this aggradation had a "negligible effect" on bed elevations and WSEs at low flows.[59] Tr. 10099:19-10103:9, 10151:20-10152:12, 10175:1-21, 10194:24-10195:22, 10224:7-18; 10354:11-16.

[59] Dr. Mussetter and Corps witnesses testified that after the dams were constructed, sediment was trapped by the reservoirs and the amount of sediment in the River drastically decreased. Tr. 9549:12-9550:23, 9555:12-9556:19 (Bitner), 9907:18-9908:13 (Mussetter). *See also* DX1142. BSNP structures also trapped sediment through accretion around the revetments and notches. Bitner 1/27/16 Rule 30(b)(6) deposition at 21:7-12, 138:4-8. According to Dr. Mussetter, the River bed degrades and aggrades depending on whether there are high flows or low flows (droughts). Tr. 9956:6-18. Dr. Mussetter explained that during high flows in 2010 and 2011, for example, the River bed dropped but has now aggraded. Tr. 9951:15-25. Dr. Mussetter also testified that WSEs have been on the increase since the 1960s, which he attributes to levees and the BSNP structures. Tr. 9897:25-9898:20, 9952:3-9953:21. There is no dispute from the plaintiffs that the River was altered with the construction of the BSNP structures and levees. Rather, the plaintiffs contend that it is the modification and removal of those BSNP structures, in combination with the System releases, that are now changing the River and causing WSEs to rise. At closing arguments, in response to the court's questions, the government conceded that the BSNP structures, which the government contends were constructed primarily to create a self-scouring navigation channel, also serve an important flood control function by ensuring a faster, smoother channel to carry flood waters down the River. Tr. 14246:4-14247:3 (Petrie).

Through his two-dimensional modeling of six locations, Dr. Mussetter opined that he was able to isolate the effects of the individual SWH features at the limited number of sites studied from other factors. He concluded that the dike and bank notches he examined have an insignificant effect on WSEs and make "virtually" no change in velocity. Tr. 10088:8-10089:6, 10092:11-14, 10103:10-24, 10199:19-10200:17, 10203:12-10219:5, 10224:19-10225:11, 10258:17-10259:14, 10262:6-10267:2. He opined that "the revetment [chute] and the bank notches [he examined] cause an insignificant impact on the sediment balance through the [River] and . . . cause[] no adverse impact on the water surface elevations." Tr. 10199:19-10200:17, 10203:12-10208:15, 10225:7-11, 10232:4-13. He concluded that any increased sediment in the River is offset by the increased conveyance of water through the chutes and other SWH projects. Tr. 10354:2-10355:16. *See also* Tr. 10175:1-9, 10224:13-10225:11, 10227:25-10228:8, 10232:4-25. He also testified that he did not find any erosion "directly" attributable to SWH-related dike notching or other SWH projects on any plaintiffs' property.[60] Tr. 9900:10-20, 10039:6-10040:6.

The plaintiffs identified numerous flaws in Dr. Mussetter's studies, which the court concludes make Dr. Mussetter's opinions unreliable. First, Dr. Mussetter did not attempt to examine the cumulative and combined impacts of the thousands of dike notches and numerous other changes that the Corps has made to the River to comply with

[60] The claims for erosion are addressed in the Individual Plaintiffs section of the opinion.

the 2003 BiOp.[61] Tr. 10381:18-10385:10. Accordingly, his opinions do not directly challenge Dr. Hromadka's or Dr. Christensen's opinions, which are based on their examination of the cumulative and combined impacts to the River from the Corps' System and River Changes.[62] Second, with regard to the models Dr. Mussetter created, the court agrees with plaintiffs that many of Dr. Mussetter's assumptions in constructing his models were not supported, and thus his models based on those assumptions are not correct. For example, Dr. Mussetter's sediment analysis assumes that the sediment introduced to the River by the Corps' actions is made up primarily of fine particles that wash downstream rather than sand, which is courser, heavier, and stays in the River closer to where it is deposited. Tr. 9998:11-17, 10004:18-23, 10033:19-10035:5, 10036:13-10037:19. Dr. Hromadka explained that Dr. Mussetter's assumption that the sediment that the Corps introduced into the River was 70 percent fine particles and only thirty percent course particles is not factually correct. Tr. 5356:13-5358:4. As Dr.

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[61] For example, in response to the question of "[d]id you model the cumulative impacts of all emergent sandbar habitat projects, all shallow-water habitat projects and all modifications to BSNP structures that the Corps undertook post-2004 in compliance with the 2003 Amended Bi-OP", Dr. Mussetter responded "I can't answer your question." Tr. 10383:2-7.

[62] Like Dr. Mussetter, the Corps witnesses also acknowledged that they have not studied the cumulative effects of their SWH projects and new Master Manual changes on the River as a whole. Tr. 9442:24-9444:12 (Pridal), 8313:21-8316:4 (Remus). The government presented testimony to show that it has collected some hydrographic, flow, velocity, and sediment data regarding some dike notching and has concluded that the River shows little change from its SWH program. Tr. 9338:4-9341:4 (Pridal); DX1041; DX1045. The court has read those documents, which were written in 2007 and 2008. Those studies involve only certain portions of the River and do not purport to provide a comprehensive study of the cumulative effects. The government also presented testimony to explain that the Corps has monitored individual off-channel projects to ensure that chutes are developing properly. Tr. 9350:18-9352:20 (Pridal); DX1060.

Hromadka explained, Dr. Mussetter had his assumptions in reverse. PX2033-B. Dr. Hromadka's opinion was confirmed by government witnesses who testified that the sediment introduced into the River in constructing SWH was mostly sand. Tr. 8297:3-8300:24 (Remus); Shumate 11/10/15 30(b)(6) deposition (PX917) at 61:18-62:1. *See also* Tr. 2413:6-2415:3, 2421:24-2423:7 (Jacobson, USGS); PX36. For example, a Corps document states that 35 million of the estimated 40 million tons, or 87.5 percent, of the sediment from SWH projects will be sand. Tr. 5360:12-20; PX36. Dr. Hromadka also explained that Dr. Mussetter "[s]ignificantly and systematically underestimate[d] the bedload sediment resulting from [the Corps'] projects[,] *i.e.*, the amount of new sediment deposited on the [R]iver bottom[.]" Tr. 5361:24-5362:5. Dr. Hromadka explained that by underestimating the amount of sand in the sediment and by underestimating the amount of bedload sediment, Dr. Mussetter necessarily underestimated the hydraulic resistance. *Id.*

The plaintiffs also identified serious problems with Dr. Mussetter's HEC-RAS model. Dr. Hromadka explained that Dr. Mussetter's HEC-RAS model of the River was full of uncertainty given the many thousands of inputs or parameters that Dr. Mussetter needed to specify in order to make his HEC-RAS model run. Tr. 5389:14-5392:9, 5396:23-5397:22. Each of these parameters had to be altered through a calibration process, which Dr. Hromadka testified made the use of HEC-RAS "unsuitable" for the purposes employed by Dr. Mussetter in this case. Tr. 5389:25-5390:11, 5392:21-5394:25. Dr. Hromadka explained that Dr. Mussetter's model was too complex to be properly calibrated, emphasizing that "[c]omplex models do not necessarily produce

more accurate results" and "adding modeling complexity does not necessarily improve accuracy." Tr. 5395:13-5397:17. Dr. Hromadka explained that as the number of parameters and adjustments increases, the more likely it is that the model can be manipulated to reach a pre-determined conclusion. Tr. 5389:14-5390:11, 5392:21-5394:25, 5396:23-5397:22. Dr. Hromadka also noted that Dr. Mussetter and Mr. Woodbury did not calibrate their models the same way and thus used different adjustments to get their respective HEC-RAS models to match measured real-world WSEs. Tr. 5393:16-20. *See also* Tr. 4826:16-20 (Christensen).

On cross-examination, Dr. Mussetter conceded that his limited one-dimensional HEC-RAS model exhibited uncertainty with every parameter. Tr. 10437:11-10438:15, 10512:15-10515:21, 10612:9-10613:12. He testified that he had altered the parameters in the models that he received from Mr. Woodbury, but he could not identify the precise changes he made to the initial models provided to him by Mr. Woodbury. Tr. 10427:2-10430:23, 10474:3-10493:6, 10556:11-10558:8, 10610:2-10612:6. He also conceded that although an accurate HEC-RAS model would require the modeler to include all hydraulic structures, he did not explicitly include any of the BSNP structures or any of the modifications to those structures in his HEC-RAS model. Tr. 10534:7-10536:8, 10460:23-10461:21. Dr. Hromadka explained that a complex model was not needed because of the available data from the Corps and USGS regarding historic WSEs and the gage measurements of post-2004 WSE changes. Tr. 5489:18-5493:21. Rather, the gage analysis Dr. Christensen created, and upon which Dr. Hromadka relied, was sufficient to formulate "but for" comparisons without the use of HEC-RAS modeling. *Id.*

The court finds Dr. Hromadka's criticisms of Dr. Mussetter's modeling persuasive. Given Dr. Mussetter's concessions and Dr. Hromadka's criticisms of Dr. Mussetter's models, the court concludes that Dr. Mussetter's models are not reliable.[63] For this reason, and because Dr. Mussetter did not consider the cumulative and combined impacts of the numerous changes the Corps has made to the River, the court finds that Dr. Mussetter's opinions do not undermine either Dr. Christensen's or Dr. Hromadka's causation and foreseeability opinions. For the reasons that follow, the court also finds that Mr. Woodbury's opinions do not undermine either Dr. Christensen's or Dr. Hromadka's opinions.

Mr. Mark Woodbury, M.S., is a hydrologist with over 25 years of experience in modeling river hydraulics and reservoir operations. Tr. 10738:11-10752:16. He received a B.S. in Civil Engineering from Texas A&M in 1988 and an M.S. in Civil and Environmental Engineering from Utah State University in 1996. Tr. 10738:18-10739:2. He has done hydraulic analyses, including river simulations for projects in Ethiopia, Sudan, and Turkey. Tr. 10739:11-10752:16. He was retained by the government to address the causes of flooding, including the impact of any changes in the Corps' reservoir management and the impact of any changes in the Corps' SWH efforts, and to quantify those impacts. Tr. 10752:18-10754:12, 10760:21-24. In order to determine WSEs Mr. Woodbury developed a reservoir model using HEC-ResSim (a variant of the

[63] As noted, Dr. Hromadka is a highly regarded expert and holds degrees and teaching positions directly related to hydraulic and hydrological modeling. His opinions on the problems with Dr. Mussetter's modeling and his support for Dr. Christensen's approach carried great weight.

HEC-RAS program) to simulate reservoir releases. Tr. 10770:8-10777:4, 10814:3-10824:23, 10847:10-10851:12 (reservoir model). He then took the results from the reservoir model and used them in his hydraulic model which also included his modeling of River channel changes, together with inputs from Dr. Mussetter. Tr. 10777:6-10782:8, 10854:10-10855:14, 10962:1-10968:20 (hydraulic model).[64] He also compared his models with the plaintiffs' takings claims.[65] Tr. 10782:18-10783:20, 10969:1-8, 10989:16-11001:11.

To prepare his HEC-RAS models, Mr. Woodbury reviewed weather conditions, calibrated the models to represent actual conditions, and then analyzed different scenarios for reservoir operations and River geometry. Tr. 10755:10-21, 10781:22-10782:5, 10787:18-10790:13, 11024:3-11036:20. He then compared the results of the actual and hypothetical scenarios to assess the impacts of the Corps' actions on flooding. Tr. 10822:5-19, 10831:23-10832:8, 10836:19-10848:9. With regard to changes in the new Master Manual, he modeled the Spring Pulse that the Corps did not implement, a variable navigation season, increased winter releases, and unbalancing of the reservoirs. Tr. 10822:5-19, 10831:22-1832:8, 10836:19-10848:9. With regard to adaptive management, he modeled two changes: implementing the Spring Pulse and unbalancing of the reservoirs. Tr. 11147:21-11149:11, 11504:23-11505:11, 11535:18-20. He did not model

[64] Mr. Woodbury did not model all of the River Changes analyzed by Dr. Christensen and Dr. Hromadka in formulating their opinions.

[65] As noted above, Mr. Woodbury used satellite imagery to confirm the periods of flooding described by the plaintiffs and determined that virtually all of the flooding complained of by the plaintiffs in fact occurred as the plaintiffs had stated. Tr. 10782:18-22.

the actual T&E releases. Tr. 10837:9-11, 11458:4-8, 11535:3-12. He only modeled changes to the River from chute construction and channel widening, based on examined bathymetric data. Tr. 10865:6-10873:1 (chutes), 10873:4-10876:16 (channel widening). Mr. Woodbury did not include any modeling of any dike notching or revetment notching in his HEC-RAS models, nor did he explicitly include any ESH. Tr. 10883:19-10884:22, 11589:15-11598:11 (notching), 11554:7-11555:18 (ESH). Additionally, he did not model the effects of chutes on levee failures or on scouring along the toes of levees, nor did he model the cumulative effects from other SWH features interacting with channel widening. Tr. 11556:12-11557:4, 11567:16-19, 11573:13-19. His model also did not account for the effects from channel widening on the reintroduction of sediment to the River and from the slower River allowing for sediment to deposit. Tr. 11569:1-15. In fact, Mr. Woodbury testified that under his model, chutes and channel widening could only reduce WSEs. Tr. 11566:23-11568:3, 11578:5-11579:12, 11589:1-14.

Mr. Woodbury testified that based on his HEC-RAS modeling, he had concluded that "precipitation, snowmelt and consequent runoff into streams, rivers and reservoirs were the fundamental cause[s] of the flooding along the Missouri River" from 2006 to 2014, and that flooding similar to that identified by plaintiffs would have occurred regardless of the Corps' changes that he modeled. Tr. 10782:23-10783:4, 10784:4-10785:8. He opined that the Corps' "[c]hanges to the operational policies of the Corps for its mainstem [S]ystem of reservoirs [have] been minor and [have] not increase[d] flood levels and flood peaks" and that "[i]n the context of the BSNP and other changes to the [R]iver, channel modifications for the purpose of establishing shallow-water habitat .

. . have been minor and have not substantially changed the . . . flood-carrying capacity of the [R]iver." Tr. 10784:10-20. He further opined that "these changes did not cause uniformly increased water surface elevations in the [R]iver that would result in increased flooding of land outside of the [R]iver channel." Tr. 10784:21-24.

The plaintiffs challenged Mr. Woodbury's modeling on numerous grounds. First, plaintiffs challenged Mr. Woodbury's conclusion that precipitation, snowmelt, and consequent runoff were the fundamental causes of flooding from 2007 to 2014. Mr. Woodbury conceded that he is not a meteorologist and is not qualified to give opinions on weather. Tr. 11404:22-11405:1, 11417:1-9. He also conceded that he is not a licensed hydrologist, nor is he a licensed professional engineer, and is therefore not qualified to give opinions as to the cause of any changes to WSEs. Tr. 11403:23-11406:10. In this connection, plaintiffs noted that the government called several meteorologists to testify, including Dr. Martin Hoerling, Ph.D., and Dr. Robert Webb, Ph.D.,[66] both of whom testified that they were not prepared to opine on the causes of the flooding in this case and could not represent that precipitation patterns had significantly changed since 2004. Tr. 12983:12-12984:12 (Webb), 13553:14-13555:20, 13571:3-6 (Hoerling). Dr. Hoerling testified that over the last 46 years, seven of the top ten highest

[66] Dr. Martin Hoerling received his Ph.D. in Meteorology from the University of Wisconsin at Madison in 1987. Tr. 13517:14-17. He is a research meteorologist in the Physical Sciences Division of the NOAA Earth System Research Laboratory in Boulder, Colorado. Tr. 13517:6-19. Dr. Webb, Ph.D., received his A.B. in Earth Sciences from Dartmouth College in 1981, his M.S. in Geological Sciences from Brown University in 1985, and his Ph.D. in Geological Sciences from Brown University in 1990. Tr. 12958:17-23. Dr. Webb is the director of the Physical Sciences Division of the NOAA Earth System Research Laboratory in Boulder, Colorado. Tr. 12957:15-20.

Basin runoff years occurred between 1970 and 1997, and only two of the top ten years have occurred since 1997. Tr. 13560:5-23, 13561:10-13; PX832 at 18-9. Indeed, Mr. Woodbury testified that he was not aware of any tributary inflows that Dr. Christensen had not taken into account in preparing his model. Tr. 11413:13-11414:15. Also, contrary to the government's contentions, with regard to the role of precipitation and flooding, it was clear from the testimony that Dr. Hromadka had in fact considered local rainfall when he offered his opinions on causation for the individual properties he examined, concluding that the monthly precipitation totals he studied could not alone explain the level of flooding or all of the incidents of flooding. Tr. 5484:4-5485:6, 5485:15-5488:25.

Second, with respect to Mr. Woodbury's modeling specifically, plaintiffs contend that Mr. Woodbury's failure to consider T&E releases undermines the reliability of his modeling. The court agrees with the plaintiffs. For example, Mr. Woodbury did not consider whether T&E releases would have been made in a "but for" world when there was downstream flooding. Tr. 11458:4-8, 11149:13-21, 11535:3-12.

Third, plaintiffs also contend that Mr. Woodbury's decision to create his own models and to not use the Corps' pre-litigation HEC-RAS models to which he had access made his models suspect. Tr. 11539:6-21, 11542:5-11546:15, 11551:23-11553:15. The court agrees that Mr. Woodbury's decision to make his own models was not explained.

Fourth, the court accepts Dr. Hromadka's opinion that with over 6,000 parameters that Mr. Woodbury had to fine tune, the court cannot be certain that Mr. Woodbury's models were not manipulated to achieve a desired result. Tr. 5373:7-5377:13, 5389:14-

5397:22. For example, Mr. Woodbury made seasonal adjustments that were illogical in order to calibrate his models. Specifically, he made seasonal changes in some portions of the River but not in others for the same period of time to get his models to match measured data. Tr. 11643:12-11646:9. He also made adjustments to local flows that defied reality. Tr. 11647:9-11653:21. For example, he set local flows from Rulo to St. Joe to "zero" for May 31, 2008 to June 20, 2008, which he conceded was "not possible." Tr. 11650:19-11652:13.

For all of these reasons, the court finds that Mr. Woodbury's modeling is not reliable and does not undermine Dr. Christensen's and Dr. Hromadka's opinions regarding why and how the Corps' actions led to higher WSEs for the years in question that would not have occurred "but for" the Corps' System and River Changes.

Importantly, however, in rejecting the government's criticisms of Dr. Christensen's and Dr. Hromadka's opinions, the court has not altered its view that plaintiffs failed to prove causation regarding System Changes in connection with the 2011 flood. As discussed above, the court has determined the Corps' System Changes did not cause the 2011 flood. In this connection and as discussed *infra* in the Individual Plaintiffs section, the plaintiffs, having presented a theory of liability that is based on the court accepting that the cumulative and combined effects of the Corps' System and River Changes caused foreseeable flooding that would not have occurred in a "but for" world, only presented evidence of higher WSEs that were based on System and River Changes combined together. PX2025-A. Dr. Hromadka's WSE charts upon which the court has based its conclusions only present WSE comparisons with and without the impacts of the

combined System and River Changes. Because the court was not presented with evidence for each individual plaintiff regarding WSE comparisons based on River Changes and System Changes separately, the court is not able to evaluate how River Changes alone affected WSEs for the 2011 flood. Therefore, except for plaintiffs' contentions regarding flooding in 2011 based on the Lower Hamburg Chute causing the Middle L-575 levee breach and the 2010 flood causing the scouring that led to the Upper L-575 levee breach, the court will not consider River Changes alone as a foreseeable cause of the 2011 flood.

c. Mr. Tofani

In addition to Dr. Christensen and Dr. Hromadka, the plaintiffs also relied on the opinion testimony of Mr. Glenn Tofani to support their claims relating to levee failures. There were five levee failures in 2007, three in 2008, fourteen in 2010, and thirty-nine in 2011. PX2577 (2007); PX2576 (2008); PX2575 (2010); PX2574 (2011). In addition, numerous plaintiffs have complained of blocked drainage and seepage leaving water on their properties when the River runs high. Mr. Tofani was retained by the plaintiffs to determine whether "but for" the Corps' System and River Changes, the levees would have failed or blocked drainage and seepage would have occurred.

Mr. Glenn Tofani, P.E., G.E., has over 30 years of experience in the fields of geotechnical, civil, and environmental engineering. Tr. 5779:22-5786:7; PX2500. He received a B.S. in Civil Engineering from California State University at Long Beach in 1982 and an M.S. in Civil Engineering from California State University in Long Beach in 1983, where he specialized in Geotechnical Engineering. Tr. 5779:22-5780:3; PX2500.

He is a registered Geotechnical Engineer in California and a registered Civil Engineer in Alabama (Inactive), Arizona, Colorado, Illinois, Missouri, Nevada, New Mexico, New York (Inactive), Texas, and Utah (Inactive). Tr. 5780:4-11; PX2500. He has provided contracting and geotechnical engineering services for the construction of more than 5,000 structures, including pipelines, roads, flood control improvements, levees, and embankments. Tr. 5780:12-20; PX2500.

He has experience investigating and evaluating the causes of flood damage for the state of California and multiple cities, counties, and private parties. Tr. 5780:21-5781:5; PX2500. He also evaluated levee and embankment designs in California while employed by the Corps as a Project Engineer between 1983 and 1984. Tr. 5781:6-11, 5784:1-11; PX2500. He has been designated as an expert on civil engineering on more than 500 occasions. Tr. 5781:22-5782:3; PX2500. From 1986 to 1992, he taught at California State University at Long Beach and was a lecturer from 2003 to 2011 at the University of California at Irvine. Tr. 5785:3-11; PX2500. At present, he is the president and principal engineer for Advanced Construction Technologies and the president of GeoKinetics, a geotechnical engineering firm. Tr. 5785:12-21; PX2500. He also owns a construction company. Tr. 5785:22-5786:2; PX2500.

Mr. Tofani was asked by plaintiffs to evaluate the nature, extent, and causes of the levee failures that flooded many of the plaintiffs' properties between 2007 and 2011 and was asked to respond to the opinions of the government's experts regarding those same

issues. Tr. 5786:8-16. He was also asked to evaluate the plaintiffs' seepage and blocked drainage claims.[67] Tr. 5779:11-14.

In conducting his evaluation of the levee failures, Mr. Tofani reviewed the operative complaint for the litigation. Tr. 5786:17-20. He also reviewed and evaluated the available documentation regarding the construction, maintenance, and performance of the levees, including: geotechnical investigation records; construction records; as-built plans; monitoring and maintenance records; Corps Project Information Reports; and Corps Levee Operation and Maintenance Manuals and Guidelines. Tr. 5786:21-5787:14. In addition, he retrieved, reviewed, and evaluated historic aerial photographs of the portions of the River at issue, including aerial maps from Google; photographs from Pictrometry; photographs from U.S. National Imagery and Mapping Agency taken by several government agencies, including the United States Department of Agriculture ("USDA") and USGS; and photographs from other photograph collections. Tr. 5787:15-5788:1. He also retrieved, reviewed, and evaluated videos and photographs of the levee failures taken by news agencies, Corps personnel, plaintiffs, and local residents. Tr. 5788:2-6.

Mr. Tofani explained that he reviewed the deposition testimony of the plaintiffs and interviewed several of them in person and over the telephone. Tr. 5788:7-19, 5809:12-20. He also reviewed the depositions of the following Corps employees: Bryan

[67] Before offering his opinions, the government asked that Mr. Tofani be qualified as an expert in geotechnical engineering and that his expert opinions be limited to the causes of the levee failures. Tr. 5848:19-5852:25.

Flere, Omaha District, Levee Safety Program Manager; Don Moses, Omaha District, Civil Engineer; Kim Thomas, Omaha District, Chief of Emergency Management; Geoffrey Henggeler, Kansas City District, Levee Safety Program Manager; and Eugene Kneuvean, Kansas City District, Chief Emergency Management. Tr. 5788:20-5789:5. Mr. Tofani testified that he also retrieved, reviewed, and evaluated the USDA soil maps for each levee failure location. Tr. 5789:7-5792:14; PX2508–PX2512.

To analyze the questions he was asked to answer, he testified that he prepared a base map of the study area with the information he collected, which included 86 miles of SWH mitigation areas on an approximately 350-mile long section of the River. Tr. 5792:15-5793:9; PX2513. He also inspected, took photos, and collected soil samples at nine levee failure locations and had an associate collect soil samples at three additional levee failure locations. Tr. 5806:6-5807:2; PX2518–PX2530. Mr. Tofani tested those soil samples. Tr. 5808:20-5809:11. He reviewed and evaluated the WSEs provided by Dr. Christensen for 2007 through 2011, along with the modifications he needed to make to determine the water levels at the precise levee breach locations. PX2553; PX2554. He retrieved, reviewed, and evaluated the WSEs measured at several gaging stations along the River by the National Weather Service from 2004 to 2016. Tr. 5813:16-5814:2; PX2534. He also retrieved, reviewed, and evaluated USGS topographic data and LIDAR data for the study area.[68] Tr. 5814:9-5819:17; PX2535–PX2550. He testified that using the data he compiled, he prepared two summary tables detailing the dates, locations, and

[68] *See* fn. 30.

WSEs in the actual and "but for" worlds for the levee failures. PX2553 (2011); PX2554 (2007, 2008, and 2010).

Set forth below is the court's analysis of Mr. Tofani's opinions and the government's criticism of those opinions. As the court has previously explained, for the year 2011 the court will only review plaintiffs' claims regarding the L-575 levee. Regarding all of the other levee failures, because the court has determined that the 2011 System releases were not part of the "single purpose" to comply with the ESA obligations, plaintiffs have failed to prove causation. The L-575 levee failure, the plaintiffs claim, was directly attributable to the construction of a chute and it is for that reason that the court will address this levee failure in 2011. Thereafter, the court turns to the levee failures for the other years.

i) Levee Failures in 2011

Based on his analysis, Mr. Tofani testified that the L-575 levee (Middle and Upper) breaches in 2011 occurred because of piping, which he explained meant that "seepage water got into the permeable sand layer that underlies the levee, pressurized that layer to the point where it was boiling up and washing out the foundation of the levee from underneath it and the levee literally collapsed or fell in on itself" at both locations. Tr. 5827:5-21, 5858:3-10. *See also* PX2578, PX2579. In contrast, the other 2011 levee failures were caused by overtopping related to the high WSEs. Tr. 5830:11-15, 5854:22-5855:9, 5940:1-5941:24, 6046:17-24; PX2553; PX2696. He explained that overtopping of a levee occurs "when water flows over the top of a levee for a sufficient period of time to cause erosion and eventually a breach of the levee." Tr. 5940:25-5941:5. He

explained that if the River "rises to a level where it overtops a levee, failure of that levee is likely, though not certain." Tr. 5854:25-5855:4. He further explained that if the levee is overtopped for a period of days by water that "rises to a level that is significantly above the levee, the chances are very slim that [the] levee is going to survive[.]" Tr. 5855:5-9.

Mr. Tofani testified that a chute constructed by the Corps called the Lower Hamburg Chute contributed to the Middle L-575 levee failure. Tr. 5859:24-5915:7, 6045:12-6046:9. The Upper L-575 levee failure, he testified, was caused by seepage related to the high water levels in 2011. Tr. 5916:10-5925:5. He opined that neither the Middle L-575 levee failure nor the Upper L-575 levee failure would have occurred "but for" the Corps' River Changes. Tr. 6044:24-6045:7.

With regard to the Middle L-575 levee failure, which occurred on June 13, 2011 at river mile 551, Mr. Tofani explained that the Lower Hamburg Chute was a contributing factor to "[s]ignificant scouring along the toe of the levee[,]" which he testified caused "[t]he piping failures and levee breach." Tr. 5859:24-5860:2, 5891:18-22, 5892:3-24; 5894:5-5895:3, 5897:2-5, 5900:14-17, 5901:6-9, 5905:24-5907:8, 5912:13-15. *See also* PX2578–PX2671. Mr. Tofani noted that in 2003 and 2004, as part of the Lower Hamburg Bend Mitigation Project, "the Corps removed the [series of rock] dikes that it [had previously] constructed in the 1940s [as part of the BSNP] to prevent flow along the former [pre-existing] secondary channel," constructed a 75-foot wide pilot chute (the Lower Hamburg Chute), and constructed a "separate side channel" (the east chute) "parallel to the levee[.]" Tr. 5819:22-5820:12, 5863:8-5864:22, 5868:11-19, 5869:10-19, 5880:13-15, 5881:8-16. *See also* PX2580–PX2626. He explained that the following

conditions caused or contributed to the Middle L-575 levee failure in 2011: (1) "[t]he geometry of the levee and the floodplain at this location, which is a preexisting condition[;]" (2) "[t]he construction and subsequent widening of the Lower Hamburg Chute which brought the [R]iver closer to the levee and caused higher flow velocities, scouring, and higher seepage pressures, beneath and along the levee, [which is] a changed condition or new [R]iver management policy condition[;]" and (3) "the higher [R]iver water levels associated with the new [River management] policy operating parameters, which is also a changed condition." Tr. 5914:19-5915:7. *See also* Tr. 5884:2-4, 5884:20-5885:6, 5892:13-5893:2 (quoting Moses). He opined that "the combination of the [Lower Hamburg Chute] and the higher water levels . . . caused the scouring" and that "the levee would not have failed but for the scouring that occurred along the toe of the levee." Tr. 5901:6-9; 5905:24-5907:8, 5912:13-16; PX2661–PX2667; PX2671. He also repeated the testimony of several plaintiffs who indicated that the Lower Hamburg Chute caused a perpendicular flow directly at the levee and that this flow also contributed to the Middle L-575 levee breach. Tr. 5885:24-5888:22.

The government took issue with Mr. Tofani's opinion that the Lower Hamburg Chute contributed to the scouring that caused the Middle L-575 levee breach. It was not disputed that the scour hole was the cause of the Middle L-575 levee failure. Tr. 6123:6-6124:13, 6162:3-7. The government's witness, Dr. Schaefer, disputed Mr. Tofani's testimony regarding the effect of the Lower Hamburg Chute on the Middle L-575 levee breach. For the reasons discussed below, the court finds Dr. Schaefer's testimony

persuasive and finds that the plaintiffs did not establish that the Lower Hamburg Chute was a contributing factor in causing the Middle L-575 levee breach.

Dr. Jeffrey Schaefer, Ph.D., P.E., P.G., has 28 years of experience in the design, construction, and analysis of levees, dams, and geotechnical structures. Tr. 12206:25-12207:6. He received his B.S. in Civil Engineering from the University of Louisville in 1987, his Masters in Civil Engineering from the University of Louisville in 1988, and his Ph.D. in Civil Engineering, with a focus on Geotechnical Engineering and Geology, from the University of Kentucky in 2000. Tr. 12206:6-16. He is both a Professional Engineer and Professional Geologist and has worked on numerous levee studies. Tr. 12210:13-16, 12211:13-12212:21, 12427:19-12429:16. He is a member of several professional societies, including the American Society of Civil Engineers, the American Society of State Dam Safety Officials, and the United States Society on Dams. Tr. 12207:7-12. He has authored approximately 60 technical presentations and technical papers, including a paper he presented in 2017 to the American Society of Civil Engineers on "Assessing the Implications of Sand Boils for Backward Erosion Piping Risk." Tr. 12206:17-22. He is currently employed by the Corps as the lead civil engineer of the Corps Institute for Water Resources Risk Management Center, where he works on risk analysis, risk assessment, and risk management involving the Corps' dams and levees. Tr. 12207:13-12209:1, 12426:18-12427:18.

Dr. Schaefer was asked by the government to evaluate: (1) whether the "changes in the operation of the [R]iver by the Corps increase[d] seepage flooding of the [p]laintiffs' properties; increase[d] flooding from levee failures on the [p]laintiffs'

properties; and increase[d] erosion of [p]laintiffs' properties[;]" and (2) whether the "construction of shallow-water habitat projects by the Corps increase[d] seepage flooding [of the] [p]laintiffs' properties; increase[d] flooding from levee failures on [the] [p]laintiffs' properties; and increase[d] erosion of [the] [p]laintiffs' properties." Tr. 12212:25-12213:12. In preparing his models to study levee breaches and to evaluate seepage, Dr. Schaefer testified that he collected available background information; visited several breach sites; evaluated aerial photographs, Google Earth images, historic maps, topographical maps, and LIDAR data; reviewed geological studies and soil studies; evaluated construction and design information, levee manuals, construction drawings, levee performance and flood damage project information reports, flood after-action reports, Corps expert reports, Corps depositions, and videos and photographs of the floods and flood damages; reviewed seepage studies from the Corps; reviewed hydraulic data, hydrographs, and two-dimensional hydraulic models from Mr. Woodbury, Dr. Mussetter, and the Corps; and developed seepage models. Tr. 12213:13-12218:19, 12245:11-12246:1, 12340:11-12.

With regard to the Middle L-575 levee breach in particular, Dr. Schaefer testified that he prepared a seepage model to study the Middle L-575 levee breach with and without the Lower Hamburg Chute in place, with and without the scour hole in place, and with and without the relief wells in place.[69] Tr. 12354:22-12355:2. *See also* DX3018-

[69] There was a great deal of testimony regarding the relief wells. Relief wells are wells designed to relieve water pressure on levees by keeping water from seeping underneath the levee. The court finds that the Corps had given the levee as a whole a "minimally acceptable" rating and had given the relief wells an "unacceptable" rating. Tr. 5907:2-5908:4 (Tofani). The court finds

264; DX3018-333. Dr. Schaefer opined that the 2011 Middle L-575 levee breach was caused by a piping failure precipitated by the "severe erosion of the [R]iver side silt layer at the toe of the levee" caused by the formation of a scour hole, which, he testified, would have occurred regardless of the Lower Hamburg Chute's construction. Tr. 12220:8-18, 12364:19-24. He concluded that "the levee failed from seepage that was caused by scour hole erosion on the river side of the levee; the seepage from the chute had no impact on the failure; and the levee would have failed with or without the chute due to the river side erosion." Tr. 12364:19-24. *See also* DX3018-293; DX3018-295. Dr. Schaefer testified that the 2011 Middle L-575 levee failure occurred due to the high magnitude and duration of the 2011 flood, the levee's kink point forming an angle that contributed to erosion, and the poor performance of relief wells. Tr. 12391:25-12392:18. Dr. Schaefer testified that the Lower Hamburg Chute did not have any influence on the scour hole because the water that caused the scouring did not come from the chute, which was 1,500 feet from the levee breach, but "was present along the levee in 2011 due to the fact that the [R]iver level [in 2011] rose above the floodplain and flooded the entire floodplain." Tr. 12367:5-12370:13; DX3018-304–DX3018-306. He discounted eyewitness testimony that water from the chute began to run perpendicularly to the levee at the breach location, testifying that the eyewitness testimony was better explained as water running through the breach as soon as it occurred. Tr. 12372:20-12381:10; DX3018-309–DX3018-316. Dr.

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that relief wells were not fully functioning and thus were a contributing factor to the Middle L-575 levee breach. DX0883; DX0884; DX3017-91.

Schaefer concluded that the "primary factors that contributed to the [Middle L-575] levee failure are: [t]he large flows and long durations of the flows associated with the 2011 flood[;] [t]he alignment of the levee [which] created a location of high velocity flow that would have existed [whether or not] the Lower Hamburg Chute was present[;] [t]he geomorphic features, remnant channels, passing below the levee which likely resulted in a thin surface blanket layer of low permeability soils underlain by high permeability soils[;] [t]he fine uniform sands and silts found along the [R]iver that are very erodible[;] [the] [e]rosion of the silt blanket layer along the riverside toe[;] [a]nd [the] reduced . . . relief well capacity/functionality due to the lack of maintenance and testing by the local levee district." Tr. 12391:25-12392:18. The court finds that Dr. Schaefer's testimony better explained how the Middle L-575 levee breach occurred and that, for the reasons he stated, the court finds that the Lower Hamburg Chute was not a contributing cause of the Middle L-575 levee breach and thus plaintiffs have not established causation for the Middle L-575 levee breach.

Mr. Tofani also testified regarding the Upper L-575 levee breach, which occurred on June 29, 2011 at river mile 571.5. Tr. 5916:10-12, 5919:16-18, 5922:7-5925:7. *See also* PX2672–PX2695. There is no chute in the vicinity of the levee. He testified that the scouring damage along the toe of the levee caused by "the high water levels and flow velocities during the 2010 flow event" had not been fully fixed prior to the 2011 flood, and this contributed to the Upper L-575 levee failure. Tr. 5917:4-16, 5921:7-5922:1. Mr. Tofani explained that the Upper L-575 levee failure was caused by: (1) "the geometry of the levee and the floodplain at this location, which is preexisting or a status

quo variable [;]" and (2) "the higher flood levels and flow velocities in 2010 and 2011 with the new [River management] policy that caused scouring and piping." Tr. 5924:25-5925:5. He testified that under the Corps' old River management policy, *i.e.*, without the Corps' System and River Changes, the water levels would have been sufficiently lower and that "the levee was not likely to fail even if scour was present." Tr. 5923:13-5924:1; PX2687–PX2695. He also testified that "without the scouring along the levee toe, the levee was not likely to fail at either the old or new [R]iver management water levels." Tr. 5924:3-24; PX2687–PX2695.

The government again presented testimony from Dr. Schaefer challenging Mr. Tofani's opinions regarding the Upper L-575 breach. Dr. Schaefer concluded that the Upper L-575 breach was caused by a piping failure due to severe erosion that was caused by the magnitude and duration of the 2011 flood. Tr. 12397:8-12398:22. He explained that a scour hole had formed after the 2010 flood that was not fully repaired by the time of the 2011 flood. Tr. 12396:8-14, 12397:6-24; DX3018-345. Dr. Schaefer opined that "the primary factors that contributed to the [U]pper L-575 levee breach are the large flows and long duration of the flows associated with the 2011 flood; the alignment of the levee[;]the kink point, that created a location of high velocity flow; the erosion of the clay/silt cap along the river side toe[,] both historically in previous years and during the 2011 flood; [the] geomorphic features, remnant channels, passing below the levee which likely resulted in a thin blanket compared to other areas; and the fine uniform sand and silts found along the [R]iver [that] are very erodible." Tr. 12397:25-12398:11. The court finds that Dr. Schaefer's opinion regarding the causes for the Upper L-575 breach are

persuasive. The court agrees with Dr. Schaefer that the prior scouring from the 2010 flood was not by itself a cause of the levee failure in 2011. Rather, the 2011 releases were so overwhelming that levee failure was inevitable. Having concluded that the plaintiffs did not establish that the Corps' System Changes in 2011 were the cause of the 2011 flood, the court finds that the Upper L-575 breach was not caused by the Corps.

ii) Levee Overtopping in 2007, 2008, and 2010

In 2007, 2008 and 2010, Mr. Tofani opined that some flooding was due to levee overtopping on some properties, but that the levees did not fail. PX2554. Mr. Tofani opined that the levee overtopping would not have occurred without the higher WSEs, which he understood from Dr. Christensen's data was caused by the Corp's System and River Changes. Tr. 6046: 17-21. He also opined that most of the levee failures in 2008 and 2010 would not have occurred without the higher WSEs, which he understood from Dr. Christensen's data was caused by the Corps' System and River Changes. Tr. 5941:20-24; PX2554, PX2888–PX2898 (2008); PX2849–PX2887 (2010). In support of his opinions regarding the causes of the levee failures, Mr. Tofani had the benefit of the studies noted above and the Corps' studies, which in many instances confirmed the cause of the levee failures.[70] Tr. 3966:11-3973:12 (Henggeler). He testified that he studied

[70] As explained *supra*, Mr. Tofani reviewed and evaluated the available documentation regarding the construction, maintenance, and performance of the levees, including: geotechnical investigation records; construction records; as-built plains; monitoring and maintenance records; Corps PIRs; Corps Levee Operations and Maintenance Manuals and Guidelines; photographs of the portions of the River at issue, including aerial maps from Google,; photographs from Pictrometry; photographs from U.S. National Imagery and Mapping Agency taken by several government agencies, including USDA and USGS; photographs from other photograph collections; and videos and photographs of the levee failures taken by news agencies, Corps personnel, plaintiffs, and local residents. Tr. 5786:21-5787:14, 5788:2-6.

each levee failure and in most instances, the testimony of the plaintiffs and Corps' documents confirmed that overtopping was the cause.[71]

The government's expert, Dr. Schaefer, did not provide any analysis regarding his opinions as to the cause of the levee breaches that occurred in 2007, 2008, and 2010. Tr. 12404:23-12406:6, 12531:2-12532:16, 12548:3-12549:8, 12550:3-12553:5; DX3018-363–DX3018-368. Dr. Schaefer offered the following opinions regarding the levee failures based largely on Mr. Woodbury's modeling: (1) "[n]one of the documented breaches occurred adjacent to any shallow-water chute projects; therefore, none of those breaches were caused by [the] shallow-water habit projects" implemented by the Corps; (2) "[r]egardless of the cause, overtopping or failure prior to overtopping, the hydraulic modeling by [Mr. Woodbury] shows the [R]iver levels under the old policy . . . and the

[71] The 2008 and 2010 overtopping failures of the L&H Investments private levee were confirmed by Mr. Henry Larson (Tr. 2736:8-2738:3, 3628:20-3634:8 (Larson), 5988:23-5989:16 (Tofani)); 2010 overtopping failure of the Ideker private levee was confirmed by Mr. Roger Ideker and photographs from the Holt County Clerk, Ms. Kathy Holstine. Tr. 4138:13-4141:12 (Ideker), 5981:7-5982:4 (Tofani); 2007 and 2010 overtopping failures of the Union Township non-federal levee were confirmed by Mr. Darwin Binder, Mr. Steven Cunningham, Mr. Eddie Drewes, Mr. Eugene Kneuvean, and a county document (Tr. 3320:7-3325:5, 3335:19-3336:3 (Drewes), 3384:16-3385:3, 3401:13-19 (Cunningham), 3528:16-24 (Binder), 5983:5-5984:9 (Tofani); PX2867–PX2871; 2007 and 2010 overtopping breaches of the Holt County Number 10 non-federal levee were confirmed by Mr. Steven Cunningham, Mr. Kneuvean, and Mr. Henggeler and Corps documents (Tr. 3379:7-33380:1 (Cunningham), 5985:4-20, 5992:22-5993:3 (Tofani); PX2875; PX2909; PX2910); 2007 and 2010 overtopping failure of the Alma Green Trust private levee were confirmed by Mr. Marvin Green (Tr. 2938:19-2940:13 (Green), 5986:10-11, 5993:19-5994:9 (Tofani)); 2008 and 2010 overtopping failures of the Rushville-Sugar Lake non-federal levee were confirmed by Mr. Lanny Frakes (Tr. 3874:9-22, 3877:4-11 (Frakes), 5987:14-24, 5989:17-5990:12 (Tofani)); 2007, 2008, and 2010 overtopping failures of the Hildebrandt private levee were confirmed by Ms. Patricia Hildebrandt (Tr. 3690:10-3691:16 (Hildebrandt), 5990:13-25, 5994:23-24 (Tofani)). While overtopping may have been the cause of levee failures, this does not mean, as discussed *infra, see* fn. 72, that some of these levees would not have also overtopped without the Corps' System and River Changes. *See,* PX2554.

new policy . . . would have been almost identical[;]" (3) "[t]he actual water elevations were not the result of changes to the new policy but were the result of exceptional snowmelt and/or precipitation events[;]" and (4) "[g]iven that the loading from the [R]iver would be the same under the two scenarios, it is expected that there would be no difference in the number of levee failures that would occur." Tr. 12411:5-24. He also testified that Mr. Tofani did not have sufficient information to determine the precise cause of the breaches, and thus his opinions are too speculative. Tr.12404:23-12406:14.

The court disagrees with the government regarding the levee breaches in 2007, 2008, and 2010. The court finds that Mr. Tofani's opinions regarding overtopping and levee failure in those years were supported. Mr. Tofani explained that overtopping can cause failure and there was no other evidence presented by the government to show that there were other causes of levee failures. Thus, where Mr. Tofani opined that WSEs without the Corps' System and River Changes would not have been sufficiently high to overtop and/or breach the levees as compared to the higher WSEs caused by the Corps' System and River Changes, the plaintiffs have established causation. They have also established foreseeability in that levee overtopping and where a breach occurred was the direct, natural, and probable result of the higher WSEs.[72]

iii) Blocked Drainage/Seepage

[72] As discussed in the Individual Plaintiffs section of the opinion, Mr. Tofani did not agree that every levee overtopping in 2007, 2008, and 2010 was attributable to the Corp' System and River Changes. Specifically, he determined that the Holt County #10 levee would have failed in 2007 and that the Union Township levee would have possibly failed in 2007 and would have failed in 2010. PX2554.

Mr. Tofani was also asked to provide his opinions regarding whether the Corps' System and River Changes caused seepage and blocked drainage. Tr. 5779:11-14, 5997:6-8. He testified that there are two primary mechanisms that could have increased the seepage associated with higher groundwater levels: (1) "higher [R]iver water levels, particularly during the spring and summer months[;]" and (2) "structural or geomorphological changes to the [R]iver associated with the shallow-water habitat or river control structure modifications." Tr. 5997:6-20. Mr. Tofani also testified regarding the USGS' 1999 study entitled *Effects on Ground-Water Levels in the Missouri River Alluvial Aquifer Caused by Changes in Missouri River Stage, Fremont and Monona Counties, Iowa*. Tr. 5997:21-6000:22; PX2917; PX2918. He explained that the 1999 study describes the potential impact to groundwater levels from changes in the River WSEs that were contemplated at that time to meet the Corps' ESA obligations. Tr. 5998:6-11. The USGS performed the study in two locations in Iowa that are covered by this litigation. Tr. 5998:12-5999:9; PX2919. The USGS installed and monitored 36 groundwater wells to evaluate how groundwater levels would be affected by various River stages. Tr. 5999:10-13. He noted that the approach taken by the USGS in the 1999 study to simulate River stages for multiple contemplated reservoir release and storage scenarios is similar to the approach taken by Dr. Christensen in his WSE analysis. Tr. 5999:14-18. The 1999 study noted that plans to increase System releases could cause groundwater levels to rise with impacts of one to four feet in groundwater level changes. Tr. 5999:19-6000:22. The 1999 study also showed that the impacts on groundwater levels can occur up to 10,000 feet away from the River. Tr. 5999:25-6000:16. The 1999

study also found that "[c]hanges in the measured groundwater levels in response to the changing [R]iver levels . . . occur[red] at distances of more than a mile from the [R]iver in both counties." Tr. 5999:25-6000:3.

Mr. Tofani also testified about several of the groundwater wells that the government's expert, Dr. Kopania, studied. Mr. Tofani explained that Dr. Kopania's results "indicated significant impacts to groundwater levels in response to fluctuating [R]iver levels for each well that he evaluated that was less than 12,000 feet from the [R]iver[.]" Tr. 6001:6-11. Mr. Tofani further explained that "the amount by which the groundwater level fluctuated in the three wells that Dr. Kopania looked at" was, on average, approximately seventy-eight percent of the associated change in the River water level, as measured by Dr. Kopania, meaning that, for example, if the River water level rose by ten feet, the groundwater level in the three wells would increase, on average, by 7.8 feet, which Mr. Tofani opined "indicates that groundwater levels are closely tied to [R]iver water levels." Tr. 6001:12-6002:4. *See also* Tr. 6013:13-19; PX2920–PX2945. Mr. Tofani opined that the Corps' System and River Changes "will result in higher groundwater levels to the extent [the Changes] create higher [R]iver water levels[.]" Tr. 6019:14-17.

Mr. Tofani also examined and offered an opinion on the effect of SWH projects on groundwater levels. Tr. 6016:25-6020:1. He stated that SWH projects "effectively bring the [R]iver closer to the farmlands" and "[a]t moderate and high [R]iver levels, the shallow-water habitats will typically cause groundwater levels to be higher within approximately two miles of the [R]iver." Tr. 6019:19-6020:1; PX2950. *See also* Tr.

5997:6-20. Mr. Geoffrey Henggeler, a Corps witness, supported Mr. Tofani's opinions regarding groundwater and seepage. Tr. 12000:15-12001:25, 12002:4-12011:6 (Worthwine Island study), 12012:19-12015:8. Mr. Tofani testified that modeling groundwater effects is very difficult because of the limited data available, and thus it was appropriate to "compare the frequency of flooding at any given [R]iver discharge level before and after the shallow-water habitat and the [R]iver structural changes were implemented" for the study area in order to determine if the River water levels have been raised sufficiently by the Corps' System and River Changes to cause groundwater levels to rise. Tr. 6020:2-6, 6021:10-23. After looking at the increased number of claims, Mr. Tofani opined that the increase in claims "appears to be at least partially attributable to structural changes to the [R]iver that have occurred, either directly or indirectly, as a result of the [Corps'] shallow-water habitat measures." Tr. 6027:10-14. The court takes from Mr. Tofani's use of the language "appears to be at least partially attributable" that he could not definitively state that any single SWH project near any individual plaintiff's property caused higher groundwater levels.

The government relied on the testimony of Dr. Andrew Kopania to respond to Mr. Tofani's seepage analysis. Dr. Andrew Kopania, D.Env., P.G., is a hydrogeologist with 27 years of experience in modeling and evaluating surface water and groundwater conditions. Tr. 12773:17-12774:2; DX2084. He received his B.S. from the University of California at Los Angeles ("UCLA") in 1981, an M.S. in Geology from the University of Michigan in 1984, and a Doctorate in Environmental Science and Engineering from UCLA in 1991. Tr. 12774:4-14; DX2084. He is a certified Hydrologist licensed in

California and a Professional Geologist licensed in California. Tr. 12773:23-12774:2; DX2084. He is a member of the Association of Groundwater Scientists and Engineers. DX2084. He is currently the president and principal hydrologist of EMKO Environmental, Inc., in El Dorado Hills, California. Tr. 12775:8-12; DX2084. He specializes in complex groundwater-surface water interactions. Tr. 12773:17-22, 12775:8-12; DX2084. He has experience studying the interaction of surface water and groundwater for the Nevada Irrigation District and at other locations. Tr. 12775:18-12776:24; DX2084. Dr. Kopania explained that he was asked by the government to evaluate: (1) "whether the Corps' actions caused the claimed flooding for the 2007 to 2014 seepage claims, which occurred at 22 of the 44 representative sites[;]" (2) "groundwater exfiltration," (where groundwater is rising up to the surface) which occurred at 8 of the 22 representative sites with seepage claims, and which he defined as "seepage flooding claim[s] or allegations of seepage flooding where the water level in the [R]iver [did not] rise to the toe of a levee or [did not] leave the bank of the [R]iver[;]" (3) "the response of the groundwater table to those changes in the [R]iver level while the [R]iver is still within [its] banks[;] and (4) "changes to the groundwater levels from the construction of [Missouri River Restoration Program] projects, such as the shallow-water habitats or chutes." Tr. 12778:17-12779:22. *See also* DX3019-15. He also compared the "effects before and after the Master Manual revisions and due to Missouri River Restoration Program actions such as the shallow-water habitat [projects]." Tr. 12777:21-24. He apparently was not asked and did not study plaintiffs' blocked drainage claims. Tr. 12894:15-12898:16.

Dr. Kopania testified with regard to seepage that, based on the best data he could find from the USGS regarding four well sites, "groundwater is [always] higher than the [R]iver except when the [R]iver is above its banks." Tr. 12788:4-18, 12810:2-16, 12825:21-12826:1. *See also* DX3019-57–DX3019-75. He found that "[t]he changes in the groundwater elevation are always less than the change[s] in the [R]iver level," and that at distances greater than two miles, the River is "not the primary influence" on groundwater elevations. Tr. 12826:2-9. Based on Mr. Woodbury's modeling, Dr. Kopania opined that "[R]iver levels, flooding events and groundwater elevations are not higher under the [new Master Manual]." Tr. 12830:21-12832:7, 12832:13-16, 12833:4-12835:7, 12891:25-12892:10. He opined, based on his review of Mr. Woodbury's and Dr. Mussetter's modelings, that "any changes to the [R]iver level due to changes in the [R]iver configurations and operations are nominal and that the differences in peak flood [R]iver levels are not consistently higher under the [new Master Manual] and MRRP actions." Tr. 12833:22-12834:3. *See also* Tr. 12835:5-12836:25. Dr. Kopania testified that "there are multiple causes of flooding related to the exfiltration events." Tr. 12851:3-5, 12852:23-12853:11, 12873:13-12874:13. He determined that while the River level could cause the groundwater table to rise, local rainfall and runoff from upslope areas can cause the groundwater table to rise in exfiltration conditions. Tr. 12801:8-13, 12852:23-12853:11, 12873:13-12874:13. Based on his review of River levels from Mr. Woodbury, Dr. Kopania opined that the changes in River levels "are not solely or primarily responsible for the rise of the groundwater table and the occurrence of exfiltration onto the ground surface[.]" Tr. 12789:15-21, 12873:10-24.

With regard to SWH projects and their impacts on groundwater levels, Dr. Kopania was tasked with studying whether SWH projects affected groundwater levels or led to a higher groundwater table. Tr. 12779:13-16, 12826:11-15. He relied upon a USGS study that examined the groundwater impacts of different chutes from 1994 to 2002. Tr. 12837:4-12841:9. *See also* DX1229. Dr. Kopania opined that so long as the water level in chutes is lower than the River level, chutes would not cause the groundwater table to rise or cause exfiltration flooding claims. Tr. 12826:22-12830:3. He explained that the "creation or expansion of the chutes widens the surface area of the [R]iver and causes the [groundwater] table to decline on the landward side of the levee in all these exfiltration situations where [the River is in] a gaining stream condition." Tr. 12874:9-13. Dr. Kopania did not, however, analyze any other types of SWH project aside from chutes, nor did he analyze the cumulative effects of all of the Corps' River Changes. Tr. 12910:23-12912:8.

The plaintiffs contend that Dr. Kopania's opinions should be discounted because he did not consider or study whether blocked drainage could explain plaintiffs' flooding claims and relied extensively on Mr. Woodbury's modeling, which, plaintiffs contend and the court has found, is not reliable. Tr. 12894:15-12898:16, 12882:24-12885:4, 12890:25-12894:24.

The court has considered Dr. Kopania's testimony and finds that it does not undermine Mr. Tofani's opinions regarding causation and foreseeability with regard to blocked drainage when WSEs are higher than they would have been before the Corps' System and River Changes. As discussed *infra*, the court has not found liability for any

seepage claims that are separate from blocked drainage, and thus the court finds that Dr. Kopania's opinions regarding groundwater seepage do not undermine Mr. Tofani's opinion that when higher River levels cause blocked drainage, there is also likely seepage.[73]

The government also relied on the testimony of Dr. Schaefer to respond to Mr. Tofani's seepage analysis with regard to seepage when the River is flooding and is at or above the toe of the levee. Tr. 12232:18-12233:6; DX3018-34. Dr. Schaefer compiled the available background information for each of the properties with seepage claims; visited the sites; examined the soil survey mapping, geological studies, and geomorphological information; evaluated the hydrographs produced by Mr. Woodbury; and developed seepage models for certain properties. Tr. 12215:19-12217:9, 12244:19-12246:5. For the properties for which he did not specifically develop seepage modeling, he extrapolated those model results to those properties that had similar characteristics and performed a "qualitative assessment . . . by comparing similar conditions." *Id.* He used a steady-state seepage analysis, where the boundary conditions are held constant, unlike plaintiffs' expert who used a transient seepage analysis. Tr.12237:5-12241:5, 12242:11-23. He testified regarding his seepage analysis of each individual property and produced a summary chart. *See* DX3018-40; DX3018-41; DX3018-240–DX3018-246. Dr.

[73] Having concluded that higher WSEs in 2007, 2008, 2010, 2013, and 2014 were caused by the Corps' System and River Changes, the court has not considered whether individual SWH projects have by themselves caused additional seepage. The court accepts the plaintiffs' theory that this case concerns the cumulative and combined impacts of the Corps' System and River Changes, and except for the plaintiffs' claims regarding the Lower Hamburg Chute contributing to the Middle L-575 levee breach, the court has not examined any individual Corps project.

Schaefer offered the following opinions regarding seepage: (1) "the quantity of seepage flow is directly related to the [R]iver stage[;]" (2) "hydraulic modeling by [Mr. Woodbury] indicates there are only minor differences in the [R]iver levels simulated from the baseline/actual condition and the pre-2000/no-MMR scenario[;]" (3) "[t]hese scenarios account for both operational and [R]iver channel geometry differences[;]" (4) "the estimated seepage quantity differences are minor and are both positive and negative[;]" (5) "[t]he shallow-water habitat chutes have not contributed to seepage flooding on the [p]laintiffs' properties[;]" (6) "[n]o shallow-water habitat chutes create the primary seepage entrance for any of the [p]laintiffs' properties[;]" and (7) "[n]one of the [p]laintiffs' properties that are claiming seepage flooding are adjacent to a levee with a chute near the levee." Tr. 12218:21-12219:18, 12335:6-12336:4.

The plaintiffs contend that Dr. Schaefer's opinions should be discounted because he failed to consider or study whether there was blocked drainage, which could explain the plaintiffs' claims. Tr. 12456:10-12460:11. Dr. Schaefer also relied on Mr. Woodbury's modeling, which plaintiffs contend is not reliable. Tr. 12441:3-12446:23, 12460:22-12461:24.

As with the opinions of Dr. Kopania, the court finds that Dr. Schaefer's opinions do not undermine Mr. Tofani's conclusions regarding the cause of seepage and blocked drainage claims on the plaintiffs' properties. Dr. Schaefer's opinions regarding causation rely on Mr. Woodbury's modeling, which the court has found is unreliable.[74] Seepage

[74] Plaintiffs Ideker, Blodgett Farms, Larson, and Hildebrandt claim that portions of their properties have eroded following the Corps' System and River Changes. As discussed in the

and blocked drainage claims in this case are all tied to higher WSEs, which for 2007, 2008, 2010, 2013, and 2014, the court has found were caused by and were the foreseeable result of the Corps' System and River Changes. Mr. Tofani's opinions, which are consistent with Dr. Hromadka's, are sufficient to establish causation and foreseeability with regard to the claims for seepage when associated with blocked drainage.

IV. Individual Plaintiffs

The court's findings regarding the plaintiffs' claims are as follows:

1. Property 1: Karen G. Hogue Trust and Peter and Karen Hogue[75]

This property is located at river mile 1323 and the Hogue plaintiffs claim a taking based on flooding only in 2011. The undisputed testimony is that flooding began late May or early June and lasted about 90 days. Virtually the entire property was inundated by overbank flooding to some extent. Some areas were deeper than others depending on the elevation. Depths of flood waters varied from one to several feet. The home on the property was protected by a ring dike that was built but water entered the home through underground seepage, causing great damage. Some crops were planted but were

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Individual Plaintiffs section of this opinion, the court finds that these claims have been complicated by the significant erosion that occurred in 2011 along the River for which the Corps is not liable and thus fail for lack of proof. Tr. 8192:11-8194:22 (Remus, discussing Andersen's property), 9062:10-9063:15 (Chapman, discussing dike notch erosion); DX3004-199–DX3004-202 (Andersen's property).

[75] After trial, the government challenged whether the Hogue Trust was the real party in interest on the grounds that when the property was flooded it was owned by Mrs. Hogue as an individual and was not transferred into the trust until later. The plaintiffs have moved to have Mrs. Hogue substituted as the real party in interest or joined on the grounds that plaintiffs mistakenly failed to include in the complaint Mrs. Hogue in her individual capacity and the government suffered no prejudice. The court finds pursuant to RCFC 17(a)(3) that Mrs. Hogue is the real party in interest and will be joined as a party. Plaintiffs' motion (ECF No. 395) is **GRANTED**.

destroyed by the floodwaters. Flooding caused erosion and left large sand deposits and debris. With great effort, the sand and debris were removed and the land was reworked, but not as it was before the flooding. Many trees on the property died. Karen Hogue has been unable to move back into the house because of air-quality concerns due to mold, despite many efforts to make it safe. Tr. 151-182.

As discussed earlier in this opinion, the court is mindful of the devastation caused by the 2011 flood. However, to establish a taking based on that flood the plaintiffs needed to prove that the flood was caused by the Corps' System Changes and that the flooding was foreseeable. Plaintiffs failed to meet their burden to prove a taking and their claim must be dismissed.

2. Property 2: Peter and Judy Masset

This private residence is located at river mile 1313. Plaintiffs own the property in fee simple and only make a takings claim for flooding in 2011. The evidence established that before flooding began in May 2011, the home was sandbagged with a ring dike/berm, five feet high. Seven pumps outside the home and seven inside the home were installed to pump water. The overbank flooding encroached upon but did not overtop the dike/berm for about two and a half months from May until September. Water infiltrated into the basement with the peak stage coming in June. The water began receding in August but did not totally recede until September. Plaintiffs slept on the floor of their bedroom for approximately two months to keep the pumps running (24 hours a day, seven days a week). As a result, plaintiffs were able to save their home. Damages included: shifted windows, cracks in the ceiling, cracks in tile flooring, cracks in walls, a

cracked driveway, ruined landscaping, a ruined sprinkler system, a ruined lawn, and a damaged foundation. Tr. 848-881.

For the same reasons as stated with regard to Property 1, Peter and Judy Masset cannot establish a taking based on the 2011 flood and their claim must be dismissed.

3. Property 3: Eric Moritz; Southport Marina, LLP; Capsco Entertainment, Inc., d/b/a The Pier Bar and Grill

This property is located at river mile 1313. Mr. Moritz and his companies own portions of the property in fee simple and lease the rest. Mr. Moritz on his own behalf and on behalf of his companies only makes a takings claim for the flood in 2011. It is not disputed that the property was inundated by overbank flooding. Floodwaters ranged from two feet deep in the restaurant to 15 feet deep in the Marina. The flooding lasted from Memorial Day until Labor Day. The flooding caused: dock damage in marinas, parking lot damage due to erosion, loss of income from boat slip rentals and marina use, erosion, and damage to marina banks. The property had a restaurant and as a result of the flooding the interior was completely lost and had to be rebuilt. It did not re-open until 2012. Tr. 184-203.

For the same reasons as noted with regard to Property 1, Eric Moritz and his companies cannot establish a taking based on the 2011 flood and their claim must be dismissed.

4. Property 4: James and Sharon Forney

This property is located at river mile 1068. The Forneys own the property in fee simple. They make a takings claim for flooding in 2011. The evidence established that

flooding began on May 20, 2011 and lasted approximately 100 days until September 14, 2011. A temporary levee was constructed by the City of Fort Pierre and the Corps just south of the property. Flood waters reached four to five feet deep on the property. The main floor of the home had water in it for the first time ever. The flood caused extensive damage to the home, farm, barn, and stock pens, and tore out several thousand feet of fencing. Additionally, extensive debris was deposited along the southern end of the farm up against the temporary levee. Noxious weeds, muck, mud, and silt inundated the farm. The alfalfa crop that had been planted was completely destroyed. Tr. 347-389.

For the same reasons as discussed with regard to Property 1, James and Sharon Forney cannot establish a taking based on the 2011 flood and thus their claim must be dismissed.

5. Property 5: Andersen Family Farms Partnership; Engra Andersen

This property is located at river mile 771 and is the first property located below Gavins Point Dam. The property is farmed. A portion of the property is owned in fee simple and the rest is farmed under a cash rental lease agreement. Plaintiffs claim a taking based on flooding only in 2011. The evidence established that approximately 100 acres were inundated with an average of two to two and half feet of water due to overbank flooding and another approximately 100 acres were injured from seepage due to an elevated groundwater table. Flooding lasted from June to late August. Approximately 200 acres of corn and soy beans were lost as a result of the flooding. In addition there

was injury to the property from erosion, scouring, sand deposits, and debris that required clean-up. Tr. 391-477.

For the same reasons as discussed with regard to Property 1, these plaintiffs cannot establish a taking based on the 2011 flood and their claim must be dismissed.

6. Property 6: Paul and Debra Dailey

This property is located at river mile 744. The Daileys own the property in fee simple and make a takings claim only for flooding in 2011. The evidence established that the overbank flooding began around June 1, 2011 and approximately 80 to 85 percent of the property was inundated with several feet of water. Floodwater depths varied on the property from one inch to four feet on the farmland, zero to eight feet on the pasture land, and 10 to 12 feet near the River bank. Flooding lasted from the first of June to the end of September. Flooding left sand deposits south of the tree line along the River up to 14 feet deep. Some areas of the bank were lost to erosion. Approximately 30 percent of the timber died immediately, with trees continuing to die, reaching approximately 40 to 50 percent. All of the corn and some soy bean crops were destroyed. The plaintiffs were also forced to sell a herd of approximately 160 cows and calves that had been in the family for three generations. Tr. 543-564.

For the same reasons as discussed with regard to Property 1, Paul and Debra Dailey cannot establish a taking based on the 2011 flood and their claim must be dismissed.

7. Property 7: Andersen Family Farms Partnership; Bryce L. Andersen

This property is located at river mile 721. Portions of the property are owned in fee simple and other portions are leased. Plaintiffs claim a taking based only for flooding in 2011. The evidence established that approximately 400 acres were inundated with an average of one to one and a half feet of water due to overbank flooding and seepage from an elevated groundwater table. Flooding lasted from late May to late August of 2011. Approximately 400 acres of corn and soy beans were lost as a result of the flooding. In addition, there was significant bank degradation and loss of some acreage in between wing dikes. Approximately five acres were also permanently lost to sand deposits. Tr. 391-477.

This is the area of the River where the Corps began to make River Changes to comply with the ESA. For purposes of establishing liability for a taking based on the 2011 flood as well as for flooding in all other years, the plaintiffs presented evidence to show that the System Changes and River Changes together caused additional flooding that would not have occurred in a "but for" world where those System and River Changes would not have been made. Specifically, as discussed, the court was presented with Dr. Hromadka's opinion testimony and WSE charts for each property, which showed the difference in WSEs between the actual and "but for" worlds that Dr. Christensen had modeled and Dr. Hromadka then modified to apply to each plaintiff's property to establish causation and foreseeability for each year of flooding. The opinion testimony presented in all instances for 2011 showed higher WSEs based on combined System and River Changes. The court does not have sufficient opinion testimony or other evidence for each property and for each year of flooding that would allow the court to separate the

System Changes from the River Changes to determine whether there would have been increased flooding at each property based on System Changes or River Changes alone for any of the years of flooding.

In such circumstances, the court finds that plaintiffs cannot establish a taking based on the 2011 flood downstream of Gavins Point Dam where changes to the River were made. Even though the court has found that the River Changes by the Corps were a cause of flooding when combined with the System Changes for purposes of establishing a taking for other flood years, the 2011 flood is different. The court has determined that plaintiffs have failed to establish causation for the 2011 System Changes and the court has no way of determining whether the River Changes alone would have caused more severe flooding than would have occurred without the River Changes given the magnitude of the System releases in 2011.

For these reasons and because the court does not have evidence to show based on WSE level changes that the Corps' River Changes alone would have caused increased flooding in the "but for" world, plaintiffs' takings claim based on flooding in 2011 fails for lack of proof of causation. Thus, this claim must be dismissed.

8. Property 8: Omaha Tribe of Nebraska

This property is located at river mile 695 and is owned by the Omaha Tribe of Nebraska ("Tribe") in fee simple. The Tribe's takings claim is based only on the 2011 flood. Floodwater on farmland reached eight to eleven feet deep. The overbank flooding lasted for approximately 90 days from June to August. There was extensive injury to land (including farmland and crop loss), sand deposits, debris, and scouring. There was

also loss of equipment, the casino closed for 18 months, and the fuel plaza and racetrack were destroyed. Additionally, 100 acres of farmland were lost that can no longer be farmed. A ring-levee approximately ten feet high was constructed around the casino in an attempt to protect it. Plaintiff tried to construct a similar ring-levee around the fuel plaza but could not complete it before the floodwaters arrived. Groundwater entered the casino ring-levee even though plaintiff ran four to eight pumps 24 hours a day. Tr. 658-723.

For the reasons discussed with regard to Property 7, the Omaha Tribe of Nebraska cannot establish a taking based on the 2011 flood and the claim must be dismissed.

9. Property 9: Tob-Isle, Inc.

This property is located at river mile 686. It is owned in fee simple. Plaintiff has a takings claim based only on the 2011 flood. The property was inundated by overbank flooding for approximately 100 to 110 days from June to September. Fifteen acres of the bank were lost due to erosion. The water depth reached approximately eight feet in the wetlands, three to four feet in the old oxbow lake, and approximately six inches in the fields. Flooding left large scour holes and sand deposits. Approximately 160 acres of cropland were flooded. There was a significant loss of land and approximately 1,400 trees died. Tr. 65-150.

For the same reasons as discussed above regarding Property 7, the court finds that Tob-Isle, Inc. cannot establish a takings claim based on the 2011 flood and the claim must be dismissed.

10. Property 10: Richard Archer

This property is located at river mile 684. Plaintiff owns a portion of the property in fee simple and has a crop-sharing agreement for a portion of the property.[76] The plaintiff has a claim for a taking based only on the 2011 flood. During the 2011 flood, the entire property was inundated by overbank flooding with a current running across the property. All of the crops were planted and fertilized when the flooding started. Floodwaters were five and a half to six feet deep over the entire property. Flooding started in early June and did not start receding until the end of August. Some water remained on the property until November. Flooding left sand deposits and debris

[76] The government argues that plaintiffs, Archer, KMJ Farms, Buffalo Hollow Farms, Salter, Frakes, and Ettleman, cannot make takings claims based on crop losses associated with property these plaintiffs do not own but farm under a crop-sharing arrangement. While the government agrees that these plaintiffs can make takings claims based on flooding on the property they own, the government contends that the plaintiffs' takings claims associated with loss of crops under their crop sharing arrangement should be dismissed on the grounds that these plaintiffs do not have compensable property interests.
The plaintiffs argue in response that it is well settled that crop losses are cognizable as a takings claim. In *Barnes v. United States* and *King v. United States* the court found that crop losses can be compensable. *Barnes v. United States*, 538 F.2d 865 (Ct. Cl. 1976); *King v. United States*, 427 F.2d 767 (Ct. Cl. 1970)). Plaintiffs assert that crops are personal property and crops are constitutionally protected. As such they contend, the owners of 50 percent of crops under a crop sharing arrangement can have their property taken by the government if the government by flooding property destroys the crops. In *Barnes*, 538 F.2d at 872, the court stated, "we think defendant took property from those plaintiffs who are owners of crops alone, measured by the amount by which the value of their respective interests were diminished as of the date of taking." The court agrees that the above-named plaintiffs have a protected property interest in the crops they grow under their crop-sharing arrangements that can be taken by the government. Whether they are entitled to compensation for any crop-share loss will be examined in Phase II of this litigation for those that proceed to that phase. For example, Archer's claim is for 2011 only and will be dismissed for failure to prove causation. Nonetheless, the court finds based on the above-cited precedent that these plaintiffs have standing to pursue takings claims based on the property interest they hold under their crop-sharing arrangements.

requiring clean-up. All of the crops were lost and the center pivot was damaged. Tr. 829-847.

For the same reasons as discussed above regarding Property 7, the court finds that Richard Archer cannot establish a taking based on the 2011 flood and the claim must be dismissed.

11. Property 11: Scott and Susan Olson and Randy and Patricia Olson

This property is located adjacent to river mile 680. The property is owned by the Olsons in fee simple. Plaintiffs based their takings claim on flooding in 2011 and 2014.

In 2011, overbank flooding led to depths of 20 to 25 feet, with most of the property being under 10 to 12 feet of water. Flooding began at the end of May, crested in early August, and did not recede until late September/early October. The flood caused severe injury to the land leaving large scour holes. One scour hole was approximately 40 feet deep, 400 feet wide, and a quarter of a mile long. Extensive sand deposits up to 12 feet deep were left on the property. The entire crop was destroyed. There were extensive amounts of debris that needed clean-up. Tr. 2579-2711.

For the same reasons as discussed above with regard to Property 7, the court finds that Scott and Susan Olson and Randy and Patricia Olson cannot establish a taking based on the 2011 flood.

In 2014, plaintiffs testified that floodwater came in from the north end of the property, near a notched dike area, starting in late August or early September lasting for two to three weeks. Plaintiffs claim the flooding covered approximately 60 acres of crop land. Tr. 2579-2711.

The government acknowledges overbank flooding in July 2014, but not in September. DX3015-255.

The flooding in late August and early September 2014 is not supported by Dr. Christensen or Dr. Hromadka's opinion testimony that showed increased WSEs in May and early June 2014 but not in September 2014. Because plaintiffs' claim is not supported by the plaintiffs' expert testimony, the takings claim based on flooding in 2014 fails for lack of proof of causation.

Because Scott and Susan Olson and Randy and Patricia Olson have not established causation for the flooding in 2011 or 2014, their takings claim must be dismissed.

12. Property 12: David and Elizabeth Brainard

This property is located at river mile 671. The plaintiffs own the property in fee simple. They claim a taking only for flooding in 2011. In 2011, flooding started in early June. The water rose about 25 feet from the inlet of Harbor 671 below the home. Water came within two feet of the back, or River side, of the home but actually entered from the front of the home, which has a lower elevation. Plaintiffs had one to six inches of water in their home. The floodwaters completely inundated the neighborhood and surrounding area. The flooding lasted approximately 120 days. Tr. 1210-1243.

For the same reasons as discussed above with regard to Property 7, David and Elizabeth Brainard cannot establish a taking based on flooding in 2011 and their claim must be dismissed.

13. Property 13: Blodgett Farms, LLC

This property is located at river mile 669. The plaintiff owns the property in fee simple. Blodgett Farms, LLC, claims a taking of its property by overbank flooding in 2010, 2011, 2013, and 2014. The plaintiff acknowledges that a portion of the property is protected wetlands for which it makes no takings claim. Tr. 1275-1360.

In 2010, flooding at this property began in late June to early July. The lower 54 acres of farmland were inundated by overbank flooding with depths of four to five feet. Seven acres of the upper piece of the farm also flooded with one to two feet of water. The water came from the north and the flooding lasted two to three months into September. The lower 54 acres could not drain because of the high River. Crops were lost and production was adversely affected.

The government does not deny that overbank flooding occurred on the property because of higher River levels. DX3015-262. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-263.

The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, flooding at the property began in the middle of May and inundated the entire farm. Despite sandbagging around the residence, about four and half inches of water got into the basement and the residence sustained significant flood damage, as did the outbuildings. The entire crop was destroyed. The flood left tremendous sand

deposits and ridges on the property, some 15 feet deep, and scour holes, one being 35 to 40 feet deep. Plaintiff had to do a lot of restoration work on the farm to get it back to the point where it could be planted. There was sand, muck, and debris everywhere. It took until 2013 for all of the scour holes to be filled. Only part of the farm could be planted in 2012. The lower 54 acres have not been able to be farmed since 2011. In addition, plaintiff lost part of the River bank due to erosion.

For the same reasons as discussed with regard to Property 7, plaintiff cannot establish a taking based on flooding in 2011.

The court has also considered plaintiff's takings claim based on erosion that allegedly occurred in 2011. The court finds that this claim fails for lack of causation and also for lack of proof. Without evidence of the precise boundaries of the property before the 2011 flood and evidence of the property's boundaries after 2011, it is not possible to determine the amount of property lost to erosion, even if causation had been established.

In 2013, flooding was similar to the flooding in 2010 according to the testimony of Mrs. Jackson. Flooding began in May and lasted several weeks. Flooding destroyed the crops that had been planted.

The government does not dispute that overbank flooding occurred due to an elevated River. Mr. Woodbury contends that local precipitation may have exacerbated the flooding. DX3015-266. He also noted that high flows in late May and early June on the Big and Little Sioux Rivers contributed to the flooding. DX3015-227. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there

would have been no change in the days of flooding with or without the changes he modeled. DX3015-267.

The court has examined the government's contention that high River flows were attributable to the Big and Little Sioux Rivers south of Gavins Point and that releases from Gavins Point during peak flows at the Omaha gage show that releases from Gavins Point accounted for 30 percent of the flow. In addition, the court understands that only a portion of the flow from Gavins Point was for T&E species. The court has found that the Corps' contribution to flows for the years other than 2011 for T&E releases, together with the River Changes, led to higher WSEs than would have occurred in the "but for" world without those Changes. The court has further found that together both the System and River Changes made for the purpose of benefitting T&E species led to greater flooding on the Blodgett Farms, LLC property. The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2013 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.[77]

In 2014 flooding was nearly identical to 2013 with overbank flooding on the lower 54 acres. After 2014, plaintiff can no longer get crop insurance for the lower 54 acres.

[77] Mr. Woodbury states that local precipitation exacerbated the flooding. Dr. Hromadka's WSE chart indicates that he looked at precipitation for each of the flooding events and at no time did he see anything extraordinary. Dr. Hromadka did not deny that rainfall contributes to flooding. Rather he testified that rainfall alone cannot explain the increased flooding that occurred. The court agrees with Dr. Hromadka.

The government does not dispute that overbank flooding occurred and that it was caused by elevated levels in the River. The government contends that the flooding may have been exacerbated by local precipitation. DX3015-268; DX3015-269. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-269.

The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2014 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiff's takings claim based on flooding in 2010, 2013, and 2014 and finds that Blodgett Farms, LLC, has shown that repeated flooding has interfered with plaintiff's use and enjoyment of their property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiff will be allowed to prove the remaining elements of its takings claim.

14. Property 14: Dennis and Janis Connealy and Quentin and Jill Connealy

This property is located at river mile 665. Some of the property is owned in fee simple and the remaining portion is a cash rental with a lease agreement. The plaintiffs' takings claim is based only on the 2011 flood. The flooding began in late May and lasted for 100 days until September. Before the flooding started, the land was dry, crops were

planted, and the River was extremely low. The floodwaters blocked all drainage ditches, including those maintained by the local drainage district. All of the crops on the property were lost. Tr. 2219-2272.

For the same reasons as discussed above with regard to Property 7, plaintiffs cannot establish a taking based on the 2011 flood and thus their claim must be dismissed.

15. Property 15: Anthony and Mary Salter and Franklin and Cheryl Salter

This property is located at river mile 662. The plaintiffs rent the property that was flooded. Plaintiffs claim a taking of their property interest based on flooding in 2008, 2010, 2011, 2013, and 2014. Tr. 565-608. In this connection, the court notes that there are several mitigation projects in the vicinity of plaintiffs' farm operations, including Sandy Point built in 2011 and 2013; Tyson Bend built in 2004, 2008, and 2009; and California Bend built in 1999 with additional work in 2003 and 2004. Def.'s Br., Table 1. In addition, the Corps has notched dikes or allowed them to degrade on the River near plaintiffs' farm operations.

In 2008, flooding occurred on the portion of acreage farmed that is known as the Krejci Farm starting in June and lasting two to four weeks. The flooding resulted in 80 acres of crops being destroyed.

Although Mr. Woodbury's model does not show any overbank flooding in 2008, Mr. Woodbury's satellite images confirm flooding occurred and thus the government does not dispute that the property flooded.

The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs

were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, flooding was similar to 2008. Mr. Salter testified that flooding occurred in June and approximately 80 acres of crops were destroyed.

The government does not dispute that overbank flooding in 2010 was caused by high flows in the River. DX3015-278. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-279.

The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, the entire property was inundated with overbank flooding. Flooding started in late May and lasted for over 100 days through September. Floodwaters reached 12 to 15 feet deep. The entire crop was destroyed and the farm was severely damaged with vast amounts of sand deposits. Flooding took away top soil and left a quarter-inch thick crust. Extensive land reclamation efforts were required. A scour hole on the portion of the farm known as the Graybill Farm was 40 feet deep and two football fields long and had to be repaired so farming could begin.

For the same reasons as discussed above with regard to Property 7, Anthony and Mary Salter and Franklin and Cheryl Salter cannot establish a taking based on the 2011 flood.

In 2013, the flooding was similar to 2008 and 2010 for both the Krejci and Graybill farms. Crops were lost and production was adversely affected.

The government does not dispute that overbank flooding in 2013 was caused by higher flows in the River. DX3015-282. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would have been no change in the days of flooding with or without the changes he modeled. DX3015-283.

The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2013 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

For 2014, plaintiffs again claim that the property flooded similar to 2008, 2010, and 2013. Flooding began in June and lasted for two weeks. Crops were lost and production was adversely affected.

The government does not dispute that extraordinary high flows in the River caused overbank flooding. DX3015-284. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-285.

The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2014 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiffs' takings claim based on flooding in 2008, 2010, 2013, and 2014 and finds that Anthony and Mary Salter and Franklin and Cheryl Salter have shown that repeated flooding has interfered with plaintiffs' use and enjoyment of their property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiffs will be allowed to prove the remaining elements of their takings claim.

16. Property 16: George Neale Farm, LLC; Neale Farms, Inc.; and Jeff and Kelli Shaner

This property is located adjacent to river mile 639. The plaintiffs own a portion of the property in fee simple and share crop a portion. They claim a taking of the property based on flooding in 2007 and 2008 (50 acres of approximately 1,200 acres due to seepage and/or blocked drainage) and flooding in 2010, 2011, and 2014 (due to overbank flooding). Tr. 1364-1423. The property is located near several River projects including the Calhoun Chute at river mile 637.5 constructed in 2009, the Boyer Backwater Chute at river miles 636 to 634 constructed in 2010, together with various chevrons and dike and revetment changes at river miles 642 and 637 to 634. DX3015-287.

The plaintiffs testified that in 2007 interior blocked drainage resulted from a high River blocking drainage ditches. It occurred in mid-June and lasted one to two weeks causing the loss of 50 acres of crops.

The government disputes that any flooding occurred in June.

Dr. Christensen's and Dr. Hromadka's testimony and analyses do not show a higher River in mid-June but only in May 2007. Because the plaintiffs' testimony is

inconsistent with the plaintiffs' experts' testimony, a takings claim based on flooding in 2007 must be rejected.

In 2008, plaintiffs claim there was interior blocked drainage and/or seepage in mid-June for one to two weeks and that approximately 50 acres of crops were lost.

The government does not dispute that there was flooding on the property in June. DX3015-291. In fact, Mr. Woodbury agrees that seepage and/or blocked drainage may have been a factor in causing the property to be wet. DX3015-290. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-291.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, the property flooded again after the crop had been planted. Flooding receded then flooded again repeatedly after the River left its banks five to six times that year. Property was inundated with floodwaters on and off from March through October/November. Each event lasted approximately one to two weeks. This type of flooding was extremely unusual and never experienced before. Crops were lost and production was adversely affected.

The government does not dispute that there was overbank flooding in 2010 consistent with plaintiffs' testimony. DX3015-292. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-293.

The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, the flooding crested in July and the entire property was completely inundated with water. The flooding left sand deposits that were 10 to 15 feet deep in places. 2011 was the first time there was extensive physical damage and erosion to the property which included huge scour holes and debris. The scope and duration of the 2011 flood were unprecedented.

For the same reasons as discussed above with regard to Property 7, plaintiffs cannot establish a taking based on the 2011 flood.

In 2014, overbank flooding started at the beginning of June and lasted one to two weeks. Approximately 40 percent of the property was flooded, killing the crops and creating erosion.

The government does not dispute that overbank flooding occurred due to elevated flows in the River. DX3015-296. Based on his modeling, which the court has rejected as

unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-297.

The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2014 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiffs' takings claim based on flooding in 2008, 2010, and 2014 and finds plaintiffs have shown that repeated flooding has interfered with plaintiffs' use and enjoyment of their property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiffs will be allowed to prove the remaining elements of their takings claim.

17. Property 17: Robert D. Adkins, Sr.; Betty Adkins; Robert D. Adkins, Jr.; Ken Adkins; and Robert Adkins & Sons Partnership

This property is located at river mile 611. The plaintiffs own the property in fee simple. The property is protected on three sides by federal levees. The takings claim is based on overbank flooding and blocked drainage and/or seepage flooding in 2007, 2008, 2010, 2011, 2013, and 2014. Tr. 1423-1483.

In 2007, flooding occurred on the property in April and May during the planting seasons. Plaintiffs claim that 400 of the 1,044 acres flooded. Flooding of the property outside the levees was the result of overbank flooding and flooding inside the levees was caused by seepage. About 50 to 60 percent of the property inside the levees was flooded for about three weeks. Crops were lost.

The government does not dispute that there was overbank flooding on the property near the River and then blocked drainage and seepage on the landward side of the levee, caused by a combination of local rainfall and elevated water levels in the River. DX3015-314. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-316.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2007 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The 2008 flooding was similar to the 2007 flooding in severity, duration, and damage. However, the flooding occurred later than in 2007. The flooding occurred in June and crops were lost.

The government does not dispute that the flooding in 2008 was caused by a combination of local rainfall and elevated water levels and that it occurred in June. DX3015-317. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would have been no change in the days of flooding with or without the changes he modeled. DX3015-318.

The court finds, based Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps'

System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, flooding was similar to 2007 and 2008 but the water was higher and stayed longer against the levees. Flooding occurred in late June and crops were lost.

The government does not dispute that there was serious flooding in 2010. The government agrees that elevated WSEs in the River along with rainfall caused blocked drainage and seepage on the property, as well as overbank flooding. DX3015-319. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-320.

The court finds, based Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, flooding began in early June and lasted through August. The River was up against the levees. About 730 acres flooded. The property outside the levees was inundated by overbank flooding. The floodwaters were between 10 to 20 feet deep outside the levees. The property inside the levees was inundated by seepage and to a lesser extent blocked drainage. Floodwaters were between four to six feet deep inside the levees. The entire property inside the levees was inundated except for the northernmost part where the homes are. Flooding outside the levees caused extensive outside damage

including erosion, deep scour, sand deposits, some of which were ten feet high, and dead trees. All the crops were lost and there were significant clean-up and restoration efforts.

For the same reasons as discussed above with regard to Property 7, plaintiffs cannot establish a taking based on flooding in 2011.

In 2013, flooding occurred from a high River all summer long through August, resulting in seepage and/or blocked drainage inside the levees. Property outside the levee was inundated by overbank flooding. Crops were lost.

The government acknowledges a higher River in late May to early June 2013, but not for the period claimed by plaintiffs. DX3015-323.

Dr. Hromadka's opinion, consistent with Dr. Christensen, also shows flooding in late May early June and not later in the summer, as plaintiffs claim.

Because plaintiffs' flooding claim is not supported by its experts, plaintiffs' claim that flooding occurred in the summer of 2013 does not support the plaintiffs' takings claim.

In 2014, flooding occurred in late June through early July. Property outside the levees was inundated by overbank flooding and water was against the levees. Approximately 50 percent of the property was flooded. Crops were lost.

The government does not dispute overbank flooding caused by a combination of local rainfall and elevated water levels in the River nor that these factors also caused blocked drainage and resulted in water on plaintiffs' property during late June and early July. DX3015-325. Based on his modeling, which the court has rejected as unreliable,

Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-326.

The court finds, based on its careful review of the WSE chart, that the plaintiffs have not established a difference in WSEs for 2014 between the "but for" world and the actual world modeled by Dr. Hromadka. Therefore the plaintiffs cannot base a takings claim based on the flooding in 2014. Having failed to show any difference in WSEs in 2014 between the "but for" and actual worlds, plaintiffs cannot base there takings claim on flooding in 2014.

The court has considered the plaintiffs' takings claim based on flooding in 2007, 2008, and 2010 and finds plaintiffs have shown that repeated flooding has interfered with plaintiffs' use and enjoyment of their property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiffs will be allowed to prove the remaining elements of their takings claim.

18. Property 18: Husz Farm Corp.; K&J Husz, Inc.; Dale and Sheryl Husz and Keith and Julia Husz

This property is located approximately one mile inland from river mile 606. The property is owned in fee simple. The property is protected on three sides by federal levees that have never over-topped. Plaintiffs claim a taking based on blocked drainage and seepage in 2007, 2008, 2010, 2011, and 2014.[78] Tr. 1548-1577. Corps construction

[78] The government established that the property is near an interior drainage structure, and historic ponding has occurred on the entire SW parcel and half of the SE parcel. DX168, Tr. 8096. These facts are relevant in the next phase of this litigation regarding the "character of the property," but given the limited history of flooding on the property prior to 2007 and the Corps' System and River Changes, these facts do not negate causation.

activities in the immediate area of this property include: Hidden Lake backwater at river mile 603 and dike notches at river mile 607. DX3015-328.

In 2007, flooding affected the southernmost portion of the property. The flooding took place from May to June and lasted two weeks during the critical planting season. The water depths varied from area to area but were deep enough to kill the crops.

The government does not dispute the property flooded during this period due to elevated River levels leading to blocked drainage in combination with local rainfall. DX3015-329. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-330.

The court finds, based Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2007 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2008, seepage and/or blocked drainage occurred from May to June and were similar to 2007 but the duration was longer. Flooding affected the southernmost portion of the property. Water depths varied from area to area but were deep enough to kill the crops.

The government does not dispute the property flooded during this period because of blocked drainage combined with local rainfall. DX3015-331. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would

have been no change in the days of flooding with or without the changes he modeled. DX3015-332.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, there was a high River for three months in the summer. The flooding occurred because of blocked drainage which affected virtually the entire property. Water depths ranged from one inch to three feet depending on the location. The crops were lost.

The government does not dispute that flooding was caused by a combination of heavy local rainfall and elevated water levels in the River nor that these factors also caused blocked drainage for the period identified by the plaintiffs. DX3015-333. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-334.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, flooding occurred because of seepage and/or blocked drainage. Soil was still somewhat saturated from the 2010 flooding, and, starting in early June, flooding in 2011 lasted for over 90 days. The entire property was affected and crops were lost.

For the same reasons as discussed with regard to Property 7, plaintiffs cannot establish a taking based on flooding in 2011.

In 2014, the River ran high in late June. Yields were fewer on the lower part of the farm and crops were lost.

The government does not dispute flooding occurred because of a higher River level and heavy rainfall in June and July that caused blocked drainage. DX3015-337. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-339.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2014 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiffs' takings claim based on flooding in 2007, 2008, 2010, and 2014 and finds plaintiffs have shown that repeated flooding has interfered with plaintiffs' use and enjoyment of their property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the

litigation the plaintiffs will be allowed to prove the remaining elements of their takings claim.

19. Property 19: Robert L. Roth; BCR Properties, L.P.

This property is located at river mile 598.5. The property is partially protected by a federal levee. There are 19 acres on the River side of the levee and 49 acres on the landward side of the levee. The property is owned in fee simple and is leased. Plaintiffs claim a taking based on flooding in 2008, 2010, and 2011 due to overbank flooding and on seepage and/or blocked drainage in all years. Tr. 1580-1653.

In 2008, damages to the property were caused by overbank flooding on the unprotected side of the levee and subsurface flooding on the protected side of the levee from seepage and/or blocked drainage due to an elevated groundwater table. Approximately 30 acres of the 49 levee-protected acres and approximately 15 of the 19 unprotected acres were inundated due to overbank flooding and an elevated groundwater table. The flooding lasted from early June to mid-July. Approximately 45 acres were lost as a result of the flooding (30 levee-protected acres, 15 unprotected acres).

The government does not dispute that there was flooding caused by a combination of overbank flooding on the unprotected portion of the property and blocked drainage on the protected portion of the property. DX3015-342. Mr. Woodbury based on his modeling, which the court has rejected as unreliable, concluded that the changes he modeled resulted in fewer days of flooding. DX3015-343.

The court finds based on Dr. Hromadka's testimony and accompanying WSE chart and Mr. Tofani's testimony, that flooding in 2008 was caused by higher WSEs that

caused blocked drainage and seepage as well as overbank flooding. The court finds that the higher WSEs were caused by and a foreseeable result of the Corps' System and River Changes which made flooding on the property more severe than would have occurred without these Changes.

In 2010, approximately 30 of the 49 levee-protected acres and approximately 15 of the 19 unprotected acres were inundated due to overbank flooding and/or an elevated groundwater table. Flooding lasted from early June to mid-or late July. Crops on approximately 45 acres of the property (30 levee-protected acres, 15 unprotected acres) were lost as a result of the flooding.

The government does not dispute that there was flooding. Mr. Woodbury states that flooding was caused by a combination of overbank flooding on the unprotected portion of the property and blocked drainage on the protected portion of the property together with seepage. DX3015-344. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-345.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, all of the acreage was inundated. The levee-protected acres were under one to two feet of water and the unprotected acres were under 10 to 12 feet of water.

Flooding lasted from early June to August. The floodwaters took a long time to recede. All of the corn crop on this property was lost. In addition, there was damage to the land from erosion, scouring, sand deposits, and debris that required reclamation and clean-up.

For the same reasons as discussed above with regard to Property 7, plaintiffs cannot establish a taking based on flooding in 2011.

The court has considered the plaintiffs' takings claim based on flooding in 2008 and 2010 finds plaintiffs have shown that the flooding was caused by and was the foreseeable result of the Corps' System and River Changes. Because the court is not convinced that the plaintiffs have yet to establish severity based on two flooding events, in the next phase of the litigation, plaintiffs will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiffs will be allowed to prove the remaining elements of their takings claim.

20. Property 20: David and Kimberly Sieck and Daniel Sieck

This property is located at river mile 597. The property is located approximately one mile away from the River. The property is owned in fee simple.[79] The plaintiffs claim a taking based on flooding from seepage and/or blocked drainage in 2008, 2010, 2011, and 2013. Tr. 943-1100. In the vicinity of the property there are notched dikes and deteriorated revetments, as well as a mitigation project on St. Mary's Island. DX3015-349; Def.'s Br., Table 1.

[79] As with several other properties, this property has had historic ponding areas. Tr. 8096:16-19. The plaintiffs also acknowledged prior flooding in 1983, 1984, 1993, 1995, and 1997. Tr. 1040:16-1043. The relevance of prior flooding will be considered in Phase II.

In 2008, seepage and/or blocked drainage occurred in June. There was crop loss and reduced yields.

The government disputes a claim of flooding in 2008 on the grounds that it is not properly before the court. As discussed in fn. 80 below, the court finds the claim for a taking based on flooding in 2008 is properly before the court. [80]

Mr. Woodbury did not provide modeling for 2008 for these plaintiffs.

The court finds, based on Dr. Hromadka's testimony and the WSE chart Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, floodwaters reached two to three feet on the property. Flooding peaked in June and lasted for approximately two to three weeks. There was crop loss and reduced yields.

The government does not dispute that there was flooding on the property caused by heavy rains and elevated flows in the River which impaired drainage. Mr. Woodbury also testified that seepage may have been an additional factor. DX3015-350. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that

[80] The government has challenged the Siecks inclusion of a takings claim based on flooding in 2008. For the reasons stated in a separate order issued today, the government's objection to the Siecks' claim has been denied.

the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-351.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, flooding lasted from May to September for 110 days. Floodwaters were streaming through the property ranging from three to five feet. There was crop loss and land needed to be reclaimed.

For the same reasons as discussed above with regard to Property 7, plaintiffs cannot establish a taking based on flooding in 2011.

In 2013, floodwaters reached two to three feet deep. Flooding began in May and lasted approximately three weeks. Crops were lost and yields were reduced.

The government does not dispute that there was a period of time when the River was above the modeled drainage level. Mr. Woodbury testified that this flooding was caused by local rainfall coupled with elevated water levels in two lakes east of the property. DX3015-354. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-355.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2013 was the result of higher WSEs. The court

finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiffs' takings claim based on flooding in 2008, 2010, and 2013 finds plaintiffs have shown that repeated flooding has interfered with plaintiffs' use and enjoyment of their property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiffs will be allowed to prove the remaining elements of their takings claim.

21. Property 21: Merril Sargent (Deceased); Ron and Dale Sargent

This property is located at river mile 585. The property is owned in fee simple. The plaintiffs' claim a taking for overbank flooding in 2008, 2010, 2011 and 2014. The property has had a history of flooding in 1984, 1993, 1995, 1996, 1997, and 1999.[81] Tr. 1485-1518. There is a private levee to the east. Corps construction activities in the area include: (1) dike notching at the south end of the property in 2004; (2) Tobacco Island chute at river mile 586 was built in 2002; and (3) dike and chevron modifications at river miles 589 to 587 in 2004. DX3105-357

In 2008, flooding began in mid-June and lasted one to two weeks. All crops had been planted and some crops were lost and production was adversely affected.

[81] As noted previously, any history of flooding on individual plaintiff properties will be considered in Phase II of this litigation which includes consideration of the character of the land at issue and reasonable investment-backed expectations. However, the fact that the property had a history of flooding does not mean that the Corps' System and River Changes did not cause greater flooding than would have occurred without those Changes.

The government does not dispute that there was flooding on the property due to a combination of seepage, overbank flooding, and local rains and elevated River stage. DX3015-358. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-359.

The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, flooding lasted two to three weeks and all crops on the property were lost.

The government does not dispute that the flooding was caused by overbank flooding and was exacerbated by heavy local rainfall and that seepage and blocked drainage were additional factors in flooding. DX3015-360. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-361.

The court finds the flooding in 2010 was due to levee overtopping based on the testimony of Mr. Tofani (who relied on Dr. Christensen's data). PX2554. Mr. Tofani found that in 2010 the private levee on the Sargent property would have failed even without the Corps' System and River Changes. Tr 14957:8-16. Plaintiffs have not made a takings claim with regard to levee overtopping or breach. Because the court has no way of determining if the flooding on the property was due to overbank flooding as opposed

to levee overtopping or breach plaintiffs have not met their causation burden and cannot rely on the 2010 flood to support a takings claim.

In 2011, flooding began in early June and lasted for four months. Up to ten feet of water inundated the property and all crops were lost. There were extensive sand deposits and erosion on the property. Plaintiffs were unable to plant 25 to 30 acres in 2012 due to the deep sand deposits.

For the same reasons as discussed above with regard to Property 7, plaintiffs cannot establish a taking based on flooding in 2011.

In 2014, flooding occurred around June 22 and lasted about one to two weeks. All crops were lost except for about 10 to 15 acres.

The government does not dispute that flooding took place and was caused by overbank flooding and blocked drainage that was exacerbated by local rainfall. In addition, the government acknowledged that seepage may have been an additional factor in the flooding. DX3015-364. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-365.

The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2014 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiffs' takings claim based on flooding in 2008 and 2014 and finds plaintiffs have shown that the flooding was caused by and was the

foreseeable result of the Corps' System and River Changes. Because the court is not convinced that the plaintiffs have yet to establish severity based on two flooding events, in the next phase of the litigation, plaintiffs will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiffs will be allowed to prove the remaining elements of their takings claim.

22. Property 22: Roth, Inc.; Steven G. Roth; BCR Properties, L.P.

This property is located at river mile 575 approximately one mile from the River. The property is owned in fee simple. Plaintiffs claim a taking for this property based on flooding in 2008, 2010, and 2011 due to seepage and/or blocked drainage. Tr: 1580-1653. The property is protected by the Upper L-575 levee. There are numerous areas near the property where dikes, were notched, lowered, or allowed to deteriorate. In addition, there are several mitigation projects that have been acquired, including Auldon Bar and Van Horn's Bend. DX3015-367; Def.'s Br., Table 1. The government claims that neither of these have been developed.

In 2008, approximately half of the 572 tillable acres of the property were rendered marshy due to an elevated groundwater table preventing the planting of a crop. Flooding lasted from mid- to late May to late June. As a result of the flooding, no crop could be planted.

The government does not dispute that flooding on the property was caused by a combination of heavy local rainfall and elevated water levels in the River which caused blocked drainage. DX3015-368. Based on his modeling, which the court has rejected as

unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-369.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, approximately half of the 572 tillable acres of this property were rendered marshy due to an elevated groundwater table. Flooding lasted from early June to mid-July. The corn crop on the affected acreage was lost as a result of the flooding.

The government does not dispute that there was flooding on the property caused by a combination of heavy local rainfall and elevated water levels in the River, resulting in blocked drainage and seepage may have been an additional factor in the flooding. DX3015-370. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-371.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, the property flooded because of the Upper L-575 levee breach. All the property was inundated, with the levee-protected acres being under two to four feet of water and the unprotected acres being under ten feet of water. Flooding lasted from early June of 2011 to January of 2012. Due to the flooding, no crops were planted on the property in 2011. In addition, there was damage to the property due to erosion, self-scouring, and debris that required reclamation and clean-up. Tr. 1578-1653.

As discussed earlier in the opinion, the court has found that the plaintiffs failed to establish causation for the Upper L-575 levee breach. Therefore, plaintiffs cannot establish a takings claim based on this flood event.

The court has considered the plaintiffs' takings claim based on flooding in 2008 and 2010 and finds plaintiffs have shown that the flooding was caused by and was the foreseeable result of the Corps' System and River Changes. Because the court is not convinced that the plaintiffs have yet to establish severity based on two flooding events, in the next phase of the litigation, plaintiffs will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiffs will be allowed to prove the remaining elements of their takings claim.

23. Property 23: Leo Ettleman

This property is located at river mile 571. The property is owned by Mr. Ettleman's parents. He farms the property under a share crop agreement. He claims a taking of his crops based on flooding caused by blocked drainage and/or seepage in 2008 and 2010, and by flooding following a levee breach in 2011. Tr. 1880-2002. The Upper L-575 levee is located west of the property. Corps' construction activities near the

property includes dike notching from river miles 569 to 556 starting in 2004. DX301-375.

In 2008, the River was high for an extended period from mid-June to the beginning of August. The northwest corner and southeast corner were covered by floodwaters six to 18 inches deep. Approximately 30 percent of the property was affected. Crop loss occurred and production was adversely affected. Additionally, the plaintiff had trouble getting the entire crop planted.

The government does not dispute that blocked drainage flooding was caused by a combination of heavy local rainfall and elevated water levels in the River in 2008 and that seepage may have been an additional factor. DX3015-376. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-377.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, flooding was similar to 2008 but lasted longer. Flooding occurred from approximately mid-June to the end of August. Approximately 60 percent of the property in the north, east, and south central portions were covered by floodwaters ranging from six to 24 inches. Crop loss occurred and production was adversely affected.

The government does not dispute that flooding was caused by a combination of heavy local rainfall and elevated water levels in the River, resulted in blocked drainage on the property. DX3015-378. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-379.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, overbank flooding occurred following the failure of the Upper L-575 levee. Levee breach occurred on June 29 at river mile 571, which is immediately adjacent to the property. Floodwaters reached up to four feet on the property and lasted until late September. The entire crop was lost, there were numerous scour holes several feet deep, and sand deposits up to four feet deep. The sand deposits still remain on the property today despite extensive land reclamation. In addition, the top soil was eroded and there was significant debris, large trees, and garbage that needed to be cleaned up.

As discussed above, the court has found that plaintiff failed to prove causation for the Upper L-575 levee breach. Plaintiff cannot establish a takings claim based on this flood event.

The court has considered the plaintiff's takings claim based on flooding in 2008 and 2010 and finds Leo Ettleman has shown that the flooding was caused by and was the

foreseeable result of the Corps' System and River Changes. Because the court is not convinced that the plaintiff has yet to establish severity based on two flooding events, in the next phase of the litigation, plaintiff will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiff will be allowed to prove the remaining elements of his takings claim.

24. Property 24: KMJ Farms, Inc.; Brian and Kelly Johnson

This property is located at river mile 564. The property has been owned in fee simple since 2009. It has been farmed by plaintiffs since 1992. It is located two miles east of the River. Plaintiffs claim a taking based on flooding in 2007, 2011, and 2013. Tr. 1654-1722.

In 2007, flooding occurred from May to June. It lasted for a couple of weeks. The lower pockets of the fields were flooded. There was crop loss and crop production was adversely affected.

The government does not dispute that flooding in 2007 was caused by a combination of heavy local rainfall and elevated water levels in the River that caused blocked drainage and that seepage may have also been an additional factor. DX3015-384. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-385.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2007 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps'

System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, overbank flooding occurred due to the Upper L-575 levee breach. Flooding lasted for over 100 days from June to September. Floodwaters reached up to two and a half to three feet deep. Flooding left scouring and sand deposits. The entire crop was completely destroyed. The rental home on the property was completely destroyed.

As discussed above, the court has found that plaintiffs failed to establish causation for the Upper L-575 levee breach. Plaintiffs cannot establish a takings claim based on the 2011 flood.

In 2013, flooding was similar to 2007. It occurred in May and lasted for a couple of weeks. There was crop loss and production was adversely affected.

The government does not dispute that the property was saturated. DX3015-390. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-391.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2013 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiffs' takings claim based on flooding in 2007 and 2013 and finds plaintiffs have shown that the flooding was caused by and was the foreseeable result of the Corps' System and River Changes. Because the court is not convinced that the plaintiffs have yet to establish severity based on two flooding events, in the next phase of the litigation, plaintiffs will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiffs will be allowed to prove the remaining elements of their takings claim.

25. Property 25: Payne Valley Farms, LLC

This property is located at river mile 558. The plaintiff owns a portion of the property in fee simple and share crops a portion. A portion of the property abuts the River and a portion is landward of an interstate berm. Plaintiff claims a taking based on flooding in 2007, 2008, 2010, 2011, and 2013. Tr.1804-1879. Some protection is also provided by the Upper L-575 levee. Corps construction activities in the area include: the Upper and Lower Hamburg Chutes. DX3015-410. In addition, there are numerous dike notches and other BSNP structures that have been allowed to deteriorate.

In 2007, 350 acres flooded by blocked drainage and/or seepage. The flooding lasted from mid-May to early June which caused a majority of the crop to die and also resulted in the plaintiff being unable to plant on a small portion of the affected land.

The government does not dispute that the property was flooded during this period and that the cause was precipitation and a higher River causing blocked drainage and seepage may have been an additional factor in the flooding. DX3015-411. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the

changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-412.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2007 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2008, similar to 2007, 350 acres flooded by blocked drainage and/or seepage. The flooding lasted from mid-May to early June and caused a majority of the crop to die and also resulted in the plaintiff being unable to plant on a small portion of the affected land.

The government does not dispute that a combination of heavy local rainfall and elevated water levels in the River caused flooding on the property during this period which resulted in blocked drainage and seepage may have been an additional factor in the flooding. DX3015-413. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-414.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, flooding of approximately 350 acres occurred in June preventing plaintiff from planting crops.

The government acknowledges that elevated water levels in the River caused flooding and resulted in blocked drainage and/or seepage. DX3015-415. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-416

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, flooding began with blocked drainage and then the Upper L-575 levee breached. The breach caused inundation of the property west of I-29 with five to six feet of water and the property east of I-29 with two to three feet of water. The flooding lasted from mid-May to early August. Crops were lost and there was erosion, scouring, sand deposits, and debris requiring reclamation. There were deposits of up to ten feet of sand on the property.

As discussed above, the court has found that plaintiff failed to prove causation for the Upper L-575 levee breach. Plaintiff cannot establish a taking based on the 2011 flood.

In 2013, flooding was similar to 2007, 2008, and 2010.

The government does not dispute that flooding on the property was caused by a combination of heavy local rainfall and elevated water levels in the River that resulted in blocked drainage and seepage may have been an additional factor in the flooding. DX3015-419. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-420.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2013 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiff's takings claim based on flooding in 2007, 2008, 2010, and 2013 and finds plaintiff has shown that repeated flooding has interfered with plaintiff's use and enjoyment of its property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiff will be allowed to prove the remaining elements of its takings claim.

26. Property 26: Woltemath Farm, Inc., Hi-Tech Farms, Inc., and Robert Woltemath

This property is located at river mile 550. The property is owned in fee simple. It is located approximately one mile from the River and is 5,000 feet landward of the Middle L-575 levee. Plaintiffs claim a taking based on flooding in 2008, 2010, and 2011.

Tr. 2068-2159. The property is located near many mitigation sites and many dikes and revetments that were notched, lowered, or allowed to deteriorate.

In 2008, flooding occurred from May 26 through June 22. Crops were damaged and yields were adversely affected.

The government does not dispute that the property flooded during this period due to blocked drainage because of high flows in the River and seepage may have been an additional factor in the flooding. DX3015-423. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-425.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, the property had standing water during flooding that began in June. Crops were damaged and production was adversely affected.

Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-427.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court

finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, overbank flooding occurred following the Middle L-575 levee breach. Following the breach, there were 12 to 15 feet of water on the property for approximately four months until September. There was extensive damage to the property including sand deposits six inches to six feet deep, scour holes, and debris requiring extensive land reclamation.

For the reasons discussed above, the court has determined that plaintiffs failed to prove causation for the Middle L-575 levee breach. Plaintiffs cannot establish a taking based on this flood event.

The court has considered the plaintiffs' takings claim based on flooding in 2008 and 2010 and finds plaintiffs have shown that the flooding was caused by and was the foreseeable result of the Corps' System and River Changes. Because the court is not convinced that the plaintiffs have yet to establish severity based on two flooding events, in the next phase of the litigation, plaintiffs will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiffs will be allowed to prove the remaining elements of their takings claim.

27. Property 27: Gary Schemmel[82]

[82] Mr. Schemmel was the only plaintiff who did not testify in person at trial. Mr. Schemmel's deposition was admitted into evidence. PX931.

This property is located at river mile 548. The property is owned in fee simple. Plaintiff's takings claim is based on flooding in 2008, 2010, 2011, and 2014. PX931. Corps construction activities near the area include: (1) Upper and Lower Hamburg Chutes at river miles 556 to 551 built in 1996 and 2005; (2) dike modifications at river miles 548, 546, and 543 in 2003; (3) Kansas Chute at river miles 546 built in 2003; and (4) Nishnabotna Chute at river mile 543 built in 2005. DX3015-431.

In 2008, flooding occurred in May or June and covered the entire acreage and plaintiff could not plant any crops.

The government does not dispute that flooding was caused by blocked drainage of the drainage ditch which runs across the north side of the R-562 levee. DX3015-432. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-425.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, flooding on the property was very similar to 2008 and prevented plaintiff from planting crops. The entire property was inundated and the flooding lasted until late summer.

The government does not dispute that flooding in 2010 was caused by blocked drainage of the drainage ditch which runs across the north side of the R-562 levee. DX3015-435. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-436.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, the property flooded for over 100 days from June through September. The entire property was flooded. The entire crop was lost.

For the same reasons as discussed above with regard to Property 7, plaintiffs cannot establish a taking based on flooding in 2011.

In 2014, approximately 20 acres were affected by interior blocked drainage and/or seepage. Flooding occurred in late June and was on the east half of the property, on which plaintiff had planted 78 acres of soybeans. Crops were lost and production was adversely affected.

The government does not dispute that flooding in 2014 was caused by a higher River that resulted in blocked drainage of the drainage ditch which runs across the northside of the R-562 levee. DX3015-440. Based on his modeling, which the court has

rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-441.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2014 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiff's takings claim based on flooding in 2008, 2010, and 2014 and finds Gary Schemmel has shown that repeated flooding has interfered with plaintiff's use and enjoyment of his property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiff will be allowed to prove the remaining elements of his takings claim.

28. Property 28: Barnes Atchison MO, LLC and Barnes Holt MO, LLC

This property is located at river mile 546. The plaintiffs owns the property in fee simple and rent it under a cash rental agreement. Plaintiffs claim a taking based on flooding in 2007, 2010, and 2011. Tr. 2013-2063. The property abuts the River on the left-descending bank. It is adjacent and landward of the Middle L-575 levee with a portion Riverward of the levee. The property is located near many mitigation sites including the Lower Hamburg Bend, Kansas Bend, Nishnabotna, and Upper Hamburg Bend. Also, many dikes and revetments were notched, lowered, or allowed to deteriorate near this property. DX3015-443; Def.'s Post Trial Brief, Table 1.

In 2007, flooding occurred from May to June. Most of the flooding that occurred on the property was due to blocked drainage and seepage. The River was out of its banks and the River was high and there was no internal drainage. Crops were adversely affected.

The government does not dispute that a combination of overbank flooding on the unprotected portion of the property and blocked drainage on the protected portion of the property caused overbank flooding leading to seepage. DX3015-444. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-445.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2007 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, overbank flooding and blocked drainage and seepage led to crop loss as in 2007.

The government does not dispute that the property flooded and that it was caused by overbank and blocked drainage flooding and seepage may have been an additional factor in the flooding. DX3015-446. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-447.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, the property was underwater all summer. Levees to the north broke and carried a lot of sand. The property was flooded by overbank flooding from the Middle L-575 levee breach. The northwest corner of the property suffered quite a bit of damage with three to four feet of sand deposits on approximately four acres of the property. Outside of the levee there was scour damage and approximately 85 percent of all the trees were lost.

For the reasons discussed above, the court has determined that plaintiffs failed to prove causation for the Middle L-575 levee breach. Plaintiffs cannot establish a takings claim based on this flood event.

The court has considered the plaintiffs' takings claim based on flooding in 2007 and 2010 and finds plaintiffs have shown that the flooding was caused by and was the foreseeable result of the Corps' System and River Changes. Because the court is not convinced that the plaintiffs have yet to establish severity based on two flooding events, in the next phase of the litigation, plaintiffs will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiffs will be allowed to prove the remaining elements of their takings claim.

29. Property 29: L&H Investments

This property is located at river mile 540. The property is adjacent to the River and owned in fee simple. Plaintiff claims a taking based on flooding in 2008, 2010, 2011, 2013, and 2014. The property is protected by a private levee on all sides. Tr. 2715-2765; 3592. There are many notched dikes and lowered revetments in the area. The property is downstream from the Kansas Bend mitigation site and across from the Nishnabotna River mitigation area. Specifically, Corps construction activities in the area include: (1) dike modifications at river miles 548, 546, and 543 in 2003; (2) Kansas Chute at river mile 546 built in 2003; and (3) Nishnabotna Chute at river mile 543 built in 2005. DX3015-451.

In 2008, the private levee breached in May. Flooding lasted seven to ten days resulting in crop loss. Plaintiff had to rebuild the levee. The government excavated land on the northern easement it controls, which funneled the River toward the levee. The levee breached on the northern part of the property and flooded the property.

The government does not dispute flooding occurred. DX3015-452. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-453.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that flooding was due to levee overtopping which led to breaching that would not have occurred without higher WSEs. PX2554. Dr. Hromadka's testimony and the WSE chart show that the higher WSEs were caused by and were a foreseeable result of the

Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, the River ran high again in May, June, and July. The flooding lasted three months. Water entered from the north and south main levee, and the Honey Creek overtopped and breached the levee. Water inundated nearly 100 percent of the property with five to six feet deep. There was significant sloughing of the bank into the River.[83] Crops were lost and there was significant expense to reclaim the land and rebuild the levee.

The government does not dispute that there was overbank flooding. DX3015-454. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would have been no change in the days of flooding with or without the changes he modeled. DX3015-455.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that flooding was due to levee overtopping which led to breaching that would not have occurred without higher WSEs. PX2554. Dr. Hromadka's testimony and the WSE chart show that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

[83] Although L&H investments makes this claim of erosion, the only evidence presented by the plaintiff appears to relate to wetlands that are the subject of an easement and not at issue in this case. Tr. 2750.

In 2011, the entire property flooded in June, July, and August. The levees held until a few days after the Corps began to release the water from Gavins Point Dam at 160,000 cfs. Water was eight to ten feet deep across the entire property. Flooding caused erosion of land and sand deposits three to five feet deep. Crops were lost and there was significant expense to reclaim the land and rebuild the levee. Since 2011, there has been continuing erosion and sloughing of the bank year after year.

For the same reasons as discussed above with regard to Property 7, plaintiff cannot establish a taking based on the 2011 flood.

In 2013, approximately half of the property flooded from blocked drainage. Floodwaters entered from the south. Flooding reached approximately one foot deep. Flooding occurred in June and lasted for a couple of weeks. Crops were lost and the property needed to be cleaned up.

The government does not dispute that the property flooded. DX3015-458. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-459.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2013 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2014, flooding occurred in June and lasted for a couple of weeks.

The government does not dispute that a combination of an elevated River stage and heavy local precipitation caused overbank flooding. DX3015-460. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-461.

The court finds Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2014 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiff's takings claim based on flooding in 2008, 2010, 2013, and 2014 and finds plaintiff has shown that repeated flooding has interfered with plaintiff's use and enjoyment of its property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiff will be allowed to prove the remaining elements of its takings claim.

30. Property 30: Garst Farms, Inc.; Charles L. Garst Living Trust; Charles and Connie Garst

This property is located at river mile 539. It is approximately one and a quarter miles from the River and is owned in fee simple. Plaintiffs claim a taking based on flooding in 2007, 2008, 2010, and 2011. Tr. 2471-2574. The property is protected by federal levee L-550. Corps construction activities in the area include: dike modifications

at river mile 543 in 2003 and Nishnabotna Chute at river mile 543 built in 2005. DX3015-463.

In 2007, the flooding lasted from May 5 to June 6. Approximately 550 acres were inundated with an average of one to one and half feet of water. Approximately 600 acres of corn and soy bean were lost as a result of the flooding.

The government does not dispute that a combination of heavy local precipitation and elevated water levels in the River caused the flooding. DX3015-464. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-465.

The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2007 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2008, flooding lasted from June 5 to July 1. 600 acres were inundated with one foot of water and corn and soy beans were lost.

The government does not dispute that a combination of heavy local rainfall and elevated water levels in the River resulted in blocked drainage that caused flooding. Mr. Woodbury also acknowledged that seepage may have been an additional factor. DX3015-466. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-467.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, flooding lasted from June 7 to July 1. Approximately 600 acres were inundated with an average of two feet of water. Approximately 600 acres of corn and soybean were lost as a result of the flooding.

The government does not dispute that flooding was caused by blocked drainage of the drainage ditch that lies to the south of the property. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-469.

The court finds based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, flooding lasted from June 23 to September 23. The entire property was inundated with an average of four to five feet of water as a result of the breach of federal levee L-550. Approximately 666 acres of corn and soybean were lost as a result of the flooding. There were also damages to the property from erosion, scouring, sand deposits,

and debris that required reclamation and clean-up. In addition, approximately 288 acres were permanently lost to sand deposits of three and half feet deep.

For the same reasons as discussed above with regard to Property 7, plaintiff cannot establish a taking based on the 2011 flood.

The court has considered the plaintiffs' takings claim based on flooding in 2007, 2008, and 2010 and finds plaintiffs have shown that repeated flooding has interfered with plaintiffs' use and enjoyment of their property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiffs will be allowed to prove the remaining elements of their takings claim.

31. Property 31: Griffin Farms Partnership

This property is located at river mile 531. The property is owned in fee simple. Plaintiff claims a taking for flooding in 2008, 2010, and 2011. Tr. 2855-2925.

The property is located approximately one mile east of the River and south of the federal levee L-550. Corps construction activities in the area include: Langdon Ben Backwater at river mile 530 and numerous dike and chevron modifications at river miles 531.5 and 529.5 constructed since 2004. DX3015-473. In addition, the property is five to six miles south of the Lower Hamburg Chute built in 2005 and five to six miles north of the Deroin Chute built in 2001 and 2002. Def.'s Br., Table 1.

In 2008, there was flooding due to interior blocked drainage and seepage which prevented planting on 41 acres of the property.[84]

[84] As discussed earlier in the opinion's Legal Standards section, the court rejects the government's contention that in the context of a physical takings claim that the court must

The government does not dispute that flooding was caused by blocked drainage of the drainage ditch that drains water from the property. DX3015-474. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-475.

The court finds, Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In this connection, Dr. Hromadka explained that he reviewed a list from the National Oceanic and Atmospheric Association ("NOAA") of the 10 highest crests since 1952 on the Brownsville USGS gage near the properties. He explained that the list shows that five of those highest crests have occurred after 2006 since the Crops' System and River Changes. In addition, for 2012–2016, the water level gage has exceeded the 31.5 feet "action stage" and the 33 feet flood stage for four of the last five years. Dr. Hromadka explained that the drainage gates for these properties are blocked at 29 to 30 feet.

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consider the "parcel as a whole" in deciding whether there has been a taking. This concept, which is critical in regulatory takings cases, does not apply to physical takings claims. However, the extent of damages is necessary to prove that interference was sufficiently severe to meet the standard articulated in *Ark. Game & Fish III*, 736 F.3d at 1374-5.

In 2010, similar to 2008, there was interior blocked drainage that caused plaintiff to lose crops on a portion of the property.

The government does not dispute that flooding was caused by blockage in the drainage ditch that drains water from the property and that high River stages may have caused seepage. DX3015-476. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-477.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, federal levee L-550 overtopped and then broke on June 23. Following the breach of the levee, water inundated all of plaintiff's bottom land farms, including the representative property, with eight to nine feet of water. The water remained on the property for months and did not recede until September/October. The floodwaters resulted in depositing large amounts of sand, silt, muck, and debris. Grain bins and irrigation pivots were damaged or destroyed. The damage was extensive and far beyond anything experienced since 1993. The property had one to two feet of sand and silt on it covering about 20 percent of the property. There was considerable clean-up expense.

For the same reasons as discussed above with regard to Property 7, plaintiff cannot establish a taking based on the 2011 flood.

The court has considered the plaintiff's takings claim based on flooding in 2008 and 2010 and finds plaintiff has shown that the flooding was caused by and was the foreseeable result of the Corps' System and River Changes. Because the court is not convinced that the plaintiff has yet to establish severity based on two flooding events, in the next phase of the litigation, plaintiff will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiff will be allowed to prove the remaining elements of its takings claim.

32. Property 32: Edward and Diana Foral

This property is located at river mile 529.5. The plaintiffs own the property in fee simple and have a cash lease agreement on the property. They claim a taking based on flooding in 2010, 2011, 2013, and 2014. Tr. 2775-2830; 2831-2854. Property is protected by federal levee L-550. Corps construction activities in the area include: Langdon Bend Backwater at river mile 530 and many dike and chevron modifications at river miles 531.5 and 529.5 in 2004. DX3015-481.

In 2010, flooding began in June and lasted through September. The floodwaters were up against the toe of the levee two to three feet. Floodwaters came in from the northwest corner of the property. The entire crop was lost.

The government does not dispute that extraordinarily high flows in the River caused overbank flooding on the property. DX3015-482. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX301-483.

The court finds, based on Mr. Tofani's testimony, Dr. Hromadka's testimony, and the WSE chart, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, flooding began in June and lasted through September for over 100 days. The entire property flooded with 12 to 14 feet of water. There was extensive damage to the land including scour holes and large sand deposits. The entire crop was lost.

For the same reasons as discussed above with regard to Property 7, plaintiff cannot establish a taking based on the 2011 flood.

In 2013, flooding occurred in late May and lasted 20 to 30 days with two to three feet of water on the property.

The government does not dispute that flooding was caused by a combination of local rainfall and elevated flows in the River. DX3015-486. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-487.

The court finds, based on Mr. Tofani's testimony, Dr. Hromadka's testimony, and the WSE chart, that the flooding in 2013 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2014, flooding occurred in the middle of October and destroyed the crop.

The government does not dispute that elevated flows in the River at the end of June caused overbank flooding. DX3015-488.

Dr. Hromadka however only opined as to flooding in May of 2014.

In such circumstance, the court does not have expert opinion testimony from plaintiff as to the cause of flooding in the fall of 2014 and, therefore, plaintiffs cannot establish a taking based on flooding in 2014.

The court has considered the plaintiffs' takings claim based on flooding in 2010 and 2013 and finds plaintiffs have shown that the flooding was caused by and was the foreseeable result of the Corps' System and River Changes. Because the court is not convinced that the plaintiffs have yet to establish severity based on two flooding events, in the next phase of the litigation, plaintiffs will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiffs will be allowed to prove the remaining elements of their takings claim.

33. Property 33: Ideker Farms, Inc.

This property is located at river mile 512. The property is owned in fee simple and plaintiff claims a taking based on flooding in 2007, 2008, 2010, 2011, 2013, and 2014.[85] Tr. 4105-4241. Corps construction activities in the area include: (1) dike construction and notching near the property; (2) dike alteration at river mile 512; and (3)

[85] Ideker Farms also had a takings claim based on erosion. For the same reason that the court has rejected the other taking-by-erosion claims, the court rejects this claim for lack of evidence. The plaintiff did not present the court with evidence of the before and after property boundaries from which to determine the amount of erosion.

Corps operations at the Thurnau Wildlife Refuge directly south of the property. DX3015-491; DX3015-492. The Corning Levee District levee separates the refuge and the property. The property is protected by a private levee built by plaintiff.

In 2007, the entire farm flooded for 30 to 60 days beginning in May. Floodwaters entered the farm (inside the mainline levees on the west and south) from the south and east, coming from the Thurnau mitigation site. The private levees held, but at that time there was no levee on the east side of the farm furthest from the River. Extensive sandbagging operations occurred. The floodwaters entering the farm were estimated to be two to ten feet deep. Grain bins and irrigation equipment were damaged or destroyed. Some land reclamation was necessary. The 55 acres Riverward of the mainline levee were flooded with an estimated nine to ten feet on the levee, four to five feet overbank. The River cabin outside the levee flooded for the first time and required extensive renovation.

The government does not dispute that a combination of heavy local rainfall and extraordinarily high River flows led to the levee breaches and caused overbank flooding on the property. DX3015-493. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-494

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2007 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps'

System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2008, flooding began in mid-June and lasted 30 to 45 days. The Ideker levees held. Like 2007, the "hole" in the levee system at Thurnau allowed waters to enter the wetland mitigation site and wrap around the Ideker farm. Extensive sandbagging operations were undertaken on the southeast corner of the Ideker farm and blocked the surface waters from entering the farm. However, a portion of the farm sustained flood damage due to seepage and blockage of the drainage culverts. The drainage ditches on the property filled and flowed over on to some crops, sustaining water from one inch to one foot deep. A portion of the crops died but was re-planted. Grain bins and irrigation equipment again sustained damage, but this time more limited damage. The 55 acres Riverward of the Ideker mainline levee again flooded due to overbank flooding much like 2007. The cabin on the property adjacent to the River was again flooded and required renovation.

The government does not dispute that elevated water levels in the River caused overbank flooding of the property on the riverward side of the levee and blocked drainage on the landward side of the levee. DX3015-495. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-496.

The court finds based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps'

System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, flooding was worse than in 2007 and 2008. Once again, the high waters entered from the Thurnau mitigation site and wrapped around the farm. Sandbagging occurred along the tie-back levee and the state highway to block the Thurnau waters from entering the farm from the southeast. The efforts were successful until the mainline levee breached on the northwest corner of the farm, leaving a 90-foot deep scour hole destroying farmland. Floodwaters entered the breach side on the northwest corner of the farm, then flowed south blowing out and exited the south levee flowing into Thurnau. After the breaches, the Thurnau waters became one with the waters entering back through the breach site. The entire farm was flooded for approximately 90 days with floodwaters on the north side of the property reaching three feet deep and 11 to 13 feet deep on the south end of the farm. The farm, home, structures, and equipment sustained extensive damage. The farmhouse flooded and had to be demolished and replaced. The River cabin was again flooded and required renovation. Up to five feet of sand were left on the 60- to 70-acre area in the northwest of the farm in the vicinity of the levee breach. Grading equipment was used to remove sand and relocate and rebuild the mainline levee on the west and south areas, widening it two to three feet and raising it two feet. Additionally, levees were built on the east side of the farm to negate floodwaters emptying into the farm from the east in the future.

The government does not dispute that flooding was caused by elevated River stages. DX3015-497. Based on his modeling, which the court has rejected as unreliable,

Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-498.

The court finds, based on Mr. Tofani's testimony, that flooding was due to levee overtopping that would not have occurred without the System and River Changes. PX2554; *see also* Tr. 14957:17-14958:4. Dr. Hromadka's testimony and the WSE chart show that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, Riverbank flooding began on the Riverward side of the Ideker mainline levee on Memorial Day weekend. Once again, floodwaters entered Thurnau and flowed east and north, reaching the new Ideker levee on the east side of the farm, but these floodwaters were blocked by the Ideker south mainline levee and the new east levee. The levee surrounding the farm held, where as other levees including federal levees in the region began to fail. The levees failed on June 19, and the reinforced, well maintained levees were the last to fail in the area. Water depth on the farm reached six to 16 feet, lasting over 100 days and leaving three to five feet of sand over approximately 70 acres of the farm. The farm sustained extensive damage as a result of the 2011 flood. Extensive land reclamation was required at great expense to remove sand and debris. Grain bins and irrigation equipment were again damaged or destroyed. The River cabin was completely destroyed and torn down. The cabin was replaced and was built to new higher elevation. The farm sustained a complete crop loss.

For the same reasons as discussed above with regard to Property 7, plaintiff cannot establish a taking based on the 2011 flood.

In 2013, flooding began in May and lasted 30 to 45 days. 55 acres on the Riverward side of the Ideker mainline levee flooded from overbank flooding. There were no levee breaches. The water was estimated at seven to eight feet on the mainline levee on the west side and two to three feet over the River bank. The new River cabin was not flooded.

The government does not dispute that flooding was caused by elevated River stages in the River on the portion of the property on the Riverward side of the levee caused overbank flooding and that seepage may have also been a factor. DX3015-501. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would have been no change in the days of flooding with or without the changes he modeled. DX3015-502.

The court finds based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2013 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2014, the 55 acres on the Riverward side of the Ideker mainline levee again flooded much like 2013. Flooding began in June with the peak water in late June but drainage was impacted periodically from June to October. Water reached the base of the mainline levee on the west side and was estimated at one to two feet over the River bank.

Floodwaters were not as deep as in 2013. Farming this acreage Riverward of the levee was determined to be no longer sustainable in light of the flood-prone River.

The government does not dispute that elevated River stages caused overbank flooding on the portion of the property on the Riverward side of the levee and that blocked drainage and seepage may have been additional factors in the flooding. DX3015-503. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-504.

The court finds based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2014 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiff's takings claim based on flooding in 2007, 2008, 2010, 2013, and 2014 and finds Ideker Farms, Inc. has shown that repeated flooding has interfered with plaintiff's use and enjoyment of their property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiff will be allowed to prove the remaining elements of its takings claim.

34. Property 34: Drewes Farms, Inc.; Eddie Drewes; David Drewes; Rita K. Drewes Revocable Trust; Robert W. Drewes Revocable Trust

This property is located one and half miles east of river mile 507. The property is owned in fee simple and plaintiffs claim a taking based on flooding in 2007, 2010, and 2011. Tr. 3306-3345. The property is near the Thurnau Mitigation Area and Rush Bottom Bend which were built from 2006 to 2008. Def.'s Post Trial Brief, Table 1.

In 2007, the Union Township and Big Tarkio levees overtopped and breached. There was no history of flooding before the levee breaches. Flood depths varied from one inch to one foot deep. Flooding occurred during the planting season and lasted for approximately one month. There was crop damage, damage to structures, replanting of crops, and clean-up of debris.

The government does not dispute that there was flooding due to blocked drainage and the levee failure, which may have been exacerbated by heavy local rainfall. DX3015-507. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-508.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that the Union Township levee could have breached in 2007 in both the "but for" and actual worlds. The court finds that when flooding could have possibly occurred without the Corps' System and River Changes, plaintiffs have not met their causation burden and cannot rely on the 2007 flood to support a takings claim.

In 2010, flooding began in June. The Union Township and Holt County #15 levees overtopped and breached. The property was completely inundated with one to two

feet of water for approximately one month. Crops were lost. There was damage to structures and clean-up from debris.

The government does not dispute the property flooded due to levee breaches that caused overbank flooding and blocked drainage. DX3015-509. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-510.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that the Union Township levee could have breached in 2010 in both the "but for" and actual worlds. The court finds that when flooding could have possibly occurred without the Corps' System and River Changes, plaintiffs have not met their causation burden and cannot rely on the 2010 flood to support a takings claim.

In 2011, the Union Township and Holt County #15 levees overtopped and breached. The property was inundated with two to three feet of water from mid-June lasting over 100 days. Crops were lost, there was damage to structures, erosion of property, land reclamation, and clean-up of debris.

For the same reasons as discussed above with regard to Property 7, plaintiff cannot establish a taking based on the 2011 flood.

Because plaintiffs cannot establish causation for any of the flood events (2007, 2010, or 2011) their takings claim must be dismissed.

35. Property 35: Steven K. Cunningham Trust; Doris I. Cunningham Trust

This property is located at river mile 503. The property is owned in fee simple. The plaintiffs claim a taking based on flooding in 2007, 2008, 2010, and 2011. Tr. 3360-3465. The property is protected by the Union Township and Holt County #10 levees. Prior to 2008, there were areas not protected by a levee. Corps construction activities in the area include Rush Bottom Bend Chute at river mile 502 built in 2006 to 2008. DX3015-514. The property is three miles downstream of the Thurnau mitigation site, and there are many dikes and revetments that were notched, lowered, or allowed to deteriorate in the vicinity of the property.

In 2007, Holt County #10 levee failed due to overtopping. Big Tarkio tie-back levee also, failed. The entire property was inundated with one and half foot deep waters. Flooding began in the first part of June and lasted approximately three weeks. Crops were lost; some crops on the property were able to be harvested, but production was adversely affected.

The government does not dispute that flooding was caused by blocked drainage, overbank flooding, and multiple levee breaches due to heavy local rainfall leading to extraordinarily high flows in the rivers (Tarkio and Missouri). DX3015-515. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-516.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that the Holt County #10 levee would have breached in 2007 in both the "but for"

and actual worlds. The court finds that when flooding would have occurred without the Corps' System and River Changes, plaintiffs have not met their causation burden and cannot rely on the 2007 flood to support a takings claim.

In 2008, flooding was similar to 2007, but the levees did not fail. The height of the water was enough to inundate the property but not breach or overtop the levees. Flooding began in June and lasted approximately one month. Floodwaters reached up to two and half feet. The entire crop was lost.

The government disputes that there was flooding in 2008 based on Mr. Woodbury's LIDAR images. DX3015-517. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would have been no change in the days of flooding with or without the changes he modeled. DX3015-519.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, the Union Township and Holt County #10 levees overtopped and failed. Flooding occurred from June to mid-July and lasted approximately six weeks. Floodwaters reached up to two feet deep in the middle of the property and one foot on the edges. All of the crops were lost.

The government does not dispute there was flooding caused by extraordinarily high flows in the River resulting in overbank flooding and at least one levee breach.

DX3015-520. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-521.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that the Union Township levee could have breached in 2010 in both the "but for" and actual worlds. In such circumstance, the property would have been inundated in the "but for" world. Although, Mr. Tofani testified that the Holt County #10 levee would not have failed in the "but for" world, the court has no way of determining whether this would have made any difference. Thus, because flooding would have likely occurred due to the Union Township levee breach, plaintiffs have not met their causation burden and cannot rely on the 2010 flood to support a takings claim.

In 2011, the Union Township and Holt County #10 levees both failed due to overtopping. Flooding began in late May and lasted through September for over 100 days. Floodwaters reached three feet and lasted three months. The entire crop was destroyed.

For the reasons discussed above, the court has determined that plaintiffs failed to prove causation for the 2011 flood. Plaintiffs cannot establish a takings claim based on this flood event.

The court has considered the plaintiffs' takings claim based on flooding in 2008 and finds plaintiffs have shown that the flooding was caused by and was the foreseeable result of the Corps' River and System Changes. Because the court is not convinced that the plaintiffs have yet to establish severity based on the 2008 flood event, in the next

phase of the litigation, plaintiffs will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiffs will be allowed to prove the remaining elements of their takings claim.

36. Property 36: Darwin and Jennifer Binder; Dustin and Jenny Binder; Richard and Karen Binder; Midwest Grain Company

This property is located three miles east of river mile 502. The property is owned in fee simple. Plaintiffs claim a taking based on flooding in 2007, 2010, and 2011. Tr. 3514-3573. The property is landward of the Union Township and Holt County #10 levees. The property is located near Rush Bottom Bend built in 2006 to 2008 and Wolf Creek mitigation site built in 2006. DX3015-525; Def.'s Br., Table 1. Also, many dikes and revetments have been notched, lowered, or allowed to deteriorate in this area of the River.

In 2007, the property was inundated by floodwaters reaching six to eight feet deep as a result of the breach in the Union Township levee. Flooding occurred in May and lasted approximately one week. Some clean-up was required to remove debris and silt. The entire corn crop was lost. Plaintiffs were able to replant soy beans but had a reduced yield.

The government does not dispute that the property flooded and that the levees breached. DX3015-526. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-527.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that the Union Township levee could have breached and Holt County #10 levee would have breached in 2007 in both the "but for" and actual worlds. Thus because flooding could would have occurred, plaintiffs have not met their causation burden and cannot rely on the 2007 flood to support a takings claim.

In 2010, flooding was similar to 2007 in that the entire property was again inundated with a depth of floodwaters six to eight feet as a result of the Union Township levee breaching. Flooding occurred in June and lasted two weeks. The entire crop was lost. There was also damage to the irrigation system. Silt and debris were removed from the property.

The government does not dispute that the flooding in 2010 was caused by extraordinarily high flows in the River that resulted in overbank flooding and at least one levee breach. DX3015-528. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-529.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that the Union Township levee could have breached in 2010 in both the "but for" and actual worlds. In such circumstance, the property would have been inundated in the "but for" world. Although, Mr. Tofani testified that the Holt County #10 levee would not have failed in the "but for" world, the court has no way of determining whether this would have made any difference. Thus, because flooding would have likely occurred due

to the Union Township levee breach, plaintiffs have not met their causation burden and cannot rely on the 2010 flood to support a takings claim.

In 2011, flooding followed the breach of the Union Township levee on June 13. The levee was overtopped. The whole area was inundated with floodwaters of at least six to eight feet deep. Flooding lasted over 100 days from mid-June to September. The entire crop was lost. The irrigation system was again damaged. Plaintiffs had considerable sand on one of the farms, requiring substantial clean-up.

For the same reasons as discussed above with regard to Property 7, plaintiffs cannot establish a taking based on the 2011 flood.

Plaintiffs are unable to establish a takings claim for any flood event claimed, and thus their takings claim must be dismissed.

37. Property 37: Dennis and Beth Saunders

The property is located three miles east of river mile 501. The property is a private residence owned in fee simple. The plaintiffs' takings claim is based on flooding in 2007, 2010, and 2011. Tr. 2165-2217.

The property is protected by the Union Township and Holt County #10 levees. Corps construction activities in the area include the Rush Bottom Bend Chute at river mile 502 built in 2008. DX3015-533. Many dikes and revetments in area have been notched, lowered, or allowed to deteriorate. Flooding was caused by levee failures in all three years.

In 2007, the property was inundated with three feet of water as a result of failures of the Union Township and Holt County #10 levees. Flooding lasted from May 5 to May

18. There were significant damages to the property and home caused by the flooding, requiring extensive repairs and clean-up. In an attempt to avoid damage from future flooding, the living area of the home was elevated by 11 feet.

The government does not dispute that the property flooded following the levee failure in 2007. DX3015-534. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would have been no changes in the days of flooding with or without the changes he modeled. DX3015-535.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that the Union Township levee could have breached in 2007 in both the "but for" and actual worlds. In such circumstance, the property would have been inundated in the "but for" world. Additionally, Mr. Tofani testified that the Holt County #10 levee would have failed in the "but for" world. Thus, because flooding would have occurred due to the Holt County #10 levee breach, plaintiffs have not met their causation burden and cannot rely on the 2007 flood to support a takings claim.

In 2010, the entire area flooded as a result of the Union Township and Holt County #10 levee failures. The property was inundated with four to six feet of water. The flooding lasted from June 12 to July 31. There were significant injuries to the property and home, requiring extensive home repairs and clean-up.

The government does not dispute the overbank flooding in 2010 was caused by a high River level from multiple levee breaches and that local rainfall may be been an additional factor. DX3015-536. Based on his modeling, which the court has rejected as

unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-537.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that the Union Township levee could have breached in 2010 in both the "but for" and actual worlds. In such circumstance, the property would have been inundated in the "but for" world. Although, Mr. Tofani testified that the Holt County #10 levee would not have failed in the "but for" world, the court has no way of determining whether this would have made any difference. Thus, because flooding would have likely occurred due to the Union Township levee breach, plaintiffs have not met their causation burden and cannot rely on the 2010 flood to support a takings claim.

In 2011, the entire area was inundated as a result of breaches in the Union Township and Holt County #10 levees. The property was inundated with seven feet of water. The flooding caused plaintiffs to evacuate their home on June 1 and the floodwaters did not recede until roughly August 1. There were significant damages to the property and the home requiring extensive repairs and clean-up.

For the same reasons as discussed above with regard to Property 7, plaintiffs cannot establish a taking based on the 2011 flood.

Because plaintiffs have not met their causation burden for any flood event, and thus their takings claim is dismissed.

38. Property 38: Cunningham Farms, Inc; Steven Cunningham

This property is located a half mile east of river mile 500. The property is owned in fee simple. Plaintiffs claim a taking based on flooding in 2007, 2008, 2010, and 2011.

Tr. 3360-3465. The property is protected by Holt County #10 levee. Corps construction activities in the area include Rush Bottom Bend Chute at river mile 502 built in 2008. DX3015-541. Excavation of the Rush Bottom Bend Chute deposited 400,000 cubic yards of sediment into the River. Many of the dikes and revetments in the area were notched, lowered, or allowed to deteriorate.

In 2007, Holt County #10 levee overtopped on both the north and south of the property. The entire property was flooded up to one foot deep. Flooding began in the first part of May and lasted approximately three weeks. Crops were lost. Some were able to be harvested but production was adversely affected.

The government does not dispute that flooding occurred in 2007. However, Mr. Woodbury testified that he was not certain the flooding was caused by overtopping but could have occurred due to seepage. DX3015-542. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would have been no change in the days of flooding with or without the changes he modeled. DX3015-543.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that the Holt County #10 levee would have breached in 2007 in both the "but for" and actual worlds. The court finds that because flooding would have occurred without the Corps' System and River Changes, plaintiffs have not met their causation burden and cannot rely on the 2007 flood to support a takings claim.[86]

[86] At closing argument, the government reiterated its criticism of Dr. Christensen's gage analysis in connection with this property and others where Dr. Christensen relied on readings from the Rulo gage. The government argued that the analysis is questionable because Dr. Christensen failed to take into account changes in the heights of levees post-2000 in the Kansas City District.

In 2008, flooding was similar to 2007 but the levee did not fail or overtop. Flooding began in June and lasted for one month. Floodwaters reached up to two and half feet. The entire crop was lost.

The government does not dispute that the flooding in 2008 was due to blocked drainage and seepage. DX3015-544. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would have been no changes in the days of flooding with or without the changes he modeled. DX3015-545.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In support, the government relies on testimony from Mr. Shumate, an engineer from the Corps Kansas City District. Tr.8782-8783; 8864-8867. As discussed above, the court has considered this criticism and rejected it because the government failed to provide any expert testimony to demonstrate that the River level increases experienced are attributable to the increased heights of the levees and not to the River Changes undertaken by the Corps. In addition, Dr. Christensen explained that he had verified his gage analysis by making several gage comparisons and determined that the increased River levels at high flows could be best explained by the numerous Changes the Corps has made to create SWH and mitigation projects along the River. The court finds that Mr. Shumate's testimony does not directly challenge Dr. Christensen's analysis or undermine Dr. Hromadka's opinions or Mr. Tofani's analysis, which relied in large part on Dr. Christensen's analysis. As discussed above, the court finds that Dr. Christensen's gage analysis establishes that increased River heights are attributable to the Corps' River Changes which created a shallower and varied River bed topography, which has also changed the velocity of the River at higher flows causing River levels to rise.

In 2010, Holt County #10 levee overtopped and breached. Flooding occurred from June to mid-July and lasted approximately six weeks. Floodwater reached up to two and half feet. All the crops were lost.

The government does not dispute that flooding in 2010 was caused by a combination of groundwater seepage under Holt County #10 levee, overbank flooding that caused overtopping of the levee adjacent to the property, and blocked drainage. DX3015-546. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-547.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that the Holt County #10 levee would not have failed in the "but for" world. The court finds, based on Mr. Tofani's testimony, Dr. Hromadka's testimony, and the WSE chart, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, the Union Township and Holt County #10 levees failed due to overtopping. Floodwaters reached three feet and lasted three months. The entire crop was again destroyed. Levee improvements were made following each flood event.

For the same reasons as discussed above with regard to Property 7, plaintiff cannot establish a taking based on the 2011 flood.

The court has considered the plaintiffs' takings claim based on flooding in 2008 and 2010 and finds plaintiffs have shown that the flooding was caused by and was the foreseeable result of the Corps' System and River Changes. Because the court is not convinced that the plaintiffs have yet to establish severity based on two flooding events, in the next phase of the litigation, plaintiffs will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiffs will be allowed to prove the remaining elements of their takings claim.

39. Property 39: Alma Green Trust and Marvin Green

This property is located at river mile 490.5. The property is owned in fee simple. There is a share crop agreement. The property is protected by a private levee. The plaintiffs claim a taking based on flooding in 2007, 2010, 2011, and 2013. Tr. 2926-2972. Corps construction activities in the area include the Rush Bottom Bend Chute at river mile 502 built in 2008. DX3015-565. Also many dikes at the northeast corner of the property were notched.

In 2007, flooding occurred in June with blocked drainage and seepage. The levee overtopped and breached in the northeast corner of the property. The property was inundated with up to eight feet of water lasting several weeks. Crops were lost and expenses were incurred for pumping and cleaning out ditches following the flood.

The government does not dispute that flooding in 2007 was caused by overbank flooding that caused overtopping of the levee and blocked drainage and that groundwater seepage may have been an additional factor. DX3015-566. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he

modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-567.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that flooding was due to block drainage and seepage and levee overtopping that would not have occurred without higher WSEs. PX2554. Dr. Hromadka's testimony and the WSE chart show that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, the south levee overtopped and then breached. Flooding started in May and lasted most of the summer. The entire property was inundated with up to nine feet of water. Crops were lost, and there were pumping expenses and repairs.

The government does not dispute that flooding in 2010 was caused by overbank flooding that led to overtopping of the levee which resulted in the levee breach and also caused blocked drainage and that seepage may have been an additional factor in flooding. DX3015-568. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-569.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's datat), that flooding was due to levee overtopping which led to breaching that would not have occurred without higher WSEs. PX2554. Dr. Hromadka's testimony and the WSE chart show that the higher WSEs were caused by and were a foreseeable result of the

Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, flooding started in early June. The levee overtopped and breached, inundating the entire property with up to 12 feet of water. The south levee overtopped and then breached. Flooding lasted at least 60 days. Crops were lost, and pumping, repair, and clean-up costs were incurred.

For the same reasons as discussed above with regard to Property 7, plaintiffs cannot establish a taking based on the 2011 flood.

In 2013, the south levee overtopped and inundated the property with up to seven feet of water. Flooding occurred from May to June for two weeks. Crops were lost, and levee repair and clean-up costs were incurred.

The government does not dispute that flooding in 2013 was caused by blocked drainage and seepage. DX3015-572. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would have been no changes in the days of flooding with or without the changes he modeled. DX3015-573.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2013 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiffs' takings claim based on flooding in 2007, 2010, and 2013 and finds plaintiffs have shown that repeated flooding has interfered with

plaintiffs' use and enjoyment of their property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiffs will be allowed to prove the remaining elements of their takings claim.

40. Property 40: Aaron and Kelly Luce d/b/a Aaron Luce Farm Co.

This property is located approximately half a mile from river mile 490. It is protected by Holt County #9 levee. The property is owned in fee simple and the plaintiffs claim a taking based on flooding in 2008, 2010, and 2011. Tr. 2973-3027. Corps construction activities in the area include dike notching.

In 2008, flooding occurred in June. Flooding was unusual and unexpected because it was the first time that these conditions had ever been observed on this property. The groundwater was so high that a person could sink into the ground. There is a pond in the northwest corner of the property that would rise and fall with the elevation of the River. Crops were lost and production was adversely affected. There were "dead areas" of corn indicative of the high groundwater table. Holt County #9 levee did not fail but the River was against the levee.

The government does not dispute that the flooding in 2008 was caused by blocked drainage of the drainage ditch that runs along the east side of the property and that high River stages may have caused increased seepage. DX3015-576. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-577.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, flooding was in June and lasted for several weeks. Flooding was similar to 2008 but greater. The River was against Holt County #9 levee but was higher than 2008. Following the 2010 flood, Holt County #9 levee was fortified to make it higher and wider. Crops were lost and production was adversely affected.

The government does not dispute that flooding in 2010 was caused by blocked drainage of the drainage ditch that runs along the east side of the property and that high River stages may have caused increased seepage. DX3015-578. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-579.

The court finds, based on Dr. Hromadka's testimony and the WSE chart, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, flooding began with interior blocked drainage and or seepage from a high River in late May but the property remained dry. Sand boils were observed near the levee. Several weeks later, Holt County #9 levee overtopped and failed in multiple

locations. The first breach occurred immediately southwest of the property near the notched wing dikes. The second breach occurred a few days later on the Little Tarkio River tie-back levee. A few exit breaches occurred along the Squaw Creek tie-back levee and where the levee ties into Holt County #9 levee. Within 12 hours of the breaches, 8,000 acres of land were completely inundated with water. The entire property was inundated and the floodwaters did not recede until September. The entire crop was destroyed.

For the same reasons as discussed above with regard to Property 7, plaintiff cannot establish a taking based on the 2011 flood.

The court has considered the plaintiffs' takings claim based on flooding in 2008 and 2010 and finds plaintiffs have shown that the flooding was caused by and was the foreseeable result of the Corps' System and River Changes. Because the court is not convinced that the plaintiffs have yet to establish severity based on two flooding events, in the next phase of the litigation, plaintiffs will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiffs will be allowed to prove the remaining elements of their takings claim.

41. Property 41: Buffalo Hollow Farms, Inc.

This property is located at river mile 478. The property is owned in fee simple. The plaintiff claims a taking based on flooding in 2007, 2008, 2010, 2011, 2013, and 2014. Tr. 2290-2366. The property is protected by a private levee. Corps construction activities near the property include the Wolf Creek Bend channel widening at river mile

481 in 2006 and dike notching at river miles 492, 490, and 487, starting in 1974. DX3015-583.

In 2007, the flooding occurred from May 7 to May 15 and again from May 24 to May 25. The flooding covered approximately 25 percent of the property inside the levee and all but two or three acres outside the levee. The River was three to four feet high against the levee and the water depths inside the levee ranged from "spongy" soil to two feet. Crops were lost, there were reduced yields, and pumping expenses were incurred.

The government does not dispute that flooding in 2007 was caused by blocked drainage of the creek that drains the property and that high River stages contributed to the flooding and may have also caused seepage. DX3015-584. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-585.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2007 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2008, flooding occurred from May 30 to June 21. The flooding covered approximately 50 percent of the property inside the levee and all but two to three acres outside the levee. The River was four to five feet high against the levee and the water

depths inside the levee ranged from saturated soil to one to two feet deep. Crops were lost, yields were reduced, and plaintiffs incurred pumping expenses and clean-up costs.

The government does not dispute that flooding in 2008 was caused by blocked drainage from the creek that drains the property and that high River stages caused seepage. DX3015-586. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would have been no change in the days of flooding with or without the changes he modeled. DX3015-587.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2008 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, flooding occurred from June 11 to August 20. Flooding covered about 75 percent of the property inside the levee and the entire property that was outside the levee. The River was four to five feet against the levee and the water depths inside the levee ranged from saturated soils to three feet deep. Crops were lost, yields were reduced pumping expenses and debris clean-up costs were incurred.

The government does not dispute that flooding in 2010 was caused by blocked drainage and that a high River contributed to seepage. DX3015-588. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in more days of flooding than would have occurred without those changes. DX3015-589.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, flooding occurred from June 20 to September 25. The levee overtopped and multiple breaches occurred, inundating the entire property with eight to ten feet of water with a current crossing the entire property. The south end of the levee overtopped on June 21, the mainline overtopped on June 27, and mainline held for three to four days of overtopping before breaching. There were significant scour holes ranging from four acres to 18 acres. Approximately half an acre of the River bank was lost due to erosion. Some scour holes measured 50 to 60 feet deep. There were erosion of the top soil and levee repairs. There were sand deposits across the property three to five feet deep and plaintiff removed 500,000 to 700,000 cubic yards of sand from the property inside the levee. The plaintiff hauled about 1 million tons of dirt from the bluffs to fill the scour holes and repair the levees. The entire crop was lost and there was extensive debris.

For the same reasons as discussed above with regard to Property 7, plaintiff cannot establish a taking based on the 2011 flood.

In 2013, flooding occurred from late May to early June. Almost all of the acres outside the levee were flooded with overbank flooding, and seepage and/or blocked drainage occurred inside the levee. Crops were lost. The River was about one to two feet high against the levee.

The government does not dispute that overbank flooding in 2013 was caused by high River stages. DX3015-592. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would have been no change in the days of flooding with or without the changes he modeled. DX3015-593.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2013 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2014, the flooding was similar to 2013.

The government does not dispute flooding in 2014 Riverward of the levee was caused by a high River that caused overbank flooding. DX3015-594. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that there would have been no change in the days of flooding with or without the changes he modeled. DX3015-595.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2014 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

The court has considered the plaintiff's takings claim based on flooding in 2007, 2008, 2010, 2013, and 2014 and finds Buffalo Hollow Farms, Inc., has shown that

repeated flooding has interfered with plaintiff's use and enjoyment of its property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiff will be allowed to prove the remaining elements of its takings claim.

42. Property 42: Scott Rouse and Scott Ryan Rouse Family Trust

This property is located approximately one and a half miles east of river mile 460. The plaintiffs own the property in fee simple. They claim a taking based on flooding in 2010 and 2011. Tr. 3478:9-3513:23. The property is protected by levee MRLS 476-L. Corps construction activities near the property include (1) the Worthwine revetment lowering near the upstream end of the property built in 2004, (2) the Worthwine Chute near the upstream end of the property built in 2006, and (3) dike notching. DX3015-597. According to Dr. Hromadka, the Corps deposited more than 400,000 cubic yards of sediment in the River and brought the River 1,000 feet closer to the levee when it constructed the Worthwine Chute.

In 2010, flooding started in early June and lasted approximately 30 days. Floodwater depth varied from saturated soil to three feet. 250 to 300 acres were flooded. The plaintiffs observed a high River level for several weeks before seeing "clean" seepage water originating near the Worthwine Island MRRP site flowing down the road towards their property. The plaintiffs observed that the seepage originated south of the property near the levee. The water began to break back in through the drainage ditches. The plaintiffs observed sand boils approximately 2,000 feet inland of the MRLS 476-L

levee which they had never seen before. Crops were lost and production was adversely affected.

The government does not dispute that flooding in 2010 was caused by either seepage or a combination of seepage and blocked drainage caused by a high River. DX3015-598. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-599.

The court finds, based on Dr. Hromadka's testimony and the WSE chart and Mr. Tofani's testimony, that the flooding in 2010 was the result of higher WSEs. The court finds that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, flooding began in late May and lasted approximately 100 days until September. Approximately 480 acres of the property were flooded similar to 2010; however, the damage was more extensive. Floodwater depth varied from saturated soil to approximately six feet deep. "Clean" water again backed up through the drainage ditches and water flowed from the Worthwine Island MRRP site toward the property. Sand boils were again observed near Worthwine Island. The Corps brought in two large pumps to pump water out of the levee near the drainage gates. The basement of plaintiffs' home took on water, but they successfully used a sump pump to evacuate it. Crops were lost and production was adversely affected.

For the same reasons as discussed above with regard to Property 7, plaintiff cannot establish a taking based on the 2011 flood.

The court has considered the plaintiffs' takings claim based on flooding in 2010 and finds plaintiffs have shown that the flooding was caused by and was the foreseeable result of the Corps' System and River Changes. Because the court is not convinced that plaintiffs have yet to establish severity based on the 2010 flood, in the next phase of the litigation, plaintiffs will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiffs will be allowed to prove the remaining elements of their takings claim.

43. Property 43: Lanny and Ramona Frakes[87]

This property is located approximately one mile east of river mile 421. The property is owned in fee simple. Plaintiffs claim a taking based on flooding in 2008, 2010, and 2011. Tr. 3850-3938. Corps construction activities near the property include: (1) Benedictine Bottoms SWH from river miles 427 to 424 built in 2004; (2) Dalby Bottoms SWH south of the property; and (3) three chutes between river miles 415 to 418 all built by 2013. DX3015-603.

In 2008, the River was high requiring sandbagging of the PL 84-99 levee. Water trickled over the levee. Notwithstanding extensive sandbagging efforts, the water overtopped the levee and then ran south onto the property. Flooding also caused the

[87] Mr. Frakes is Vice Chair and VP of the Missouri Levee & Drainage District Association. He testified to certain changes to the River near his property. He testified that his drainage culverts are now blocked at a lower River reading at the St. Joe gage due to aggradation in the area and that the River rises much more quickly than it did before 2004.

Sugar Lake drainway and the farm drainage ditch network to back up. The flooding lasted approximately one month in June. The majority of the property experienced flooding in 2008 ranging from saturated soil to nearly three feet of water. Crops were lost on 60 to 70 percent of the property and the remaining crop production was adversely affected.

The government does not dispute that some flooding that occurred in 2008 was caused by elevated flows in the River, but it does not acknowledge levee overtopping and instead attributes flooding due to blocked drainage and possible seepage. DX3015-604. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-605.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that flooding was due to levee overtopping that would not have occurred without higher WSEs. PX2554. Dr. Hromadka's testimony and the WSE chart show that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, the River overtopped the PL 84-99 levee similar to 2008. Again, despite extensive sandbagging efforts the flooding ensued. The Sugar Lake drainway and Sugar Creek again backed up causing seepage and blocked interior drainage just like in 2008. The duration of flood was longer and the volume of water was greater than in 2008.

Flooding lasted approximately six weeks starting in early June. Crops were lost on 60 to 70 percent of the property and crop production was adversely impacted.

The government does not dispute that some flooding occurred in 2010 that was caused by elevated flows in the River which resulted in blocked drainage and possibly seepage. DX3015-606. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-607.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that flooding was due to levee overtopping that would not have occurred without higher WSEs. PX2554. Dr. Hromadka's testimony and the WSE chart show that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, the River breached the PL 84-99 levee at multiple locations causing the interior area to be inundated with floodwaters including the representative property. One of the levee breaches was approximately due west of Rushville, Missouri, on the mainline levee, and was an entry breach. The property was completely inundated with four to ten feet of water. The entire crop was lost and the barns and outbuildings were destroyed.

For the same reasons as discussed above with regard to Property 7, plaintiff cannot establish a taking based on the 2011 flood.

The court has considered the plaintiffs' takings claim based on flooding in 2008 and 2010 and finds plaintiffs have shown that the flooding was caused by and was the

foreseeable result of the Corps' System and River Changes. Because the court is not convinced that the plaintiffs have yet to establish severity based on two flooding events, in the next phase of the litigation, plaintiffs will have to meet the severity standard articulated in *Ark. Game & Fish III* before plaintiffs will be allowed to prove the remaining elements of their takings claim.

44. Property 44: George (Deceased) and Patricia Hildebrandt

This property is at river mile 408.5. The plaintiffs own the property in fee simple. They claim a taking based on flooding in 2007, 2008, 2010, and 2011. Tr. 3677-3701; Tr. 3701-3721. Most of the property is protected by a private levee connected to the Grape-Bollin-Schwartz non-federal levee. Additionally, the property is protected by federal levee NLD to the west. DX3015-611. It is immediately downstream of the Oak Mills Bend mitigation site. There are many notched dikes in the area.

In 2007, flooding started in May and lasted less than one month. The levee overtopped and floodwaters reached four to five feet in the house and another two to three feet higher in the fields. Crops were lost and the homestead was damaged.

The government does not dispute that flooding in 2007 was caused by elevated flows in the River that resulted in overtopping of the private levee surrounding the property. DX3015-612. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-613.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that flooding was due to levee overtopping that would not have occurred without

higher WSEs. PX2554. Dr. Hromadka's testimony and the WSE chart show that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2008, the private levee overtopped. Floodwaters reached five to six feet in the house. Crops were lost and the homestead was damaged.

The government does not dispute that, like 2007, the flooding in 2008 was caused by elevated flows in the River that caused the private levee surrounding the property to overtop. DX3015-614. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-615.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that flooding was due to levee overtopping that would not have occurred without higher WSEs. PX2554. Dr. Hromadka's testimony and the WSE chart show that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2010, the levee overtopped with flooding similar to 2007 and 2008. The entire crop and family home were destroyed.

The government does not dispute that flooding in 2010 was caused by elevated flows in the River that overtopped the private levee surrounding the property. DX3015-616. Based on his modeling, which the court has rejected as unreliable, Mr. Woodbury

concluded that the changes he modeled resulted in fewer days of flooding than would have occurred without those changes. DX3015-617.

The court finds, based on Mr. Tofani's testimony (who relied on Dr. Christensen's data), that flooding was due to levee overtopping that would not have occurred without higher WSEs. PX2554. Dr. Hromadka's testimony and the WSE chart show that the higher WSEs were caused by and were a foreseeable result of the Corps' System and River Changes which resulted in more severe flooding than would have occurred without these Changes.

In 2011, the property was inundated when the private levee breached. There were seven to ten feet of water on the property. Scour holes and sand deposits were left on the property.

For the same reasons as discussed above with regard to Property 7, plaintiff cannot establish a taking based on the 2011 flood.

The court has considered the plaintiffs' takings claim based on flooding in 2007, 2008, and 2010 and finds plaintiffs have shown that repeated flooding has interfered with plaintiffs' use and enjoyment of their property and was caused by and was the foreseeable result of the Corps' System and River Changes. In the next phase of the litigation the plaintiffs will be allowed to prove the remaining elements of their takings claim.

V. Conclusion

For the reasons stated, the court concludes as follows:

(1) The following plaintiffs have established causation, foreseeability and severity, and their takings claims will proceed to the next phase of the litigation where the court

will decide whether the United States has any defenses to these plaintiffs' claims and other legal and factual issues associated with proving entitlement to just compensation and if entitlement is established the appropriate amount:

- Blodgett Farms, LLC (Property 13)[for flooding in 2010, 2013, and 2014]
- Anthony and Mary Salter and Franklin and Cheryl Salter (Property 15) [for flooding in 2008, 2010, 2013, and 2014]
- George Neale Farm, LLC, Neale Farms, Inc., and Jeff and Kelli Shaner (Property 16) [for flooding in 2008, 2010, and 2014]
- Robert D. Adkins, Sr., and Betty Adkins, Robert D. Adkins, Jr., Ken Adkins, and Robert Adkins & Sons Partnership (Property 17) [for flooding in 2007, 2008, and 2010]
- Husz Farm Corp., K & J Husz, Inc., Dale and Sheryl Husz and Keith, and Julia Husz (Property 18) [for flooding in 2007, 2008, 2010, and 2014]
- David and Kimberly Sieck and Daniel Sieck (Property 20) [for flooding in 2008, 2010, and 2013]
- Payne Valley Farms, LLC (Property 25) [for flooding in 2007, 2008, 2010, and 2013]
- Gary Schemmel (Property 27) [for flooding in 2008, 2010, and 2014]
- L & H Investments (Property 29) [for flooding in 2008, 2010, 2013, and 2014]
- Garst Farms, Inc., Charles L. Garst Living Trust, and Charles and Connie Garst (Property 30) [for flooding in 2007, 2008, and 2010]
- Ideker Farms, Inc. (Property 33) [for flooding in 2007, 2008, 2010, 2013, and 2014]
- Alma Green Trust and Marvin Green (Property 39) [for flooding in 2007, 2010, and 2013]
- Buffalo Hollow Farms, Inc. (Property 41) [for flooding in 2007, 2008, 2010, 2013, and 2014]

- George and Patricia Hildebrandt (Property 44) [for flooding in 2007, 2008, and 2010]

(2) The following plaintiffs have established causation and foreseeability but have not yet established severity. In the next phase of the litigation, these plaintiffs will be required to establish severity in addition to responding to the government's defenses and proving entitlement to just compensation, and if entitlement is established, the appropriate amount:

- Robert L. Roth and BCR Properties Limited Partnership (Property 19) [for flooding in 2008 and 2010]
- Merril Sargent, Deceased and Ron and Dale Sargent (Property 21) [for flooding in 2008 and 2014]
- Roth, Inc., Steven G. Roth and BCR Properties Limited Partnership (Property 22) [for flooding in 2008 and 2010]
- Leo Ettlemen (Property 23) [for flooding in 2008 and 2010]
- KMJ Farms, Inc. and Brian and Kelly Johnson (Property 24) [for flooding in 2007 and 2013]
- Woltemath Farm, Inc., Hi-Tech Farms, Inc., and Robert Woltemath (Property 26) [for flooding in 2008 and 2010]
- Barnes Atchison, MO, LLC and Barnes Holt MO, LLC (Property 28) [for flooding in 2007 and 2010]
- Griffin Farms Partnership (Property 31) [for flooding in 2008 and 2010]
- Edward and Diana Foral (Property 32) [for flooding in 2010 and 2013]
- Steven K. Cunningham Trust and Doris I Cunningham Trust (Property 35) [for flooding in 2008]

- Cunningham Farms, Inc. and Steven Cunningham (Property 38) [for flooding in 2008 and 2010]

- Aaron Luce Farms Co. and Aaron and Kelly Luce (Property 40) [for flooding in 2008 and 2010]

- Scott Rouse and Scott Ryan Rouse Family Trust (Property 42) [for flooding in 2010]

- Lanny and Ramona Frakes (Property 43) [for flooding in 2008 and 2010]

(3) The following plaintiffs have failed to establish causation and therefore their claims are subject to dismissal:

- Karen G. Hogue Trust and Peter and Karen Hogue (Property 1) [for flooding in 2011]

- Peter and Judy Masset (Property 2) [for flooding in 2011]

- Eric Moritz, Southport Marian, LLP, and Capsco Entertainment, LLP d/b/a The Pier Bar and Grill (Property 3) [for flooding in 2011]

- James and Sharon Forney (Property 4) [for flooding in 2011]

- Andersen Family Farms Partnership and Engra Andersen (Property 5) [for flooding in 2011]

- Paul and Debra Dailey (Property 6) [for flooding in 2011]

- Andersen Family Farms Partnership and Bryce L. Andersen (Property 7) [for flooding in 2011]

- Omaha Tribe of Nebraska (Property 8) [for flooding in 2011]

- Tob-Isle, Inc. (Property 9) [for flooding in 2011]

- Richard Archer (Property 10); [for flooding in 2011]

- Scott and Susan Olson and Randy and Patricia Olson (Property 11) [for flooding in 2011 and 2014]

- David and Elizabeth Brainard (Property 12) [for flooding in 2011]

- Dennis and Janis Connealy and Quentin and Jill Connealy (Property 14) [for flooding in 2011]

- Drewes Farms, Inc., Eddie Drewes, David Drewes, Rita K. Drewes Revocable Trust, and Robert W. Drewes Revocable Trust (Property 34) [for flooding in 2007, 2010, and 2011]

- Darwin and Jennifer Binder and Dustin and Jenny Binder, Richard and Karen Binder, and Midwest Grain Company (Property 36) [for flooding in 2007, 2010, and 2011]

- Dennis and Beth Saunders (Property 37) [for flooding in flooding in 2007, 2010, and 2011]

s/Nancy B. Firestone
NANCY B. FIRESTONE
Senior Judge