IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY, AND THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES,

Plaintiffs,

v

LEE MUELLER; BOYCE MICHIGAN, LLC; EDENVILLE HYDRO PROPERTY, LLC; BOYCE HYDRO POWER LLC; BOYCE HYDRO, LLC; WD BOYCE TRUST 2350; WD BOYCE TRUST 3649; AND WD BOYCE TRUST 3650,

Defendants.

No. 1:20-cv-528

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BRIEF IN SUPPORT OF
PLAINTIFFS' MOTION FOR SUMMARY JUDGMENT

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Dated: May 25, 2023

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CONCISE STATEMENT OF ISSUES PRESENTED

1. The doctrine of collateral estoppel directs that a question put in issue and decided by a court of competent jurisdiction cannot be disputed in a subsequent action between the same parties. A state court already issued a final judgment in litigation between the same parties regarding issues that are also present in this case. Does the doctrine of collateral estoppel prevent Boyce Hydro[1] from attempting to relitigate issues in this Court that it already had a full and fair opportunity to litigate in state court?

2. Part 315 of the Michigan Natural Resources and Environmental Protection Act (NREPA) required Boyce Hydro to notify the Michigan Department of Environment, Great Lakes, and Energy (EGLE) of any defects in the Edenville Dam that may affect its safety. Boyce Hydro discovered a defect in 2010, but did not repair it, nor did it notify EGLE of the defect. Did Boyce Hydro violate Part 315?

3. Part 17 of NREPA barred Boyce Hydro from conduct that would pollute, impair, or destroy Michigan's water or other natural resources unless Boyce Hydro could show that there was no feasible and prudent alternative to its conduct and that its conduct was consistent with the public welfare. Here, Boyce Hydro failed to repair a known defect of its dam, and the dam failed in exactly the way Boyce Hydro predicted it would. It could have fixed the defect but chose instead to pursue expensive extracurricular activities unrelated to dam safety. Did Boyce Hydro violate Part 17?

4. Part 31 prohibited Boyce Hydro—without a permit—from filling floodplains or streams; harmfully interfering with the discharge characteristics of a stream; or discharging injurious substances into Michigan's waters. The evidence in this case shows that the failure of Boyce Hydro's dam resulted in all three occurrences. Did Boyce Hydro violate Part 31?

[1] "Boyce Hydro" refers to defendants Boyce Michigan, LLC, Boyce Hydro Power LLC, Boyce Hydro, LLC, WD Boyce Trust 2350, WD Boyce Trust 3649, and WD Boyce Trust 3650.

5. Part 301 prohibited Boyce Hydro—without a permit—from diminishing an inland lake or depositing fill on bottomlands. The evidence in this case shows that the failure of Boyce Hydro's dam resulted in both occurrences. Did Boyce Hydro violate Part 301?

CONTROLLING OR MOST APPROPRIATE AUTHORITY

Authority: *Lopez v. Union Carbide Corp.*, 83 F. Supp. 2d 880, 884 (E.D. Mich. 2000).

Keywell & Rosenfeld v. Bithell, 254 Mich. App. 300, 340, 657 N.W.2d 759, 782 (2002).

Mich. Comp. Laws § 324.31520(1).

Mich. Comp. Laws § 324.1703(1).

Mich. Comp. Laws § 324.3108(1).

Mich. Comp. Laws § 324.3109(1).

Mich. Comp. Laws § 324.30102(1).

INTRODUCTION

The Edenville Dam was private property. It was regulated by the Federal Energy Regulatory Commission (FERC) until FERC walked away in September 2018. Boyce Hydro—which was controlled by Lee Mueller—owned the dam and is responsible for the May 19, 2020 failure of the dam's east embankment. In emails that Mr. Mueller tried to keep secret, Boyce Hydro acknowledged that it knew by 2010 that the east embankment could fail if the water level behind it got too high. But Boyce Hydro apparently never divulged that information to FERC, nor did it share that information with Michigan after September 2018 once the dam fell under state jurisdiction. Boyce Hydro did not repair the defect in the dam. It could have installed an upstream sheet pile cutoff wall on the east embankment; constructed a downstream buttress on the east embankment just as it did on other parts of the dam; or increased the dam's spillway capacity just as it promised federal regulators it would do. Any of those things would likely have prevented the failure of the east embankment. But Boyce Hydro did none of them. Instead, Boyce Hydro spent its time and money on non-dam-safety related projects, such as attempting to hold a music festival, designing a marina and RV park, operating a sawmill, and trying to develop a residential neighborhood. Its dam safety engineer finally resigned in protest in 2017 when he saw that Boyce Hydro was not willing to prioritize key dam safety issues. Boyce Hydro's neglect of the east embankment of the dam led to the embankment's failure, which resulted in the tragic flooding of downstream properties and massive destruction of Michigan's natural resources.

STATEMENT OF FACTS

Boyce Hydro recognized that the eastern end of the embankment was at risk of failure but did not address the problem.

Boyce Hydro took control of the Edenville Dam in 2006. (Ex. A, Lee Mueller Tr, 10:16.) From that time until the dam's eastern embankment failed in May 2020, Boyce Hydro was controlled by Lee Mueller, and Mr. Mueller was the person who acted for Boyce Hydro. (First Amend. Compl., ¶¶ 16–18, PageID.2522–2523; Ex. B, 3/8/2023 State Court Judgment, ¶ 4; Ex. C, 3/3/2021 Bankruptcy Signature Page; Ex. D, 2/5/2020 Email Confirming Lee Mueller and Boyce Hydro Control; Ex. E, Letters from Lee Mueller designating Boyce Hydro's agents.)

Shortly before Boyce Hydro took control of the dam, its previous owner in 2004 had constructed overlays on the downstream side of two areas of the dam's embankment to strengthen the embankment. (Ex. 1 to Ex. A Lee Mueller Tr, Dam Modifications; Ex. A, Lee Muller Tr., 27:8–28:6.) And then Boyce Hydro, in 2007, performed an additional construction project on another area of the downstream side of the dam to further strengthen the dam's embankment. (*Id.*)

In 2010, Boyce Hydro held a meeting which included Mr. Mueller, Frank Christie (Boyce Hydro's dam safety engineer), and a consultant named Steve Doret. (Ex. 2 to Ex. A, Mueller Tr., 11/17/2021 Email.) In the meeting, Mr. Mueller "expressed concern" that the east embankment of the dam was "far too narrow and the side slopes too steep," such that it was "not particularly conducive to withstanding the hydrostatic pressures of an elevated pond in the extreme flood conditions." (*Id.*) Mr. Christie and Mr. Doret "agreed" with Mr. Mueller. (*Id.*) To

address this concern, in October 2012, Mr. Mueller and Mr. Christie came up with plan to "install sheet piling from the very east end of the Edenville Dam all the way . . . to the existing concrete spillways" on the upstream side of the dam. (Ex. A, Lee Mueller Tr., 24:24–25:19.) The purpose was to, among other things, create "a cut off wall . . . for water flow." (*Id*.) The project would have been the first phase of a multi-phase project to also replace the concrete spillways on the dam. (Ex. A, Lee Mueller Tr, 31:21–34:12; Ex. 3 to Ex. A Lee Mueller Tr, October 2012 Plan.)

Boyce Hydro did not carry out its October 2012 plan to install the upstream sheet pile cut off wall on the east embankment. Mr. Mueller testified that even if Boyce Hydro did not carry out its full multi-phase construction plan to replace the concrete spillways, it "absolutely" could still have carried out the first phase of the plan and installed the upstream sheet pile wall on the east end of the embankment. (Ex. A, Lee Mueller Tr., 33:8–34:12.) Mr. Mueller acknowledged that Boyce Hydro believed that part of the embankment might fail if there was "an elevated pond." (Ex. A, Lee Mueller Tr, 34:5–34:12.) But Boyce Hydro did not install the sheet pile wall, apparently because the Federal Energy Regulatory Commission (FERC) did not explicitly order it to do so. (Ex. A, Lee Mueller Tr., 33:18–33:24.) There is no indication in the record that Mr. Mueller informed FERC of Boyce Hydro's concerns about the ability of the eastern embankment to withstand an elevated water level.

In 2012, Boyce Hydro constructed an embankment overlay on the downstream side of the *western* end of the embankment, and in 2014, it placed additional "buttress fill" in that same location. (Ex. 1 to Ex. A Lee Mueller Tr, Dam

Modifications.) But Boyce Hydro did not do anything to strengthen the *east* end of the embankment that it recognized might fail in the event of an elevated water level.

Boyce Hydro spent significant time and money on projects unrelated to operating a hydroelectric dam.

Boyce Hydro did find time and significant resources to perform side projects unrelated to the operation of a hydroelectric dam. Mr. Christie, Boyce Hydro's dam safety engineer and chief operator, testified that by the time Boyce Hydro took over the Edenville Dam, "FERC was concerned" that so much time had passed "without anybody doing anything to try to increase the [spillway] capacities," and he told Mr. Mueller that "we got to start showing some action here." (Ex. F, Christie Tr., 40:22–42:21.) Mr. Mueller testified that he believed Mr. Christie was "truthful" and that he trusted Mr. Christie "implicitly." (Ex. A, Lee Mueller Tr, 23:19–23.) But instead of adopting Mr. Christie's recommendations, Boyce Hydro "delayed the whole process" because Mr. Mueller had "developed a grandiose plan" of cutting into the Edenville Dam's embankment to create "a huge marina" to serve as a "cash project for . . . Boyce Hydro." (Ex. F, Christie Tr., 40:22–42:21.) Mr. Christie tried to talk Mr. Mueller out of it, explaining that digging a marina into an earthen embankment would "introduce some serious concerns about dam failure," but Mr. Mueller insisted on repeatedly taking it to FERC, which finally shut down the idea. (*Id.*) The "marina" idea delayed the capacity increase efforts "for a year or two." (*Id.*)

Shortly after the marina idea was rejected by FERC, in about 2008, Boyce Hydro "spent almost a half a million dollars trying to put on a music festival" at the Edenville Dam. (Ex. F, Christie Tr, 56:9–13; 59:17–20.) Mr. Christie noted that he "could've built the [interim] spillway" he had designed with that kind of money. (Ex. F, Christie Tr, 80:12–14.)

By 2015, Mr. Christie had spent "about a year" with Boyce Hydro developing plans to construct an "interim spillway" that "would pass some significant flow," and the "board of consultants had signed off on it," and the project was "ready to start construction in 2015." (Ex. F, Christie Tr, 11:6–13:18.) But then at the last minute, Boyce Hydro changed the design because Mr. Mueller also wanted to build "a large travel trailer park on the dam." (*Id.*) Boyce Hydro came up with an "overwhelming" design that stymied the project, dramatically increased its cost, and further delayed the effort to increase the dam's spillway capacity. (*Id.*) Mr. Christie at that point refused to be the "project manager" for the project, telling Mr. Mueller: "this is your design, I don't agree with it, and I'm not going to do any more design work for you. If you want to build this, you run it." (Ex. F, Christie Tr, 78:8–20; 88:6–14.)

Mr. Christie observed that Boyce Hydro routinely pursued expensive endeavors unrelated to the operation of the dam. He testified that Boyce Hydro purchased "a $50,000 sawmill" just so it could cut lumber for a short period of time. (Ex. F, Christie Tr, 56:9–60:5.) Boyce Hydro also purchased "dump trucks and [a] bulldozer and skid steers and backhoes," and built a "very nice pole barn to keep

them in." (*Id.*) Boyce Hydro was regularly "building roads and cutting trees and regrading areas," including building a new and unnecessary "parking lot" and performing "a lot of earth moving," all of which cost "a lot of money." (*Id.*) Mr. Christie and "the guys that were operating the facilities" expressed concerns to one another, wondering "Why are we doing all this construction work?" (*Id.*) Mr. Christie testified that "everyone that worked there, you know, were just kind of shaking their heads. 'Why are we putting on a music festival? Why are we building these roads and doing all this logging on some of the property we got?'" (Ex. F, Christie Tr., 93:4–11.) Mr. Christie tried to explain to Mr. Mueller that "You're in the hydro business now, you got to pay attention here," and "concentrate on being in the hydro business, you got to pay attention to FERC." (Ex. F, Christie Tr, 57:22–60:5.) Mr. Mueller replied that "I'm not in the hydro business . . . I'm in the money-making business." (*Id.*)

Mr. Christie finally hit his "tipping point" in 2017 and resigned his position. (Ex. F, Christie Tr., 87:5–93:3.) Boyce Hydro "owned 11 or 12 acres at Smallwood" and "wanted to dig a huge pond in the middle of that 12 acres, construct a canal going out into the impoundment . . . and then develop a subdivision around that," even though the "property was 30 feet above the lake level." (Ex. F, Christie Tr., 14:2–12; 58:22–59:16.) The project was unrelated to hydroelectric operations, yet Boyce Hydro was using Boyce Hydro staff to perform the construction. (*Id.*) In the meantime, Mr. Christie had identified a "major problem" with hydroelectric operations related to a gate at the Sanford Dam that needed immediate repair over

the winter of 2016–2017. (Ex. F, Christie Tr., 90–91.) Mr. Christie had lined up the work tasks and helped arrange to obtain the materials to perform the work. (*Id.*) Each time Mr. Christie visited the site over the winter, there was no sign Boyce Hydro was working on the Sanford gate. Instead, "every time I went back, they were digging this pond up at . . . Smallwood, and trying to get down deep enough to dig a channel to the pond." (Ex. F, Christie Tr, 92:1–10.) Mr. Christie determined "'This is it.' I said, 'Enough problems. I mean there are a bazillion problems around here, but if they're not going to address the immediate concerns, I'm done.'" (*Id.*) Mr. Christie resigned in May 2017. (Ex. F, Christie Tr., 87:5.)

FERC revoked Boyce Hydro's license to generate electricity at the Edenville Dam on September 10, 2018, noting among other things, Boyce Hydro's refusal to spend its money on actually increasing the spillway capacity of the dam, rather than just planning for it. 164 FERC ¶ 61,178, at *1–*4. FERC noted that Boyce Hydro "refused to provide basic information regarding its financial resources," and therefore had "not substantiated its claims regarding financial hardship with evidence." 164 FERC ¶ 61,178, at *12.

The eastern end of the embankment that Boyce Hydro thought would fail did fail.

Once FERC revoked Boyce Hydro's license to generate electricity, the Edenville Dam fell under the jurisdiction of EGLE—just like more than 1,000 other dams in Michigan. Mr. Mueller did not believe that Michigan law required Boyce Hydro to take any action to increase the spillway capacity of the Edenville Dam.

(Ex. B, State Court Judgment, ¶ 7.) Consistent with that belief, Mr. Mueller never expressed to his employees or to Plaintiffs that Boyce Hydro considered it unsafe to maintain the normal level of Wixom Lake "without first increasing the spillway capacity of the Edenville Dam." (Ex. B, State Court Judgment, ¶¶ 12, 19.) So, when Lee Mueller "lowered Wixom Lake more than three feet below its normal level beginning in November 2019," it was not because he "believed that it would be unsafe to maintain the normal level of Wixom Lake without increasing the spillway capacity of the Edenville Dam." (Ex. B, State Court Judgment, ¶ 14.) It was because he "thought doing so would be a more effective way of managing ice buildup over the winter months." (*Id.*) Boyce Hydro always intended "to return Wixom Lake to its normal level in the spring of 2020." (Ex. B, State Court Judgment, ¶ 15.) And Boyce Hydro did so on May 4, 2020. (Ex. B, State Court Judgment, ¶ 18.)

On May 19, 2020, after a multi-day rainstorm raised the level of Wixom Lake to a record level, the east end of the Edenville Dam's embankment failed due to "static liquefaction." (5/4/2022 Report, PageID.3581.) Essentially, loose soil within the east embankment became so saturated with water that it lost integrity and acted like a liquid instead of a solid. (Ex. F., Dr. Olson Declaration, ¶ 1.) The water in the reservoir did not run over the top of the Edenville Dam—the dam's spillways were still passing enough water to keep that from happening. (5/4/2022 Report, PageID.3584; Ex. F, Olson Report, at 3.) But the water level rose to a high enough level for a long enough period of time that it triggered the liquefaction within the soils of the east, or "left," embankment. (Ex. F, Olson Report, at 3–5.) Mr. Mueller

confirmed that the section of the east embankment that failed was the section of the embankment that Boyce Hydro identified in 2010 as potentially not being able to withstand the pressure of an elevated water level. (Ex. A, Lee Mueller Tr, 28:7–28:15 and Ex. 1 to Mueller Tr., Dam Modifications (with highlighted circle in bottom right).)

The failure of the east embankment of the Edenville Dam sent a gush of water downstream that overwhelmed the Sanford Dam, also causing water to overtop its embankment. (PageID.3581.) FERC issued an emergency order requiring Boyce Hydro to "fully lower" the reservoir behind the Sanford Dam. (Ex. G, 5/20/2020 FERC Order.)

The dramatic loss of water from Wixom Lake behind the Edenville Dam, and the loss of water behind the Sanford Dam, effectively destroyed the Village of Sanford and flooded hundreds of homes and other buildings, causing a devastating impact on the people in the community. (First Amend. Comp. ¶ 83, PageID.2543; Ex. L, Matousek Declaration, ¶¶ 7, 9, 14; Ex. M, Brooks Declaration, ¶¶ 7, 9–11.) Fortunately, there "were no fatalities or serious injuries" to people. (5/4/2022 Report, PageID.3590–3591.) But that is because the Midland County emergency manager did not follow Boyce Hydro's "inconsistent and contradictory" emergency action plan. (*Id.*) Had the emergency manager "strictly" followed Boyce Hydro's plan, "it is entirely possible that lives would have been lost." (*Id.*)

The failure of the east embankment of the Edenville Dam also caused significant natural resource damage. It caused approximately $21 million in

damages to the fishery (Ex. H, Jolley Report, at 1), and approximately $91 million in damages to the freshwater mussel ecosystem (Ex. I, Gulotty Report, at 17). The "deluge" from the failure "also washed large amounts of potentially contaminated sediments, debris, garbage, and other harmful substances into the waters of the State, regulated bottomlands, regulated floodplains, and . . . regulated wetlands." (First Amend. Comp. ¶ 84, PageID.2543; Ex. L, Matousek Declaration; Ex. M, Brooks Declaration.)

Boyce Hydro could have prevented the failure of the east embankment of the Edenville Dam.

As the Court is already aware, both FERC and EGLE ordered Boyce Hydro to hire a team of independent engineers to investigate the failure of the Edenville Dam. (8/26/2022 Order, PageID.4422–4426.) Boyce Hydro selected the engineers, and believed they were "competent and qualified in their fields." (Ex. A, Lee Mueller Tr, 8:20–10:10.) The only reason that FERC ended up paying them for their work is because Boyce Hydro would not do so. (8/26/2022 Order, PageID.4422.) Once the team of engineers began their work, they became known as the Independent Forensic Team (Team). Mr. Mueller explained that he regularly provided the Team with "truthful" information, that he was "candid and forthcoming" with them and "at no time" did he provide them with "incorrect or untruthful information." (Ex. A, Lee Mueller Tr., 9:2–10:10.)

As explained above, as early as 2010, Mr. Mueller acknowledged that Boyce Hydro believed the east embankment might fail if there was "an elevated pond."

(Ex. A, Lee Mueller Tr, 34:5–34:12.) The letter describing this meeting is one of the letters Mr. Mueller sent to the Team. (Ex. 2 to Ex. A, Mueller Tr, 11/17/2021 Email.) Boyce Hydro developed a plan to "install sheet piling from the very east end of the Edenville Dam all the way . . . to the existing concrete spillways" on the upstream side of the dam. (Ex. A, Lee Mueller Tr, 24:24–25:19.) The purpose was to, among other things, create "a cut off wall . . . for water flow." (*Id.*) If Boyce Hydro had done so, the "cutoff wall" would have "reduce[d] and slow[ed] seepage through the embankment and any natural foundation sands present above the hardpan, particularly under the transient increases in reservoir water level during the May 2020 flood." (Ex. F, Olson Report, at 6.) According to Dr. Olson, "the sheet pile wall would have been more likely than not to have prevented the failure" of the Edenville Dam. (*Id.*)

But installing the sheet pile wall on the upstream side of the east embankment was not the only way Boyce Hydro could have prevented the dam failure. "Any effort to reduce the static shear stresses in the downstream slope would have decreased the potential for triggering static liquefaction." (Ex. F, Olson Report, at 5.) Dr. Olson reviewed the Team's report, in which the Team concluded that strengthening the downstream embankment would have prevented the dam failure and agreed that "constructing a downstream buttress (i.e., stabilizing berm) similar to that constructed in other areas of the Edenville embankment . . . would have prevented static liquefaction failure . . . to a reasonable degree of certainty." (Ex. F, Olson Report, at 5–6.) The Team even concluded that there was no question

that Boyce Hydro "would have been able to afford" that type of buttressing, since it had performed that type of work on other parts of the embankment. (5/4/2022 Report, PageID.3581.)

Dr. Olson also agreed with the Team's conclusion that if Boyce Hydro would have installed "an upgraded spillway system designed to handle the probable maximum flood," it "would have limited reservoir water levels to elevations lower than historical highwater levels . . . and would have prevented the May 19, 2020, static liquefaction flow failure." (Ex. F, Olson Report, at 5.) Boyce Hydro spent "over 14 years" promising FERC that it would install such a system, but never did so. *Order Revoking License,*164 FERC ¶ 61,178 (September 10, 2018), at *1–*4.

Notably, the Team also examined potential actions Boyce Hydro could have taken that *would not* have prevented the failure. (5/4/2022 Report, PageID.3665–3667; Ex. K, Trumble Report.) For example, the Team considered whether it would have made a difference if Boyce Hydro had kept Wixom Lake at its winter 2019/2020 level. (Ex. K, Trumble Report, at 3–6.) As explained above, Boyce Hydro did not actually consider that option because it had always planned to return Wixom Lake to its normal level by spring 2020 and did so by May 4, 2020. (Ex. B, State Court Judgment, ¶¶ 15, 18.) But *even if* Boyce Hydro had kept the water at its winter 2019/2020 level, the Team concluded that it "would have resulted in less than 0.2 feet difference in the peak leak level," so it was "unlikely to have prevented the failures." (Ex. K, Trumble Report, at 4, referring to 5/4/2022 Report, PageID.3667, PageID.6730.) In other words, "if the lake had been kept lower by

this amount until the May 2020 flood occurred, the effect on the lake level on May 19, by itself, would very likely have been too small to prevent the dam failure." (Ex. K, Trumble Report, at 4, referring to 5/4/2022 Report, PageID.3667, PageID.6730.)

LEGAL STANDARD

The Court "shall grant summary judgment if the movant shows that there is no genuine dispute as to any material fact and the movant is entitled to judgment as a matter of law." Fed. R. Civ. P. 56(a). Because Plaintiffs are moving for summary disposition on their claims for which they have the burden of persuasion, to show that they are entitled to judgment as a matter of law, they "must show that the record contains evidence satisfying the burden of persuasion and that the evidence is so powerful that no reasonable [fact finder] would be free to disbelieve it." *Surles v. Andison*, 678 F.3d 452, 455 (6th Cir. 2012) (citation omitted). To support their claims, Plaintiffs must cite "to particular parts of materials in the record, including depositions, documents, electronically stored information, affidavits or declarations, stipulations (including those made for purposes of the motion only), admissions, interrogatory answers, or other materials." Fed. R. Civ. P. 56(c)(1)(A).

If Boyce Hydro wishes to instead go to trial on the claims, it also must either cite to "particular parts" of the record to demonstrate that there is a genuine dispute that needs to be tried or show that a trial is needed because "the materials cited" by Plaintiffs "do not establish the absence . . . of a genuine dispute." Fed. R. Civ. P. 56(C)(1). Boyce Hydro cannot merely point to its answer. *Anderson v.*

Liberty Lobby, Inc., 477 U.S. 242, 248 (1986). Instead, it must present "significant probative evidence" to show that "there is [more than] some metaphysical doubt as to the material facts." *Moore v. Philip Morris Cos.*, 8 F.3d 335, 339–40 (6th Cir. 1993).

Importantly, at the motion stage, the "material" cited by Plaintiffs "may be presented in a form that would not, in itself, be admissible at trial." 10A Fed. Prac. & Proc. Civ. § 2722 (4th ed.), *citing Lee v. Offshore Logistical & Transp., L.L.C.*, 859 F.3d 353, 355 (5th Cir. 2017), as revised (July 5, 2017). So, it is not enough for Boyce Hydro to simply argue that the materials in the record cited by Plaintiffs may not be in an admissible *form*. The question for the Court is only whether the material *could* "be presented in a form that would be admissible" if there were a trial. Fed. R. Civ. P. 56(c)(2). *See also Lee*, 859 F.3d at 355; *Jones v. UPS Ground Freight*, 683 F.3d 1283, 1293–94 (11th Cir. 2012) (despite the "general rule" that "inadmissible hearsay cannot be considered on a motion for summary judgment," a "district court may consider a hearsay statement in passing on a motion for summary judgment if the statement could be reduced to admissible evidence at trial or reduced to admissible form") (citations omitted).

ARGUMENT

I. Boyce Hydro is barred from relitigating issues resolved by a final judgment in state court.

The doctrine of collateral estoppel dictates that a "question that is put in issue and decided by a court of competent jurisdiction cannot be disputed in a subsequent action between the same parties, even if the subsequent suit alleges a different cause of action." *Lopez v. Union Carbide Corp.*, 83 F. Supp. 2d 880, 884 (E.D. Mich. 2000). When the doctrine is asserted in federal court and the prior judgment was from a state court, "federal courts must apply the preclusion law of the state in which that prior judgment was rendered." *Id.* (citation omitted).

Here, the parties were also parties to a state court case. (Ex. B, State Court Judgment.) Plaintiffs moved for summary disposition in that case as to 19 discrete issues, arguing that they were not genuinely in dispute. (*Id.*) Plaintiffs attached 41 exhibits to their motion in the state court, including deposition transcripts and many other types of evidence. In response, Boyce Hydro did not attach a single exhibit or even cite to any evidence in the record, nor did they argue that a trial on any of the issues was necessary. The state court held two hearings on Plaintiffs' motion and entered a final judgment against Boyce Hydro on March 8, 2023. (Ex. B, State Court Judgment.)

There is no need for this Court to reexamine the 41 exhibits Plaintiffs presented in state court to which Boyce Hydro had no response. In Michigan, the doctrine of collateral estoppel applies to prevent "relitigation of an issue in a subsequent, different cause of action between the same parties when the prior

proceeding culminated in a valid final judgment and the issue was actually and necessarily determined in the prior proceeding." *Keywell & Rosenfeld v. Bithell*, 254 Mich. App. 300, 340, 657 N.W.2d 759, 782 (2002) (citations omitted). The "previous litigation must have presented a full and fair opportunity to litigate the issue presented in the subsequent case." *Id.* (citations omitted). And when the doctrine is asserted offensively, as here, there must not only be "mutuality"—which is that the person invoking the doctrine would have been bound by the previous judgment if it had gone against them—but the parties in the two lawsuits must be "identical." *Knoblauch v. Kenyon*, 163 Mich. App. 712, 720, 415 N.W.2d 286, 290 (1987).

Each of the elements are satisfied here. There is mutuality and the parties are identical. Boyce Hydro had a full opportunity to respond to Plaintiffs' motion and make arguments in two different hearings. And the issues identified in the Statement of Facts section above are identical to several of the issues in this litigation, including when and why Boyce Hydro changed the levels of Wixom Lake leading up to the failure of the dam. Boyce Hydro is barred from trying to relitigate the issues in this Court. This is precisely the situation in which the doctrine of collateral estoppel should apply. Applying it here will not only "relieve parties of multiple litigation," but it will "conserve judicial resources, and, by preventing inconsistent decisions, encourage reliance on adjudication." *Keywell*, 254 Mich. App. at 341.

II. Boyce Hydro is responsible for the failure of its dam, which resulted in the violation of multiple environmental laws.

Michigan's Natural Resources and Environmental Protection Act (NREPA) contains dozens of parts, and as explained below, Boyce Hydro violated many of them.

A. Boyce Hydro violated Part 315 of NREPA (Dam Safety).

Part 315 of NREPA governs the construction, operation, or alteration of dams in Michigan. Mich. Comp. Laws § 324.31501 *et seq*. It does not apply to a dam that is regulated by FERC. Mich. Comp. Laws § 324.31506(2)(a). But as noted above, FERC revoked Boyce Hydro's license, which means that approximately 20 months before the dam's failure, it became one of the more than 1,000 other dams in Michigan regulated by EGLE. Boyce Hydro, therefore, had an obligation to comply with Part 315, which required it to "advise [EGLE] and the affected off-site public authorities and safety agencies of any . . . unusual or alarming circumstance or occurrence existing or anticipated that may affect the safety of the dam . . . ." Mich. Comp. Laws § 324.31520(1). It did not do so.

As explained above, Boyce Hydro knew for at least 10 years before its dam failed that the part of the dam that failed was susceptible to failure if lake levels got too high. (Ex. 2 to Ex. A, Mueller Tr, 11/17/2021 Email.) That is exactly what happened. (Ex. A, Lee Mueller Tr, 28:7–28:15 and Ex. 1 to Mueller Tr., Dam Modifications (with highlighted circle in bottom right).) Boyce Hydro designed a sheet pile cutoff wall to address the problem. (Ex. A, Lee Mueller Tr, 24:24–25:19.) And Boyce Hydro admits that it "absolutely" could have installed the sheet pile

cutoff wall. (Ex. A, Lee Mueller Tr, 33:8–34:12.) But it did not do so because FERC did not explicitly order it to do so. (*Id*.) There is no evidence Boyce Hydro informed FERC of the defect. Regardless, Mr. Mueller acknowledges that Boyce Hydro believed the east embankment might fail. (Ex. A, Lee Mueller Tr, 34:5–34:12.) If Boyce Hydro had installed the sheet pile cutoff wall it designed, Dr. Olson opined that it would "more likely than not" have prevented the failure of the embankment. (Ex. F, Olson Report, at 6.)

As explained in the Statement of Facts section, Boyce Hydro also could have prevented the failure of the Edenville Dam by either strengthening the downstream side of the eastern embankment or constructing the spillway project that it promised FERC for 14 years it would construct. It simply chose not to do either of those projects. Instead, Boyce Hydro wasted its time and resources on a failed music festival, unneeded sawmill, extracurricular construction projects, ill-fated plans to transform its dam into a marina or RV park, and—the final straw for its long-serving dam safety engineer—trying to dig a pond for a housing subdivision rather than fix a critical safety defect on one of its dams. (Pages 4–13 above.)

Boyce Hydro did not share with EGLE its concern that the east embankment might fail or explain its plan to install the cutoff wall to address the problem. It kept that concern to itself, never installed the cutoff wall, nor did it take any other action to strengthen the east embankment. That was a violation of Part 315. Had Boyce Hydro shared its concern with EGLE as Part 315 required and if Boyce Hydro was not willing to take "the required remedial action" on its own initiative, EGLE

could have ordered it to do so. Mich. Comp. Laws § 324.31524(2). But EGLE could not act on information that Boyce Hydro unlawfully withheld. There is no genuine dispute about whether Boyce Hydro withheld from EGLE and others information that Part 315 required it to divulge. Mich. Comp. Law § 324.31520(1)

B. Boyce Hydro violated Part 17 of NREPA (Environmental Protection).

Part 17 of NREPA authorizes a suit "for declaratory and equitable relief against any person for the protection of the air, water, and other natural resources and the public trust in these resources from pollution, impairment, or destruction." Mich. Comp. Laws § 324.1701(1). Once Plaintiffs, as they have done here, show "that the conduct of the defendant has polluted, impaired, or destroyed . . . the . . . water, or other natural resources or the public trust in these resources," Mich. Comp. Laws 324.1703(1), the "court shall adjudicate the impact of the defendant's conduct on the . . . water, or other natural resources, and on the public trust in these resources, in accordance with this part." Mich. Comp. Laws § 324.1704(3).

Boyce Hydro could, of course, submit "evidence to the contrary," to try to show that its conduct has *not* caused massive harm to Michigan's public resources. Mich. Comp. Laws § 324.1703(1). But it has no evidence of that nature to submit. It did not identify any experts or provide any expert reports. And the evidence against Boyce Hydro is overwhelming.

Even so, Boyce Hydro could perhaps try to "show, by way of an affirmative defense, that there is no feasible and prudent alternative to [its] conduct," and that

Boyce Hydro's "conduct [was] consistent with the promotion of the public health, safety, and welfare in light of the state's paramount concern for the protection of its natural resources from pollution, impairment, or destruction." Mich. Comp. Laws § 324.1703(1). Perhaps that is the affirmative defense Boyce Hydro had in mind in its answer, when it asserted that it "acted in good faith and had a reasonable belief that [it was] not in violation of any natural resources law." (PageID.2688.) But there is no way Boyce Hydro can successfully support that affirmative defense.

As explained in detail above, there *was* a "feasible and prudent alternative" to ignoring the problem with the dam's eastern embankment that Boyce Hydro first identified in 2010: *Boyce Hydro could have fixed the problem*. It could have installed the upstream cutoff wall, it could have constructed a downstream buttress, or it even could have constructed the spillways that it promised FERC for over 14 years that it would construct. There is no way Boyce Hydro could show that *failing* to select any of these alternatives, and instead ignoring the problem with the east embankment of its dam, was "consistent with the promotion of the public health, safety, and welfare." Mich. Comp. Laws § 324.1703(1).

There is no genuine dispute as to whether Boyce Hydro's conduct polluted, impaired, or destroyed Michigan's "water, or other natural resources or the public trust in these resources." Mich. Comp. Laws § 324.1703(1). The Court, therefore, should enter an order under § 324.1704(3) declaring that Boyce Hydro is, in fact, responsible for the impacts on Michigan's natural resources, including those documented in Exhibit L.

C. Boyce Hydro violated Part 31 of NREPA (Water Resources).

Part 31 is aimed at protecting water resources in general and provides for both civil and criminal penalties. Mich. Comp. Laws § 324.3115. Boyce Hydro has violated it in at least three ways.

First, a person cannot "fill or grade or permit the filling or grading [of] . . . a floodplain, stream bed, or channel of a stream" without a permit. Mich. Comp. Laws § 324.3108(1). As explained above, Boyce Hydro is responsible for the failure of its dam, and that failure caused the filling of stream beds, floodplains, and stream channels. (Ex. L, Matousek Declaration, ¶¶ 7, 10; Ex. M, Brooks Declaration, ¶¶ 7, 8, 12.)

Second, without a permit, a person cannot "undertake or engage in an activity on or with respect to land that is determined by the department to interfere harmfully with the discharge or stage characteristics of a stream." Mich. Comp. Laws § 324.3108(1). The failure of Boyce Hydro's dam interfered harmfully with the discharge characteristics of the Tobacco and Tittabawassee Rivers and many of their tributaries. (Ex. L, Matousek Declaration, ¶¶ 7, 10, 11, 13; Ex. M, Brooks Declaration, ¶¶ 7, 12.)

Finally, without a permit, a person cannot "directly or indirectly discharge" a "substance that is or may become injurious . . . into the waters of the state." Mich. Comp. Laws § 324.3109(1). A substance is "injurious" if it impairs "the public health, safety, or welfare," the "value of riparian lands," the "commercial [or] recreational" use of the waters, the welfare of "wild animals, birds, fish, aquatic life, or plants," or the "value of fish and game." *Id.* Plainly, as documented above, Boyce

Hydro has discharged injurious substances into the waters of the state. Not only did the failure of their dam injure the value of fish and aquatic life, but it also dramatically impaired the recreational value of Wixom and Sanford Lakes, it harmed the value of the riparian lands bordering Wixom and Sanford Lakes, and the deluge endangered the public's health and safety. (Ex. H, Jolley Report; Ex. I, Gulotty Report; Ex. L, Matousek Declaration, ¶¶ 7–11, 14; Ex. M, Brooks Declaration, ¶¶ 7, 10, 12; First Amend. Comp. ¶¶ 82–93, PageID.2542–2545.)

D. Boyce Hydro violated Part 301 of NREPA (Inland Lakes and Streams).

Part 301 protects the integrity of inland lakes and streams. Inland lakes include not only naturally formed lakes, but impoundments, such as Wixom and Sanford Lakes. Mich. Comp. Laws § 324.30101(i). A person cannot "diminish an inland lake or stream" without a permit. Mich. Comp. Laws § 324.30102(1)(d). Nor can a person "fill bottomland" without a permit. Mich. Comp. Laws § 324.30102(1)(a). Bottomland is "the land area of an inland lake or stream that lies below the ordinary high-water mark." Mich. Comp. Laws § 324.30101(a). As demonstrated above, Boyce Hydro plainly did both. Boyce Hydro's dam—which it controlled—dramatically diminished Wixom Lake without a permit. (Ex. L, Matousek Declaration, ¶¶ 7, 8, 12–14; Ex. M, Brooks Declaration, ¶ 10; 5/4/2022 Report, PageID.3619–3639; First Amend. Comp. ¶¶ 82–93, PageID.2542–2545.) And the deluge from the failure of Boyce Hydro's dam deposited a large amount of unauthorized material on bottomland of both Sanford Lake and other water bodies

downstream of the Edenville Dam. (Ex. L, Matousek Declaration, ¶¶ 7, 8, 10, 11; Ex. M, Brooks Declaration, ¶¶ 7, 8, 10, 12.)

CONCLUSION AND RELIEF REQUESTED

Boyce Hydro is responsible for one of the worst dam failure disasters in Michigan history. It could have prevented the failure of its dam, but it was too distracted pursuing non-dam-safety-related ventures to strengthen the east embankment of the dam that failed—the very area it identified as a weak point as far back as 2010. This was an entirely preventable disaster if Boyce Hydro had focused its time and resources in a responsible manner.

Plaintiffs request that the Court enter an order under 28 U.S.C. § 2201(1) that declares the following:

1. Boyce Hydro owned and controlled the Edenville Dam beginning in 2006, and up to and including the date its east embankment failed on May 19, 2020.
2. Boyce Hydro violated Part 315 of NREPA because it was aware of a defect in the east embankment of the Edenville Dam that could affect the safety of the dam, but it neither divulged that information to EGLE nor repaired the defect.
3. Boyce Hydro violated Part 17 of NREPA because its conduct of not repairing the defect in the east embankment of its dam caused the pollution and destruction of Michigan's natural resources, and it had

feasible and prudent alternatives to its conduct: it could have repaired the defect.

4. Boyce Hydro violated Part 31 of NREPA by filling or allowing the filling of stream beds, floodplains, and stream channels; harmfully interfering with the discharge characteristics of the Tobacco and Tittabawassee Rivers and many of their tributaries; and discharging injurious substances into the waters of the state—all without a permit.
5. Boyce Hydro violated Part 301 of NREPA by diminishing Wixom Lake without a permit and depositing unauthorized material on bottomland of both Sanford Lake and other water bodies downstream of the Edenville Dam—all without a permit.

Despite Boyce Hydro's shocking culpability, Plaintiffs recognize that the bankruptcy plan confirmed by the U.S. Bankruptcy Court for the Eastern District of Michigan prevents Plaintiffs from pursuing the substantial civil fines available under NREPA, or other damages, against Boyce Hydro. Accordingly, Plaintiffs request that once it enters the declaratory relief requested by Plaintiffs, the Court determine under Rule 54(b) that there is no just reason for delay, and make its declaratory judgment final as to Boyce Michigan, LLC, Boyce Hydro Power LLC, Boyce Hydro, LLC, WD Boyce Trust 2350, WD Boyce Trust 3649, and WD Boyce Trust 3650.

Respectfully submitted,

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Dated: May 25, 2023

LF: Dam-Mueller, Boyce Hydro (EGLE & DNR v)/AG# 2020-0291918-C-L/Plaintiffs' Brief in Support of Motion for Summary Judgment 2023-05-25

CERTIFICATE OF COMPLIANCE

As required by LCivR 7.2(b)(ii), the number of words in this brief as defined by LCivR 7.2(b)(i) is 6,548. The brief was prepared using Microsoft Word for Office 365.

Respectfully submitted,

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Dated: May 25, 2023

STATE OF MICHIGAN

CIRCUIT COURT FOR THE 30TH JUDICIAL CIRCUIT

INGHAM COUNTY

THE DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY and THE DEPARTMENT OF NATURAL RESOURCES,

Plaintiffs,

v File No. 22-255-CE

HON. WANDA M. STOKES

LEE MUELLER; BOYCE MICHIGAN, LLC; EDENVILLE HYDRO PROPERTY, LLC; BOYCE HYDRO POWER LLC; BOYCE HYDRO, LLC; WD BOYCE TRUST 2350; WD BOYCE TRUST 3649; WD BOYCE TRUST 3650; STEPHEN B. HULTBERG; and MICHELE G. MUELLER,

Defendants.

/

VIDEO CONFERENCE VIDEO DEPOSITION OF LEE MUELLER

Taken by the Plaintiffs on the 27th day of October, 2022, via Zoom, at 11:00 a.m.

APPEARANCES:

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Appearing in Pro Per:	MR. LEE MUELLER 5190 South Conquistador Street Las Vegas, Nevada 89148
Also Present:	Aaron Martinez
RECORDED BY:	Lori Johnston, CER 15628 Certified Electronic Recorder Network Reporting Corporation Firm Registration Number 8151 1-800-632-2720

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possible as we move through some of this information.

LEE MUELLER

having been called by the Plaintiffs and sworn:

DIRECT EXAMINATION

BY MR. GAMBILL:

Q So could you please spell your -- your full name, Mr. Mueller?

A Lee, L-e-e, Worthington, W-o-r-t-h-i-n-g-t-o-n, Mueller, M-u-e-l-l-e-r.

Q And Mr. Mueller, what is your connection to the trust entities that are defendants in this lawsuit?

A I am the -- the co-trustee.

Q Are there other co-trustees?

A At this point, no. I believe that the other co-trustee has resigned.

Q Was that Stephen Hultberg?

A Correct.

Q Before Stephen Hultberg, who was the co-trustee with you?

A Michael d'Avenas.

Q And before Michael, who was it?

A Forgive me, the name escapes me at the moment. If we move on, I'll -- I'll try -- I'll try to remember it.

Q What years approximately was Michael the co-trustee with you?

A He and I both become trustees in 19 -- no, wait a minute. I

became a trustee in 1998. Your -- your forbearance with my memory will pay off -- Carol Biondi, B-i-o-n-d-i, was -- was appointed co-trustee -- family member co-trustee with me in 1998. I believe around 2000, Carol resigned and Michael d'Avenas became -- was appointed as a trustee.

(Mr. Martinez joined deposition)

A **And then in -- around 2007, I believe -- '07 or -- yeah, I think it was 2007 or '08, Stephen Hultberg became a trustee, Michael d'Avenas resigned and Stephen was appointed.**

Q And on a slightly different topic, are you familiar with the Independent Forensic Team that was appointed to investigate the failure of the Edenville and Sanford's Dams?

A **Very -- very familiar, yes.**

Q What was that Independent Forensic Team?

A **I'm sorry. You're asking what was the team?**

Q Yes. What was -- let me rephrase. What was their purpose?

A **Their purpose was to conduct a technical investigation of the failure of the Edenville Dam and the subsequent failure of the Smallwood -- I'm sorry -- the Sanford Dam.**

Q And you -- you selected the members of the team; isn't that right?

A **As a matter of fact, I did.**

Q And in your opinion, they were qualified, competent people?

A **I -- yes, of course. They were -- they were competent and qualified in their fields -- their respective fields of**

expertise.

Q Did you interact with the team members during the course of their investigations?

A I -- I reacted -- yes, I did, I interacted with them; yes.

Q In what way did you interact with them during the course of their investigation?

A To the extent that they -- they had questions about the history of the dam -- dams, plural. To the extent that they had questions about the physical conditions of the dams. To the extent they wanted to have records of filings with FERC, communications with the Federal Energy -- Federal Energy Regulatory Commission, that's FERC, F-E-R-C. To the extent they required opinions from me as to operations or matters that influenced the operations of the dam, I -- I responded.

Q So you sent them letters; is that correct?

A I -- I wrote -- I wrote as well. Now, I wrote many letters to them.

Q And you also wrote emails to them?

A Yes.

Q Did you have phone conferences with them?

A I had -- I had several. I don't remember how many, but they're -- yes.

Q Did you meet in person with any them?

A No.

Q It was all just remote? Were you -- were you truthful in

your communications with them?

A Well, I certainly believe I was.

Q Would you say that you were candid and forthcoming with the information they requested?

A Probably too much so.

Q Do you remember times when you gave them incorrect or untruthful information?

A I didn't -- incorrect or -- what was the other word?

Q Untruthful.

A No, at no time.

Q The -- the owner of the Edenville Dam were the trusts; is that correct?

A Yes. Unlike lots of press reports and other written statements, I have never been a owner of the -- of the dams.

Q And when did the trust acquire the dams?

A The closing was -- I believe it was March 23rd, 2006.

Q And prior to purchasing the dams in March 2006, did you ask any engineers to evaluate the conditions of the dams?

A Yes, I did.

Q Who did you ask to do that work?

A Stephen Doret.

Q Is that D-o-r-e-t?

A D-o-r-e-t, yes.

Q And what -- what were the -- what was the report that Mr. Doret made to you about the conditions of the dams?

focusing on consulting for hydroelectric projects. He eventually became a partner or part-owner in a couple small hydro projects himself. And prior -- the prior owners -- two prior owners to -- to the Boyce Trust retained Frank Christie as a -- as a general manager for the -- the four -- the four hydro projects that the trusts bought. And so Mr. Christie was well-acquainted with the facilities and shortly after -- within a year after the -- the purchase of the -- the dams, I -- I hired Mr. Christie to be the general -- general manager if you will of the -- the dams.

Q And to hire Mr. Christie, was that a decision that you made on your own or did Michael have to sign off on it?

A Technically Michael d'Avenas had to sign off on it, he was very -- very glad to do so.

Q Is there -- once -- once Frank Christie was hired by you, did he report to anyone beside you?

A No. It -- well, to me and technically to the other co-trustee, whoever that may have been at the time.

Q Did you -- did you trust Mr. Christie?

A Implicitly, yes.

Q Was your experience with him that he -- that he was truthful?

A I had no reason to feel otherwise. Yes, he was truthful.

Q Starting in 2010, you had intended to reinforce the eastern end of the spillway -- or excuse me -- the eastern end of

the embankment east of the Tittabawassee spillway; isn't that right?

A That's correct.

Q And part of your concern about that portion of the embankment that was east of the Tittabawassee spillway is that it was too tall and steep; right?

A Not too tall, but it -- it was too -- the crest of the embankment was -- was too narrow, in opinion. It was not wide enough to support vehicular traffic for maintenance purposes or for construction purposes.

Q But you also worried that it wouldn't be able withstand hydrostatic pressure put on it by an extreme flood situation; isn't that right?

A That -- that may have been -- I may have expressed that opinion, I don't remember exactly.

Q And that's why when Mr. Christie and you put together a plan in October 2012 to replace the Tainter gates on both the Tittabawassee and Tobacco spillways, you also intended to reinforce that portion of the spillway east of the Tittabawassee -- or excuse me -- that portion of the embankment east of the Tittabawassee spillway, wasn't that part of your plan?

A I would use a different word than "reinforce." Specifically, the -- the concept that I came up with and that Frank agreed with was that we would install sheet

piling from the very east end of the Edenville Dam all the way to the -- to the existing concrete spillways. And if this sheet pile would emulate the sheet piling installation that had been already done at the Smallwood Dam. By installing the sheet piling upstream of the -- the crest of the dam and then backfilling behind it with appropriate tie backs for the sheet piling, the -- two things would take -- would be accomplished. One, there would be a -- what we would call a cut off wall if you will for water flow through -- through the dam, at least to a certain level. And number two, the crest would then be significantly widened and therefore, there would be more mass at -- at the top. And then we would then have the ability -- once properly compacted and so on, we would have the ability to have a proper surface wide enough for maintenance vehicles and construction vehicles, which would be -- which would then be dispatched to rebuild the spillways, which was what our plan was in 2010. And that, by the way, was -- was my decision. There had -- there had been prior considerations, the prior owner had been studying this PMF issue and -- with FERC and was considering proposing a different spillway capacity increase, which was called a fuse plug. And that fuse plug exists -- did exist at -- at Sanford dam was a solution that prior owners had -- had proposed and FERC had accepted for the Sanford Dam. I had -- I had looked at that

solution, I didn't have much confidence in it and I felt that the proper thing to do was to rebuild all of the -- the six spillways at the Edenville Dam and put in a larger -- well, deeper Tainter gates and thereby we would increase the capacity of the -- the spillway capacity, the CFS capacity if you will. And at the same time, we would then by reinvesting in the concrete structure and essentially rebuilding and renewing them for the long term investment.

Q Well, when the board of consultants considered both of those proposals, the prior owner's proposal to install a fuse way plug spillway and your proposal to just replace the Tainter gates entirely, didn't the board of consultants actually approve the spillway plug?

A No. They -- they -- they were very much in favor of the proposal that basically Frank Christie and Steve Doret and I all -- all made, again, probably in 2008 or '09, following through in 2010. I -- I don't -- I don't have any evidence to -- to the contrary.

Q With the -- I'm going to share my screen and show you --

(Counsel shares document via video)

Q Do you need me to adjust the size of this, Mr. Mueller?

A No, that's fine. But I do have a request. This is going to be an exhibit; is that correct?

Q Yes.

A I don't have the ability here to -- to make copies of that.

Will you be able to furnish me with -- with a copy after the deposition at some point?

Q So the court reporter will have all of the exhibits.

A Okay.

Q And if you obtain a transcript from them, then they will include not just the transcript, but the exhibits for you so you can reference it in the future.

A Okay. So do you -- do you recognize by any chance this graphic from the Independent Forensic Team's report?

A I don't -- I don't recall seeing it, but I'll take your word for it that that's what it is.

Q Okay. It's figure B-6 from the Independent Forensic Team's report. And this -- this next graphic is actually from Irfan Alvi from a presentation he did about that report. And he points out that between 2004 and 2014, about 30 percent of length of the downstream slope had overlays placed; do you see that?

A Yes, I do.

Q Does that sound right to you?

A Yes, it does.

Q And it looks to me like he circled those areas where the overlays were placed; do you see that?

A Yes.

Q What was the purpose of those overlays?

A Primarily the purpose was to increase the mass of the dam to

resist the pressures of the reservoir in -- in the event of a -- well, just simply to resist the -- the mass of the -- I'm sorry -- the pressure of the -- the reservoirs on the dam to -- to give them an increased factor of safety.

Q So basically just make the embankment stronger; right?

A Yes. Bottom line.

Q And the part of the dam that failed is -- is right about here (indicating); is that right?

A Yeah.

Q Down onto the far eastern end where it says "5-plus-zero-zero"?

A Yes.

Q And -- so let's mark this as Exhibit 1. And I'll just write directly on it to help keep track.

(Plaintiff's Exhibit 1 marked)

A Would -- would it be acceptable if I took a photograph of that for my -- for my recording purposes.

Q Well, how about this, Mr. Mueller, when I send these exhibits to the court reporter after this deposition, I'll copy you on that email.

A Oh, excellent. Thank you.

Q Does that work?

A Yes, it does.

Q Okay. So that's Exhibit 1. And let me just give you a second to look at this email.

(Witness reviews exhibit)

Q And if it's -- do you -- do you recognize this email now that you've looked at it, Mr. Mueller?

A Yes, of course.

Q And it's from you and it's to Irfan Alvi; right?

A Yes.

Q And it -- Mr. Alvi was on the Independent Forensic Team?

A Yes.

Q So let's mark this as Exhibit 2.

(Plaintiff's Exhibit 2 marked)

Q And in this email, if we go down to Mr. Alvi -- Mr. Alvi's question. He sent you this picture and he's asking if this photo below is showing the east most section of the embankment; right?

A Correct.

Q And you confirmed that that's correct, that photo is the eastern most section of the embankment; right?

A Yes.

Q And then you -- you said,

"What I do remember is that in 2010 I expressed concern, and Frank Christie and Steve Doret agreed with me that the top of the embankment from the east end to the spillway was far too narrow and the sides slopes too steep for the top seven or eight feet. We were all concerned about this for multiple reasons."

Do you see that?

A Yes, I do.

Q Do you remember writing that to Mr. Alvi?

A Let's say I don't remember the moment that I did it, but I certainly recall having -- having done so.

Q But these are your words, that's -- that's correct?

A Yes; yes, they are.

Q Okay. So if we -- if we look back at Exhibit 1, the portion of the embankment you're referring to is circled down there on the bottom right; is that correct?

A Correct.

Q And you listed that you were concerned about this for multiple reasons, and you mentioned prior in your testimony about the need to be able to drive construction vehicles onto the embankment to access the spillway; right?

A Yes.

Q But you also said that,

> "The narrow and very steep cross section of the crest at this eastern end location was also not particular conducive to withstanding the hydrostatic pressures of an elevated pond in extreme flood conditions, at least that was my impression."

Correct?

A Yes.

Q Those are your words?

A Yes, they are.

Q And then you explained that,

"In one form or another, it was always my intention to reinforce the eastern end of the Edenville Dam embankment with a structural barrier and a wider cross section for service vehicle and construction equipment access."

Right?

A Yes.

Q And so let's go to Exhibit 3 -- which we'll mark as Exhibit 3.

(Plaintiff's Exhibit 3 marked)

Q And this isn't the entire report, these are just excerpts. But let me scroll through and ensure that you recognize this document.

A I -- I do have a question. The document does not have a Bates stamp on it, so I would presume that that's a document that you did not receive from -- from me then.

Q This document is from the Dropbox folder.

A Okay. Very good.

Q And again, it's very long so I'm not going to attach the whole thing and look at every page of it. But I just wanted to draw your attention to -- to the title, to the table of contents, and then we'll look at Exhibit F, the sheet pile walls. So do you recognize this document, Mr. Mueller?

A I -- I do.

Q And Mr. Christie prepared this; is that right?

A Correct.

Q And he prepared it for Boyce Hydro?

A Correct.

Q At your direction, I assume; right?

A Yes.

Q And he's explaining in this report the plan to construct sheet pile walls, to widen the embankment crest for adequate access to construction access; do you see that?

A Yes, I do.

Q And if we go to Appendix F, sheet pile wall design on the Edenville spillway. Does -- does this graph here depict what you were describing below about widening that embankment?

A Yes.

Q And that's -- takes it from approximately 12 feet wide to 24 feet wide; right?

A It depends on which section of the dam this particular cross section was referencing. I take exception to the 12 feet of the existing. We had 12 feet in portions of -- in many portions of the dam, but at the far eastern end, it was less than 12 feet, it was probably closer to 8 feet.

Q And the plan -- the construction plan was to increase the width of that embankment right at the beginning of the

construction period; isn't that right?

A **It would be logical to do so, yes.**

Q And so, you know, I'm in a -- oops, wrong -- wrong button. But these parts of Exhibit 3 that I'm highlighting, those are associated with widening the embankment on that eastern side of the Tittabawassee spillway; isn't that right?

A **Yes.**

Q And the -- this larger design plan of replacing both Tainter gates, that never happened; right?

A **Correct.**

Q But Boyce Hydro could have widened the embankment, couldn't have? Even if it didn't end up doing the full project?

A **Well --**

Q It's a -- it's a "yes" -- it's just a "yes" or "no" question, Mr. Mueller. I mean, they could have went ahead and widened that embankment, couldn't they?

A **If -- if the funding were available for it, absolutely.**

Q And did you ever propose just widening the embankment and -- and not going all the way and completing the full project to replace the Tainter gates?

A **I did -- I did not propose that and I can give you a reason for it. Which is FERC was primarily interested in Boyce Hydro coming up with a plan and then executing a plan that in and of itself would increase the spillway capacity.**

Q So they -- FERC wasn't focused on -- at least from your

understanding, FERC wasn't focused on increasing the width of that embankment portion east of the Tittabawassee spillway; right?

A That -- that's correct.

Q But your concerns, you could see just with your own eyes, you said "With my impression that" -- looking back at Exhibit 2 that, "The narrow and very steep cross section was not particular conducive to withstanding the pressures of an elevated pond." I mean, that proved to be prophetic; right? Because that's the section that ended up failing when there was an elevated pond level; right?

A Correct.

Q Okay. Each of those have been marked. So the main -- the primary purpose of the Edenville Dam was to generate electricity; wasn't it?

A That's correct.

Q I mean, the original people who constructed the dam, they weren't trying to control floods, they were trying to make a profit; right?

A They -- they were trying to -- they definitely built the project to -- to generate an income and in so doing, they -- I believe that they recognized that they were creating some flood control capacity because evidently from what I've read in past history, the Tittabawassee River was subject to pretty extreme flooding in the -- in the spring -- spring

runoff conditions. But to answer your question conclusively, the dam was built for the purpose of generating an income and a profit.

Q And let me show you a new exhibit here.

(Counsel shares exhibit via video)

Q Is this too big or too small, Mr. Mueller?

A It's fine. But it's also -- also too painful to look at.

Q Yes. I -- it is. So do you recognize this report?

A Yes, I do.

Q And it's the final report the Independent Forensic Team put together; right?

A Correct.

Q And this exhibit -- let's mark it as Exhibit 4.

(Plaintiff's Exhibit 4 marked)

Q The Independent Forensic Team report is something like 500 pages, so it's not -- not all here, these are just excerpts. But I -- I wanted to draw your attention to page F-2 of the report. Do you see this highlighted portion?

A I do.

Q And the I -- the IFT concluded that,

> "The storage provided by the facilities was found to inadequate to effectively manage downstream flooding, and any flood mitigation provided by dam operations was viewed as a secondary benefit."

Do you see that?

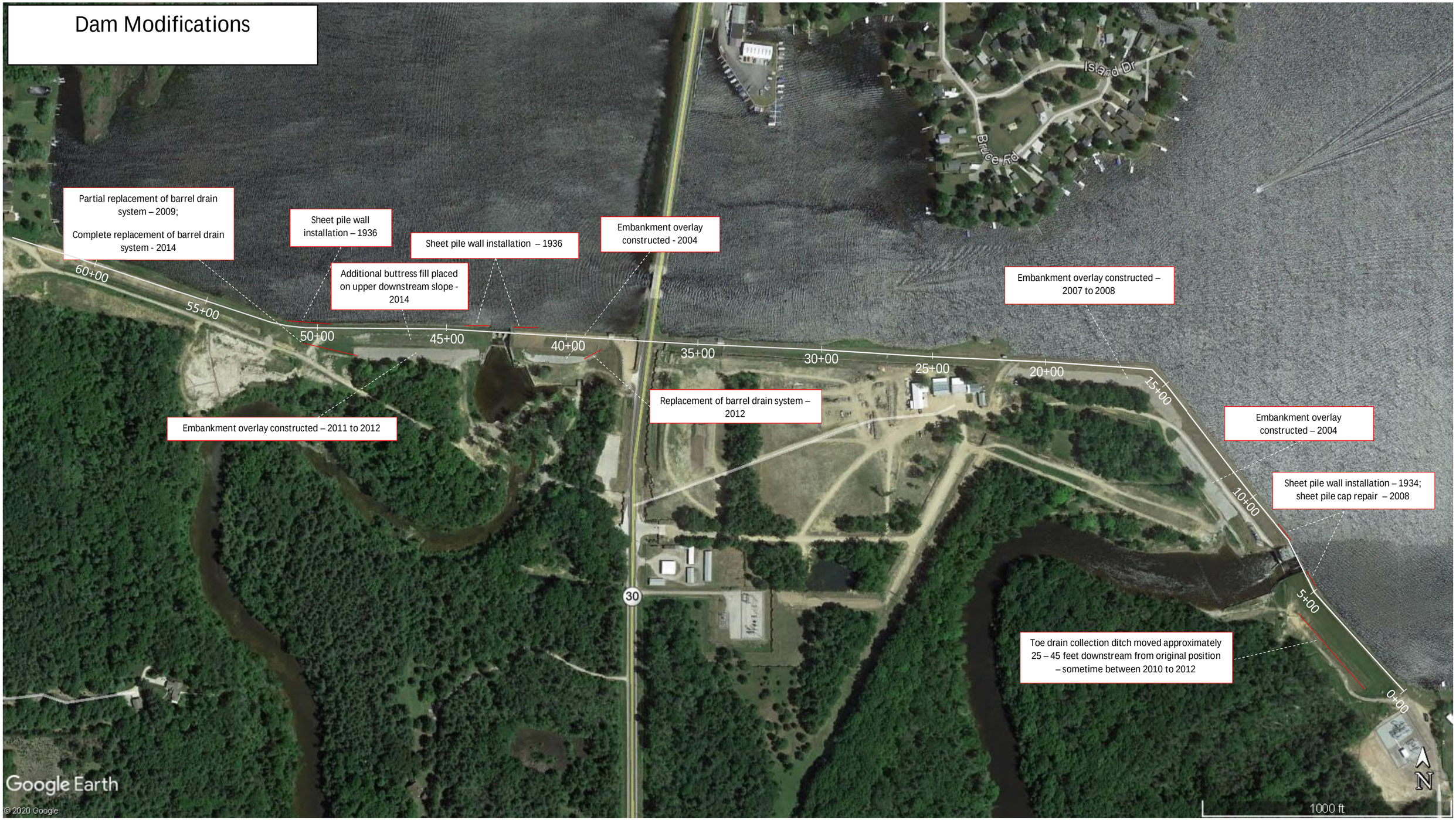
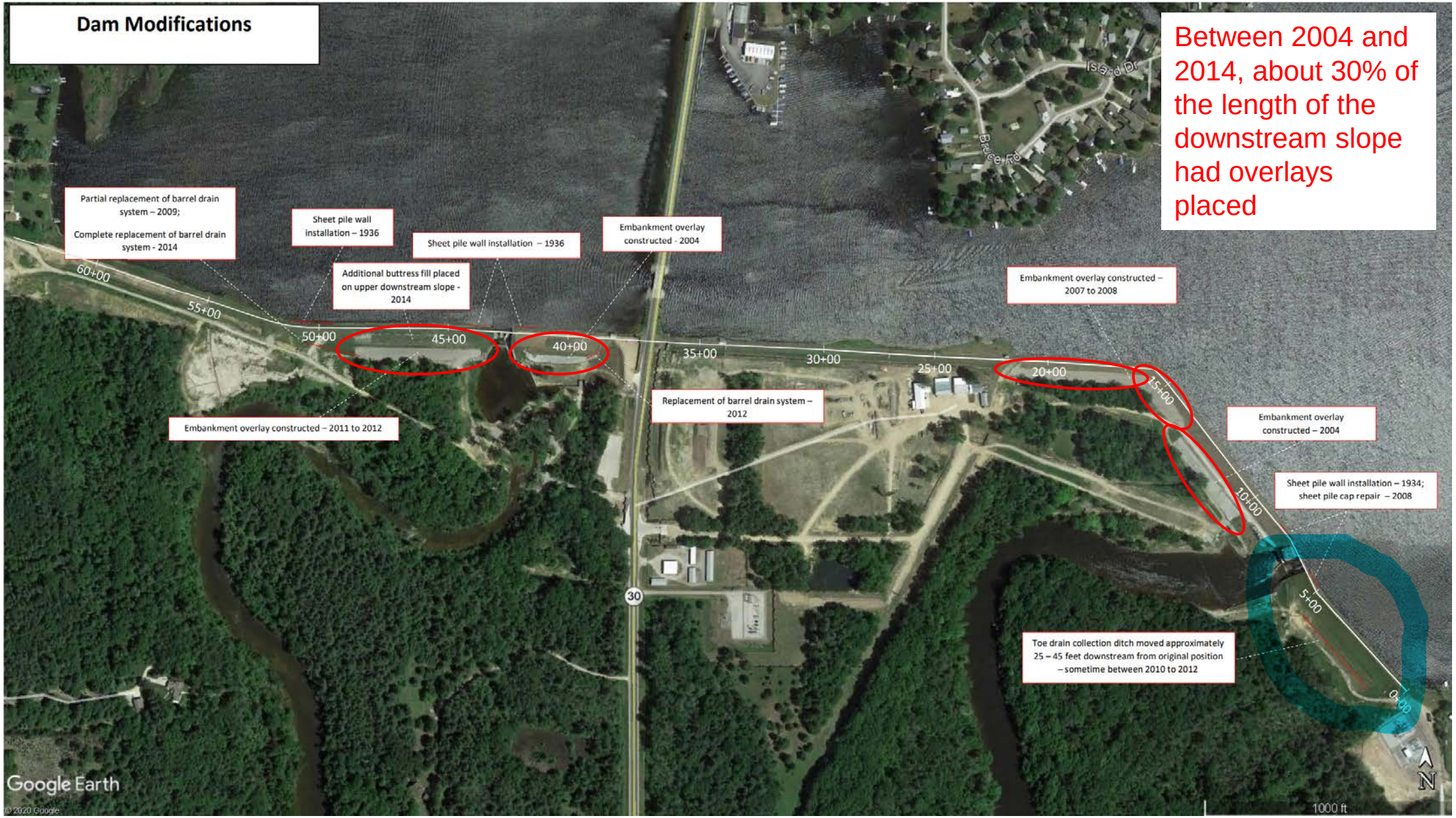


Figure B-6: Dam Modifications

Edenville Dam Modifications



Between 2004 and 2014, about 30% of the length of the downstream slope had overlays placed

Lee W. Mueller

From: Lee W. Mueller <lee@muellerslv.com>
Sent: Wednesday, November 17, 2021 6:40 PM
To: 'Irfan Alvi'
Cc: 'michelegm@muellerslv.com'
Subject: Removal of Consumers Energy Electrical Equipment from Edenville powerhouse roof top

Irfan A. Alvi, PE
President & Chief Engineer
Alvi Associates, Inc.
110 West Road, Suite 250
Towson, MD 21204
Phone: (410) 321-8877 x16_12
Email: ialvi@alviassociates.com

Irfan: Yes, the photo displayed below is of the eastern end of the Edenville Dam in the vicinity of the breach area, but probably just to the west of the initial failure location. Consumers Energy removed the electrical equipment and towers from the roof of the powerhouse in 2018 after this 2017 photo was taken.

The "waviness" you observe in the slope of the downstream embankment was not a topic of discussion in any of the FERC annual inspections of the 5-year Independent Consultant Safety Inspections that I can recall going back to 2008.

What I do remember is that in 2010 I expressed concern, and Frank Christie and Steve Doret agreed with me that the top of the embankment (the crest) from the east end to the spillway was far too narrow and the side slopes too steep for the top seven or eight feet. We were all concerned about this for multiple reasons.

First was the fact that construction vehicles could not drive on the crest as it was too narrow, and no sizable equipment, such as a crane, could be driven to the spillway structure for maintenance or repairs. We also could not drive a drill rig on this section of the crest to take borings through the top of the embankment. Construction work involving a crane, such as turbine bay head door replacement or emergency repairs to the spillway mechanical systems was simply not possible without access from the east end of the embankment.

The narrow and very steep cross section of the crest at this eastern end location was also not particularly conducive to withstanding the hydrostatic pressures of an elevated pond in extreme flood conditions, at least that was my impression.

For the above identified reasons, it was decided when we began designing the spillway alteration project after preliminary analysis had been completed in 2010, that the first design element of the project was to be the installation of a sheet pile wall similar to the one installed in 2000 at the Smallwood Dam. This is detailed in the construction plans reviewed by the BOC in the course of several meetings, and eventually approved by FERC in 2013. The location of the sheet piling would result in a minimum 24' wide crest for the length of the eastern section of the embankment up to the spillway structure.

Later on in 2018, working with Dee Purkeypile, we designed a labyrinth spillway located in that area which itself would have included sheet pile cutoff walls on the reservoir side of the embankment. Thus in one form or another, it was always my intention to reinforce the eastern end of the Edenville Dam embankment with a structural barrier, and a wider cross section for service vehicle and construction equipment access.

When I was informed that FLTF made the decision to spend some of its $5 Million State grant money in 2019 for concrete repairs to the spillway structures, I discussed the project with the General Contractor project manager, Rusty Friedle, inquiring if a sheet pile wall and widening of the travel path to the construction location was going to be employed. He informed me that it would be less expensive to simply undertake the work using temporary barges as work platforms. That is how the grant funds were allocated for the summer construction season of 2019, and for

the work concrete repair performed during November and December of 2019 for which the drawdown permit application to the MDEQ was denied.

Lee W. Mueller
5190 S. Conquistador Street
Las Vegas, NV 89148
tel: (702) 367-7302
fax: (702) 367-3440
lee@muellerslv.com

From: Irfan Alvi [mailto:ialvi@alviassociates.com]
Sent: Wednesday, November 17, 2021 2:25 PM
To: Lee W. Mueller
Cc: michelegm@muellerslv.com
Subject: RE: Removal of Consumers Energy Electrical Equipment at Edenville

Lee,

Thanks for that info. The question was motivated by trying to determine if the photo below is showing the eastmost section of the embankment. You can see electrical equipment on top of the powerhouse, and other more recent photos don't show electrical equipment at the powerhouse. Do you concur that this photo shows the eastmost embankment? I've attached the full series of photos.

The wavy surface of the downstream slope caught my eye. Was that waviness noted during inspections, and was it ever discussed among Boyce, FERC, EGLE, consultants, etc.?

Irfan

From: Lee W. Mueller <lee@muellerslv.com>
Sent: Wednesday, November 17, 2021 3:40 PM
To: Irfan Alvi <ialvi@alviassociates.com>
Cc: michelegm@muellerslv.com
Subject: Removal of Consumers Energy Electrical Equipment at Edenville

Irfan: After the license termination, Consumers Energy eventually removed most, if not all, of its electrical panels, meters, and related equipment that had been located inside the powerhouse. Boyce Hydro installed a couple of new electrical "house panels" in order to facilitate the installation of a new commercial power feed to operate the building and the spillway gates.

This was a very curious question. I hope my answer was useful. Lee

Lee W. Mueller
5190 S. Conquistador Street
Las Vegas, NV 89148
tel: (702) 367-7302
fax: (702) 367-3440
lee@muellerslv.com

From: Irfan Alvi [mailto:ialvi@alviassociates.com]
Sent: Wednesday, November 17, 2021 6:25 AM
To: Lee Mueller
Cc: Michele Mueller; johnwfrance.pe
Subject: Electrical Equipment at Edenville

Lee,

After FERC revoked the Edenville license, was any equipment for power generation or transmission removed? Looking at some before and after photos, I think I see some equipment in the before photos at the powerhouse which is not there in the after photos.

Thanks,

Irfan

_____

Irfan A. Alvi, PE
President & Chief Engineer
Alvi Associates, Inc.
110 West Road, Suite 250
Towson, MD 21204
Phone: (410) 321-8877 x112 *
Email: ialvi@alviassociates.com
Website: www.alviassociates.com

* *Alvi Associates will be teleworking until the coronavirus situation passes. The best way to reach me is by email.*

Design Report
Dam Modifications for Upgrading Spillway Capacity
Edenville Hydroelectric Project
FERC No. 10808

Prepared for

Boyce Hydro Power, LLC
Edenville, Michigan

Prepared by

Christie Engineering
Onekama, Michigan

October, 2012

Table of Contents

List of Appendices

9. Sheet Pile Walls and Cofferdam

Sheet pile walls will be constructed to outline the staging areas and to widen the embankment crest for adequate access to the construction areas. In all instances the sheet pile walls will be tied back to deadman anchors. The existing sheet pile walls at each spillway will be used as the deadman anchors for the upstream walls of the staging areas. Steel sheet piling will also be used for the dewatering cofferdams. All sheet pile calculations are presented in Appendix F.

A. Method of Analysis

The sheet pile walls were designed using the SPW911, v2.20, Pile Buck computer program. The program uses classical soil mechanics procedures for the analysis and design of sheet pile walls. The walls were designed for the depth that would result in a safety factor of 1.5. The phreatic surface elevations used for water levels in the embankment were taken at very conservative levels (high) in relation to the water level encountered in the embankment borings. The walls were designed for the following loading combinations:

- *Normal water levels* – Headwater at elevation 675.5 feet and phreatic surface at elevation 675.5 feet
- *PMF*– Headwater at elevation 682 feet and phreatic surface at elevation 678.8 feet.
- *Low water condition* – Headwater at elevation 668.0 feet and phreatic surface at elevation 672.8 feet.
- *Surcharge* – A surcharge loading of 300 pounds per square foot was added to all of the above loading combinations to simulate the construction loading conditions.

The cofferdam design does not contemplate driving the piling into soil and so was designed as a beam member using the working stress method. The top of cofferdam at El. 670.3 was used for the full water load.

B. Properties of Materials

Soil properties were obtained from the soil exploration and testing report in Appendix C. The following sheet pile properties were used in the analysis:

Sheet pile steel A572 Gr. 50, or A857..... F_y = 50,000 psi
F_b = 25,000 psi

Section modulus and moment of inertia ..... Determined for each pile section used

Steel modulus of elasticity ..... E = 29,000,000 psi

Boyce Hydro Power LLC.

Edenville Spillway Construction Schedule, FERC P-10808

October 26, 2012

Job Detail	2013			2014												2015						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1. Lower Reservoir 4'																						
2. Add Wall Extensions,Drive Sheet Pile for Staging Area & Road at Tobacco & Edenville																						
3. Backfill Sheeting and Construct Road																						
4. Lower Reservoir 8'																						
TOBACCO																						
5. Install Cofferdam at Tobacco Spillway																						
6. Construct Pier Extensions, Tobacco																						
7. Construct Powerhouse Penstock, Tobacco																						
8. install Stop Logs, Tobacco Bay 3																						
9. Concrete Pours, 1 & 2																						
10. Demolish Existing Spillway																						
11. Concrete Pours 3, 4 & 5, New Spillway																						
12. Construct Bridge on Bay 3																						
13. Install Gate																						
14. Construct New Powerhouse and Retaining Walls																						
15. Excavate Tailrace Channel, Tobacco River																						
16. Install Generation Equipment																						

indicates work by Construction Contractor

indicates work by Boyce Hydro Power LLC.

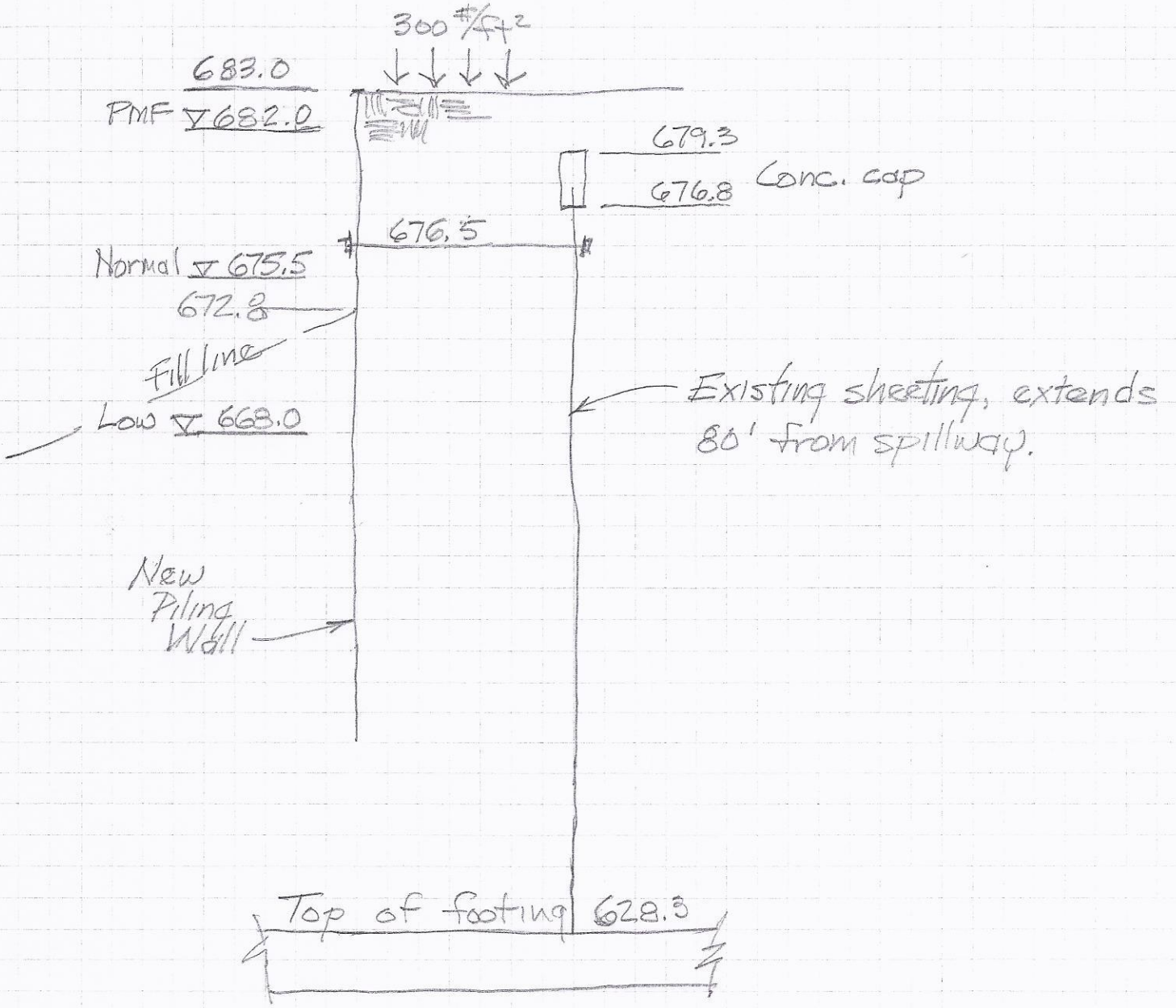
Appendix F

Sheet Pile Wall Design

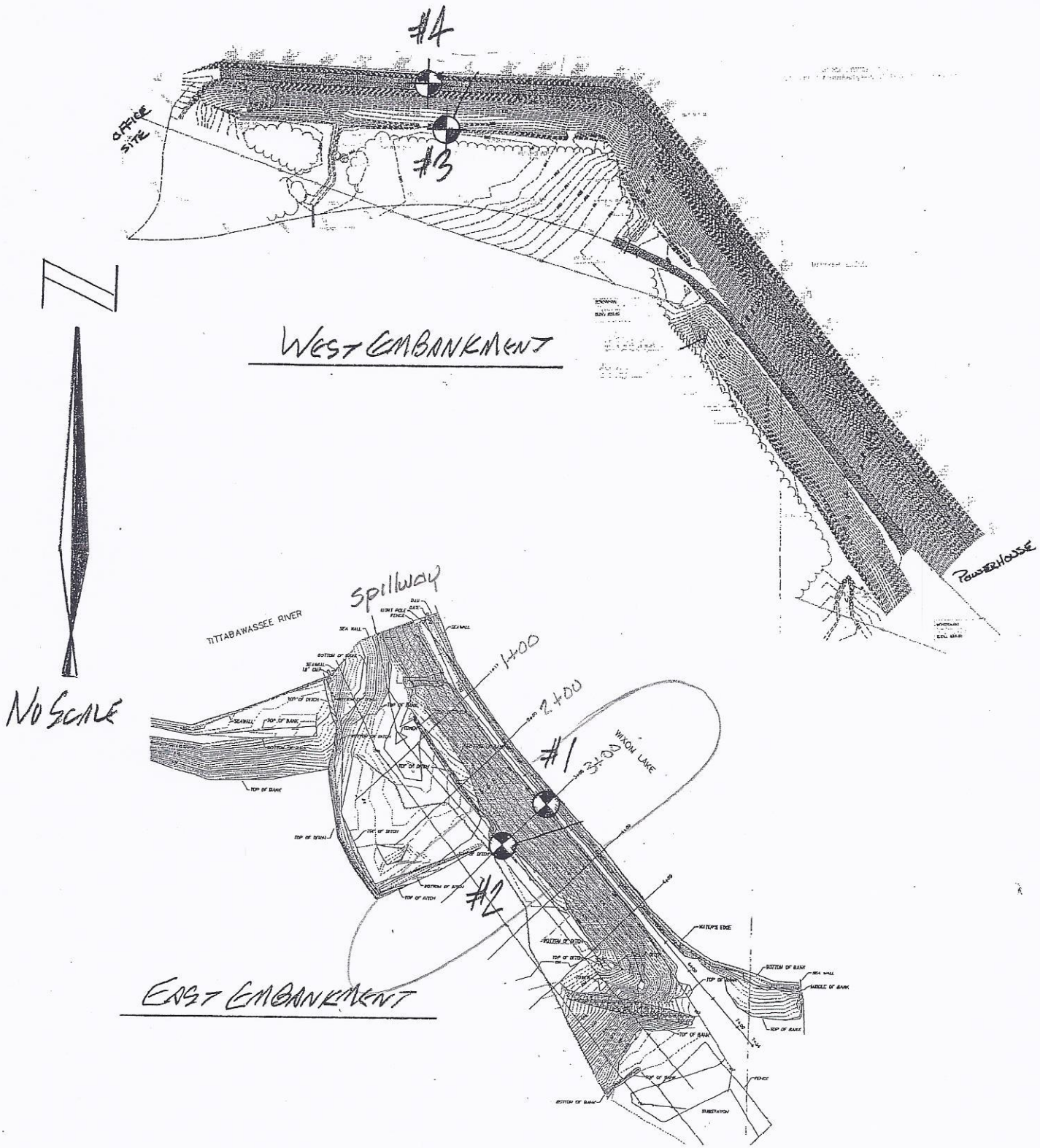
11/29/11
FE

Edenville Spillway

Embankment Sheet pile addition - East End, staging area



Design New Piling Wall under these three loading conditions



Soil Boring Location Plan

#05-63139

Edenville Spillway

11/29/11
EC

Sheet Pile Wall - Staging Area

Use 18 foot long sheeting with $S.M. \geq 5\ in^3$.

From pile design, max load on waler = 3.3 k/ft

for $1\frac{1}{4}$" treback, max. load = $75^k (40\%) 1\ in^2 = 30^k$
(Dywidag #9 Tie Rod, A615 grade)

Use @ 8' spacing = $8' \times 3.3^{k/ft} = 26.4^k$ O.K.

Use double channels for waler - continuous beam.

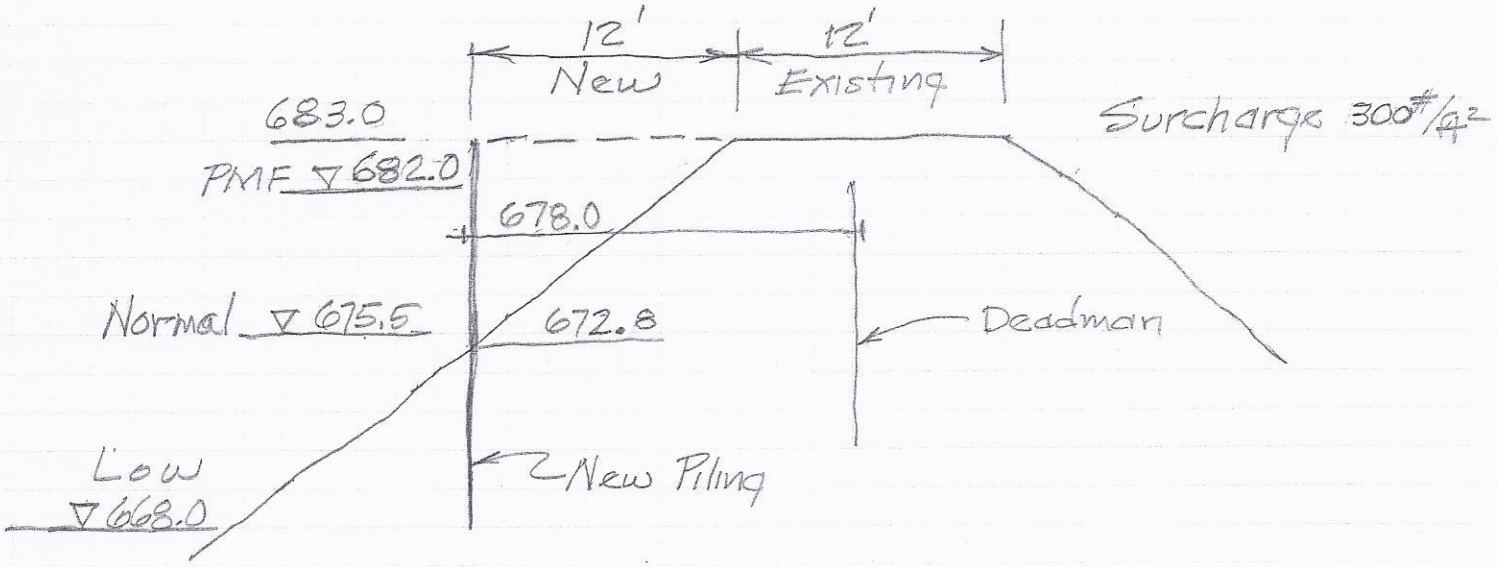
$Mom. = 0.11 w l^2 = 0.11(3.3)8^2 = 23.2^{1k}$

$S = \frac{23.2(12)}{24} = 11.6\ in^3$, use 2- C8x11.5, $S = 2(8.14) = 16.3$

11/24/11

Edenville Spillway

Embankment Sheet Pile for access road on top of dike.



Design Piling wall for 3 conditions

EXHIBIT B - BRIEF IN SUPPORT OF MOTION FOR SUMMARY JUDGMENT

STATE OF MICHIGAN
CIRCUIT COURT FOR THE 30TH JUDICIAL CIRCUIT
INGHAM COUNTY

THE DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY AND THE DEPARTMENT OF NATURAL RESOURCES,

Plaintiffs,

v

LEE MUELLER; BOYCE MICHIGAN, LLC; EDENVILLE HYDRO PROPERTY, LLC; BOYCE HYDRO POWER LLC; BOYCE HYDRO, LLC; WD BOYCE TRUST 2350; WD BOYCE TRUST 3649; AND WD BOYCE TRUST 3650,

Defendants.

No. 20-255-CE

HON. WANDA M. STOKES

Nathan A. Gambill (P75506)
Assistant Attorney General
Attorney for Plaintiffs
Michigan Department of Attorney General
Environment, Natural Resources,
and Agriculture Division
P.O. Box 30755
Lansing, MI 48909
(517) 335-7664
gambilln@michigan.gov

Lee Mueller
Defendant In Pro Per
5190 South Conquistador St.
Las Vegas, NV 89148
lee@muellerslv.com

Anthony J. Kochis (P72020)
Attorney for Liquidating Trustee
Wolfson Bolton PLLC
3150 Livernois, Ste. 275
Troy, MI 48083
(248) 247-7102
akochis@wolfsonbolton.com

ORDER GRANTING PLAINTIFFS' MOTION FOR SUMMARY DISPOSITION UNDER MCR 2.116(C)(10) AND DEEMING FACTS ESTABLISHED UNDER MCR 2.312(D)(1)

At a session of said Court, held in the circuit courtroom, City of Mason, County of Ingham, State of Michigan, on the 8 day of MARCH 2023.

PRESENT: HONORABLE WANDA M. STOKES
Circuit Court Judge

The Court has reviewed the documents Plaintiffs Michigan Department of Natural Resources and Michigan Department of Environment, Great Lakes, and Energy submitted with their December 20, 2022 motion for summary disposition. The Court has also reviewed any document filed in response, along with any reply, and held a hearing on the motion on February 9, 2023. For the reasons stated on the record, the Court GRANTS Plaintiffs' motion. The Court further finds that the requests to admit served on Lee Mueller on October 28, 2022 are deemed admitted under MCR 2.312(B)(1), and thus conclusively established under MCR 2.312(D)(1), as to Lee Mueller.

The Court finds the following facts are material, and are not genuinely in dispute:

1. Boyce Hydro owned and operated the Edenville Dam between 2007 and May 19, 2020.

2. Lee Mueller knew that the Edenville Dam's ability to store flood water in Wixom Lake was negligible because the dam's primary purpose when constructed was to generate hydroelectricity and not to manage downstream flooding.

3. In 2013, Lee Mueller had directed the study of, and rejected, the theory that Wixom Lake had sufficient storage capacity to make lowering Wixom Lake

more than three feet below its normal level an effective way to manage a major flood.

4. Lee Mueller controlled Boyce Hydro between September 25, 2018 and May 4, 2020.

5. At Lee Mueller's direction, Boyce Hydro used the Edenville Dam to lower Wixom Lake more than three feet below its normal level beginning in September 2018.

6. Boyce Hydro lowered Wixom Lake more than three feet below its normal level beginning in September 2018 because it laid off the staff needed to control the lake level, not because Boyce Hydro or Lee Mueller believed that it would be unsafe to maintain the normal level of Wixom Lake without increasing the spillway capacity of the Edenville Dam.

7. Lee Mueller did not believe that the spillway capacity of the Edenville Dam needed to be increased to meet Michigan safety standards.

8. The lowering of Wixom Lake more than three feet below its normal level in 2018 did, in fact, result in the death of hundreds of thousands of freshwater mussels.

9. Boyce Hydro and Lee Mueller knew that lowering Wixom Lake more than three feet below its normal level in 2018 would diminish an inland lake, and the action did, in fact, diminish an inland lake.

10. Once the Task Force agreed to pay Boyce Hydro $40,000 per month, and reimburse Boyce Hydro for certain construction expenses, Boyce Hydro began returning Wixom Lake to its normal level in April 2019.

11. Lee Mueller confirmed to the Task Force in April 2016 that it would be "safe" to maintain the normal level of Wixom Lake if certain construction items were completed—none of which had anything to do with the spillway capacity of the dam.

12. Lee Mueller did not express to the Task Force, nor to Boyce Hydro employees nor Plaintiffs, that it would be unsafe to maintain the normal level of Wixom Lake in 2019 without first increasing the spillway capacity of the Edenville Dam.

13. At Lee Mueller's direction, Boyce Hydro used the Edenville Dam to lower Wixom Lake more than three feet below its normal level beginning in November 2019.

14. Lee Mueller lowered Wixom Lake more than three feet below its normal level beginning in November 2019 because he thought doing so would be a more effective way of managing ice buildup over the winter months, not because he believed that it would be unsafe to maintain the normal level of Wixom Lake without increasing the spillway capacity of the Edenville Dam.

15. When Boyce Hydro lowered Wixom Lake more than three feet below its normal level beginning in November 2019, it intended the lowering to last only during the winter months, and always planned to return Wixom Lake to its normal level in the spring of 2020.

16. The lowering of Wixom Lake more than three feet below its normal level in 2019 did, in fact, result in the death of hundreds of thousands of freshwater mussels.

17. Boyce Hydro and Lee Mueller knew that lowering Wixom Lake more than three feet below its normal level in 2019 would diminish an inland lake, and the action did, in fact, diminish an inland lake.

18. Boyce Hydro began returning Wixom Lake to its normal level in April 2020 just as it always planned to do, and Wixom Lake was returned to its normal level on May 4, 2020.

19. Lee Mueller did not express to the Task Force, nor to Boyce Hydro employees nor Plaintiffs, that it would be unsafe to maintain the normal level of Wixom Lake in 2020 without first increasing the spillway capacity of the Edenville Dam.

The Court grants the declaratory relief sought by Plaintiffs, and declares that Defendants Lee Mueller, WD Boyce Trusts 2350, 3649, and 3650, and the LLCs Boyce Michigan, Boyce Hydro Power, Boyce Hydro, and Edenville Hydro Property violated Parts 17 and 31 of the Natural Resources and Environmental Protection Act.

This Order is final as to Defendants WD Boyce Trust 2350, 3649, and 3650, and the LLCs Boyce Michigan, Boyce Hydro Power, and Boyce Hydro, and those Defendants are dismissed from this case.

This Order is not final as to Defendants Lee Mueller and Edenville Hydro Property LLC, and this Order does not close the case as to those Defendants.

Per MCR 2.602(B) This order, there is no just reason for delay.

3/6/23

Entered because

P74048 for

HON. WANDA M. STOKES
Circuit Court Judge

LF: Dam-Boyce Hydro Wixom Lake Mussel Injury (DNR v) CC/AG# 2019-0255621-B/Order 2023-02-09

PROOF OF SERVICE

I hereby certify that I mailed a copy of the above ORDER to each attorney of record, or upon the parties, by placing the true copy in a sealed envelope, addressed to each, with full postage prepaid and placing said envelope in the United States mail at Mason, Michigan, or by electronic email communication pursuant to MCR 2.107(C)(4) on March 10, 2023.

Christina Beahan
Judicial Assistant to Hon. Wanda M. Stokes

words "without limitation," and (iv) the word "or" shall be disjunctive but not exclusive, References to this Agreement and other documents shall be deemed to include all subsequent amendments and other modification thereto.

IN WTINESS WHEROF, the Parties have executed this Agreement as of the date set forth, along with the respective signatures below.

FEDERAL INSURANCE COMPANY

By_____
Name: _____
Title: _____

EVANSTON INSURANCE COMPANY

By_____
Name: _____
Title: _____

BOYCE MICHIGAN. LLC

By Lee W. Mueller
Name: Lee W. Mueller
Title: C0-Member Manager

BOYCE HYDRO, LLC

By 

Name: Lee W. Mueller

Title: Co-Member Manager

BOYCE HYDRO POWER, LLC

By 

Name: Lee W. Mueller

Title: Co-Member Manager

EDENVILLE HYDRO PROPERTY LLC

By 

Name: Lee W. Mueller

Title: Co-Member Manager

SANFORD HYDRO PROPERTY LLC

By 

Name: Lee W. Mueller

Title: Co-Member Manager

SECORD HYDRO PROPERTY LLC

By 

Name: Lee W. Mueller

Title: Co-Member Manager

SMALLWOOD HYDRO PROPERTY LLC

By 

Name: Lee W. Mueller

Title: Co-Member Manager

W.D. BOYCE TRUST 2350

By 

Name: Lee W. Mueller

Title: Co-Trustee

W.D. BOYCE TRUST 3649

By 

Name: Lee W. Mueller

Title: Co-Trustee

W.D. BOYCE TRUST 3650

By 

Name: Lee W. Mueller

Title: Co-Trustee

EXHIBIT D - BRIEF IN SUPPORT OF MOTION FOR SUMMARY JUDGMENT

From:	Lee W. Mueller
To:	Trumble, Luke (EGLE)
Cc:	DeVaun, Dan (EGLE); Greg Uhl; Michele Mueller
Subject:	State of Michigan"s Dam Safety Unit"s Pre-Application Meeting re Edenville Dam
Date:	Wednesday, February 5, 2020 2:22:28 PM

Luke: Thank you for contacting me regarding current and planned activities associated with Spicer Engineering's intentions for future alterations to the Edenville Dam. Notwithstanding the future plans for an ownership transition with the Edenville Dam, Boyce Hydro is operating company for the facility for at least the next two years and is therefore the entity to contact regarding any questions about the current conditions at the dam and regarding any requests for access on the part of the Dam Safety personnel employed by the State of Michigan.

By copy of this e-mail to Greg Uhl, the Boyce Hydro chief operator and on-site supervisor, I am requesting that he accommodate your request for a tour of the facilities tomorrow, February 6th. Greg's cell phone number is [redacted]. Please let him know what time you would like to meet with him at the Edenville office.

Sincerely yours,

Lee W. Mueller, Architect & Co-Member Manager
Boyce Hydro, LLC
6000 South M-30 (P.O. Box 15)
Edenville, MI 48620
tel: (989) 689-3161 / fax: (989) 689-3155
lwmueller@boycehydrollc.com

From: Trumble, Luke (EGLE) [mailto:TrumbleL@michigan.gov]
Sent: Wednesday, February 05, 2020 5:50 AM
To: lwmueller@boycehydrollc.com
Cc: DeVaun, Dan (EGLE)
Subject: Pre-Application Meeting re Edenville Dam

Good morning Lee,

FYI, we have a pre-application meeting with the Spicer Group scheduled for tomorrow, Feb. 6th, to discuss proposed/upcoming improvements to the Edenville Dam. A site visit is not scheduled as part of that meeting, so I had inquired if EGLE Dam Safety Staff (myself and Dan DeVaun) would be able to access the site prior to the afternoon pre-application meeting so that Dan can get familiar with the dam and it's appurtenances and so that we could be better informed for the pre-application discussions, specifically discussions related to potential auxiliary spillway locations. Spicer Group indicated that we should reach out to you directly to arrange access to the site. Would it be possible for Dan and I to gain access to the dam (both sides) tomorrow morning, probably around 9:00 or 10:00?

Also, FYI, Dan DeVaun started with EGLE last July, taking over for Jim Pawloski who retired in 2019 and had previously administered the state Dam Safety Program for Gladwin and Midland Counties. Dan now covers Jim's old area (including Gladwin and Midland Counties) and will eventually be the point of contact for Dam Safety related issues related to dams in those counties. I had stepped in to assist Jim Pawloski as he progressed toward retirement, but Dan will eventually take over once he's fully up to speed. Dan will be coming down for the pre-application meeting, so I'd like to take advantage of having us both in the same place and do a quick walkthrough of the dam site. Previously, when I have visited site, I had been let in and escorted by either your wife, Michelle, or by the dam operator, Greg.

Please let us know if this will be possible.

Thanks,

Luke Trumble

Lucas A. Trumble, P.E.
Hydrologic Studies and Dam Safety Unit
Water Resources Division, EGLE
517-420-8923
trumblel@michigan.gov

BOYCE HYDRO LLC

A W.D. Boyce Trusts Legacy Enterprise

Lee W. Mueller & Stephen B. Hultberg, Co-Member Managers
6000 S. M-30 (PO Box 15)
Edenville, MI 48620
Tel: (989) 689-3161 Fax: (989) 689-3155

10 February, 2020

Michigan Department of
Environment, Great Lakes and Energy
Hydrologic Studies and Dam Safety Unit
Water Resources Division
401 Ketchum Street, Suite B
Bay City, MI 48707-5430

Subject: Letter of Delegation – Four Lakes Task Force
Edenville Dam – Wixom Lake, Gladwin and Midland Counties
EGLE Application File No. HNW-JPAC-HF81Q

Dear EGLE Water Resources Division Representative:

On behalf of Boyce Hydro, LLC, please be advised that I hereby authorize the Four Lakes Task Force, and its respective consultants and agents, to apply for an EGLE permit to perform the emergency work with respect to the Edenville Dam in accordance with EGLE Application File No. **HNW-JPAC-HF81Q**. This authorization is effective as of February 6, 2020 and shall also apply to any additional permit applications and permits as necessary with respect to the Edenville Dam.

Sincerely,

Lee W. Mueller
Co-Member Manager
Boyce Hydro, LLC
(989) 689-3161
lwmueller@boycehydrollc.com

cc: Dave Kepler, Chairperson, FLTF
Ron Hansen, P.E., Spicer Group (Consulting Engineers)

Sutton, Kelsea R.

To: Hansen, Ron B.; Miller, Warren T.
Subject: RE: Authorization to apply for MDEQ Permit

From: David Kepler <dave@keplertcp.com>
Date: April 17, 2019 at 1:26:26 PM EDT
To: "Hansen, Ron B." <ronh@spicergroup.com>
Subject: FW: Authorization to apply for MDEQ Permit

Ron
Will you please implement this on behalf of the Four Lakes Task Forces
You have my authorization as the Chairman of the Four Lakes Task Force

Best Regards

Dave Kepler
TCP Investments
Midland Brewing Company

From: Lee W. Mueller <lwmueller@boycetrusts.com>
Sent: Wednesday, April 17, 2019 1:20 PM
To: David Kepler <dave@keplertcp.com>
Subject: Authorization to apply for MDEQ Permit

David E. Kepler, II, President
Sanford Lake Preservation Association
Four Lakes Task Force
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Mr. Kepler: This correspondence shall serve as your written authorization to apply for an MDEQ Permit relative to matters associated with an intended Part 307 Lake Level Court Order alteration of the Wixom Reservoir pond levels that cover the bottom lands owned by Boyce Michigan, LLC and Edenville Dam Property, LLC whose sole members are the W.D. Boyce Trusts. This authorization is valid as of this date through 31 December, 2019.

Sincerely yours,

Lee W. Mueller, Architect & Co-Trustee
W.D. Boyce Trusts 2350, 3649, & 3650
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Las Vegas, NV 89147
tel: (702) 367-7302 / fax: (702) 367-3440
lwmueller@boycetrusts.com

IN THE UNITED STATES DISTRICT COURT

FOR THE WESTERN DISTRICT OF MICHIGAN

SOUTHERN DIVISION

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY, AND THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES,

Plaintiffs,

v

File No. 1:20-CV-528

HON. PAUL L. MALONEY

LEE MUELLER; BOYCE MICHIGAN, LLC; EDENVILLE HYDRO PROPERTY, LLC; BOYCE HYDRO POWER, LLC; BOYCE HYDRO, LLC; WD BOYCE TRUST 2350; WD BOYCE TRUST 3649; AND WD BOYCE TRUST 3650,

Defendants.

/

DEPOSITION OF FRANK O. CHRISTIE

Taken by the Plaintiffs on the 9th day of September, 2022,

at 2122 South M-37, Traverse City, Michigan, at 9:00 a.m.

APPEARANCES:

For the Plaintiffs:
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RECORDED BY: Ann Holmes, CER 2629
Certified Electronic Recorder
Network Reporting Corporation
Firm Registration Number 8151
1-800-632-2720

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Traverse City, Michigan

Friday, September 9, 2022 - 8:58 a.m.

MR. GAMBILL: All right. Mr. Christie, my name is Nate Gambill and I represent the Plaintiffs in this lawsuit. So my clients are the Michigan Department of Natural Resources and the Michigan Department of Environment, Great Lakes, and Energy, which used to be called DEQ.

REPORTER: Do you solemnly swear or affirm that the testimony you're about to give will be the whole truth?

MR. CHRISTIE: Yes, I do.

FRANK O. CHRISTIE

having been called by the Plaintiff and sworn:

EXAMINATION

BY MR. GAMBILL:

Q Could you please state and spell your full name for us, please?

A Frank Christie. That's Frank, F-r-a-n-k C-h-r-i-s-t-i-e.

Q And have you ever been deposed before, Mr. Christie?

A Yes.

Q How long has it been?

A It's probably been ten years.

Q What was the matter that you were deposed in, was it related to Boyce Hydro?

A That's a good question. I'm -- maybe it's been -- it's been more than ten years. It was -- it was in relation to a --

to a project I was working on in New Hampshire, a hydro plant.

Q So have you ever been deposed regarding a project you've worked on in Michigan?

A Long ago when I was a younger engineer working for a company in Ann Arbor.

Q Was it Boyce Hydro?

A No; no.

Q Okay. Different company? As Ann noted -- which you're doing great for, I should have clarified -- all your answers need to be verbal so we can --

A Yes.

Q -- so she can keep a record.

A Yes.

Q Okay. Maybe it would be -- before we get too far along, it would be helpful if you could provide just a background of your maybe educational history, and then we can go to your professional history.

A Okay. I have a bachelor's of science in civil engineering from Michigan Tech, and I went about halfway through a master's program at the University of Michigan. Didn't finish it. That's the -- that's basically the extent of my education. I've been a professional engineer -- registered engineer for -- since 1964, and I gave up the registration when I left Boyce in 2017.

Q So 1964 to 2017 you were a registered professional engineer?

A Yes.

Q In Michigan or elsewhere?

A Michigan and elsewhere.

Q What other places were you registered?

A New York primarily. I worked in New York for probably 30 years. Not in the city, but in northern -- the northern part.

Q And what is your background -- well, let me rephrase that. When did you start doing work related to the Edenville Dam?

A I started in -- I made a slight -- time line here, I'll just quote from this.

Q Okay.

A I started with -- at Edenville, at that time it was called Wolverine Power, and I started on the 2nd of January in 2000. I worked there until 2004, when it was sold to a Canadian company and they didn't need -- they didn't want a manager there at that point, so I left. Boyce then bought the facilities -- I think it was 2006, right around there anyway -- and I went back to work at that point in time. And I worked there then from 2006 until 2017.

Q And when you worked there beginning in 2000, what was the scope of your responsibilities?

A General manager and engineer.

Q So were you on site each day?

A Yes; yes.

Q Were you an employee or a contractor?

A I was -- I was a contractor.

Q But it was your full-time job?

A Yes. Well, it wasn't my full-time job. I guess I never worked there as a full-time job, it was -- it has always been, like, three days a week and then on call -- if someone needed to talk to me, they could get ahold of me anytime. And a lot of times I worked the fourth day at home. At the same time I was working as a general manager for a limited partnership that we -- where we owned three other hydros in Michigan. And so I was -- I had a full scale -- a full plate, but I usually worked three days, sometimes three and a half or four days for Boyce. Well, for anyone, it was even before Boyce took over.

Q Please describe -- was it Wolverine who you worked for in 2000?

A Yes; yes.

Q So could you describe, please, what your job was as the general manager? Like, what sort of things would you do?

A Well, I'd supervise -- mainly, I supervised the -- the operators and was responsible for the production of the -- of electricity and I'd -- dealing with the state and with the FERC.

Q And when you say "the FERC" you mean the Federal Energy

Regulatory Commission?

A Yes.

Q So you were the main contact for Wolverine with the FERC?

A Yes.

Q And at the time that you worked for Wolverine, was the FERC trying to get Wolverine to increase the spillway capacity of the Edenville Dam?

A Yes.

Q What is your memory of those interactions with the FERC, with Wolverine?

A That was a long time ago. It seems to me we had to -- we had to kind of keep FERC informed of what our plans were. And the facilities at that time were owned by basically a financial banker in New York City, and they had very little intent of doing anything to increase the capacity. I think they were -- even at that time, they were looking towards selling.

Q How did you know that they had very little intent with doing anything?

A By their -- by discussions with them.

Q They just told you that?

A Yeah. They weren't -- they didn't really -- they didn't really want to spend the kind of money or to look for the kind of money it would take to increase the spillway capacities.

Q And is that what you told FERC, the FERC?

A Oh, I can't remember exactly what I told FERC, but I didn't -- I probably didn't say that specifically, but I -- I can't remember.

Q Was there a plan put in place when you were working for Wolverine to install a fuse plug emergency spillway?

A Yes; yes.

Q Could you please describe that plan?

A It was basically an auxiliary spillway at Sanford.

Q At Sanford or Edenville?

A No, at Sanford.

Q Oh, okay.

A The -- we were only about 5,000 cubic feet per second short of being able to pass the inflow design flood, which FERC required to be passed at every dam. And the -- the Sanford facility had the capacity to pass almost all of that. It was about 5,000 cfs short, so the solution was to build this auxiliary spillway. It was called a fuse plug because it was a concrete spillway built into the embankment with an earthen -- a small -- a low earthen embankment on top of the concrete so that if the water in the reservoir rose up a foot or two, it wouldn't go over the spillway. But if it was in a flood condition, it would go over this little berm on the concrete spillway before it topped the embankment and thus wash away the -- the berm on the concrete and allow the

water full passage through the spillway.

Q So a fuse plug spillway wouldn't normally have water --

A No, it would not.

Q -- coming over? Only in the extremes?

A Only in extreme flood, yes.

Q I understand. Were you ever involved in a plan to install a fuse plug spillway on the Edenville Dam?

A Yes.

Q Could you describe what that plan was?

A We -- after some -- some failed attempts by Boyce to try to design a major spillway, we came up with the idea to -- I think this was in conjunction with FERC, in conjunction with my conversations with FERC -- we decided to pursue an interim spillway that would not pass the IDF, but it would pass some significant flow. So the idea was to -- first to build one on the Tobacco side of the Edenville Dam. The Tobacco River comes in on the -- on one side, and the Tittabawassee River comes in on the other. So the idea was to first build one on the Tobacco side and then subsequent to that, to build one on the Tittabawassee side. So we started the design -- I started the design and -- well, basically finished it, almost a copy of what we had built at Sanford. Little heavier -- a little heavier construction, but it was basically the same thing. And I'd -- at that time, we were going through some evaluations on the

embankments with a couple of experts. And so FERC said, "We want you to sit down with these experts as a board of consultants and review your plans in detail to do this -- to construct the spillway -- before you construct the spillway at the Tobacco side." So we went through that for about a year, and FERC was at all of the meetings. They had two -- couple representatives at each meeting. And we got to the point where everything was set. The board of consultants had signed off on it saying, "This is a good plan, it'll work." And FERC hadn't formally accepted, but they were -- they were at the last meeting and they said, "Yeah, send it in and we'll -- we'll start the process going." And at that time, I even had a -- a construction schedule laid out and started to talk to contractors about getting started the next year, the next summer. And that's as far as it got. Lee Mueller, who was the main trustee, decided he was going to change the design. And so he started in on a -- a design that ended up never getting very far.

Q What year was that; do you remember approximately?

A Yeah, that year -- it was -- we were ready to start construction in 2015.

Q Why did Lee Mueller change the design?

A Lee had decided that he was going to build a -- a large travel trailer park on the dam on the Tobacco side of the spillway, on top of the spillway and downstream of the

spillway. And he had it pretty well designed, pretty well laid out. But the spillway that we had -- that I had designed and we had gone through with the board of consultants didn't really match very well with what his plan was. So he decided to change it so that he could still build -- in the future, still build his travel trailer park. And the project he came up with was just -- I would call it overwhelming. As an example, he ended up with I think it was 250 feet of 18-foot-high retaining wall. I mean, that in itself would've cost half a million dollars. The spillway that I had designed, because I -- because I had built the one at Sanford a few years before, I had a pretty good idea what it would cost. And the spillway I had designed I'm quite sure could've been built for about a half a million dollars. And we never got to a point of getting -- I don't think that we -- at least I was not aware of ever getting to a point where he had a price on -- on the facility he had designed.

Q Why did he want to build a mobile trailer park?

A I don't know; I don't know.

Q He didn't talk to you about it?

A No. I have no idea. That was only one of the -- one of the projects he wanted to construct there at the -- because there was quite a bit of land available in those four facilities, he wanted to build other things.

Q Can you remember what some of those other things are?

A Well, he wanted to build a -- he -- we -- he owned the -- Boyce Hydro owned 11 or 12 acres at Smallwood. He wanted to dig a huge pond in the middle of that 12 acres, construct a canal going out into the impoundment behind Smallwood so boats could go in and out, and then develop a subdivision around that. That was another one. He had a lot of other ideas that, just in passing, I never knew which -- which ones were serious and which ones weren't. Those two were serious.

Q Yeah.

A Because he'd started working on them.

Q So back to his idea at the Edenville Dam to build mobile trailer park, you had prepared these plans to build an auxiliary spillway, you thought it would be about a half million dollars, and then Lee pulled the plug on that 'cause he wanted to change the design?

A Right.

Q Okay. And was this explained to the FERC?

A He had some conversations with FERC, I did not. And I don't know what the -- what the context of those conversations were.

Q Did you ever have a conversation with the FERC where you explained what you just explained to me, that the reason that the auxiliary spillway wasn't constructed in 2015 was

"PMF passage concept was changed to reconstruct both spillways with larger gates." Do you see that?

A Uh-huh (affirmative).

Q At that early time in meeting number four, did you figure that it would be too expensive for Boyce to afford that?

A I think that was about the time we really just started it. I mean, we were discussing all kinds of things that as noted in the first three there, we were discussing the fuse plug ideas and the auxiliary spillway ideas from the beginning. Mainly because we did it at Sanford, and that was one thing that I think that FERC brought up initially. "Why don't you look at doing the same things you did at Sanford and see what that will do for you?" So a lot of things were being discussed in the first three meetings, including the stability of the embankments and the spillways. Then I think -- I think Lee suggested in this meeting that -- meeting four, that we were going to start looking at rebuilding the spillways.

Q And so going back to meetings maybe one and two, where it's talking about the fuse plug spillway at Edenville, why was that idea abandoned?

A Because it was never going to accomplish the full passage of water, so it would have been kind of an interim thing. And FERC was concerned that these facilities had gone for so long without anybody doing anything to try to increase the

capacities that we got to start showing some action here. And so that's why it was discussed early on, and -- at least I -- that's how I recall it was discussed. And then Lee had -- initially when he first took over, Lee had developed this grandiose plan of accomplishing the bypass by creating a huge marina inside the Edenville Dam and allowing that to be the fuse plug. And that took a year to -- he took it -- Chicago regional office didn't really want to do much with it. And so he took it to Washington and basically got thrown out of the office and so -- and FERC said, "Don't ever come back with anything like this again." And the consultant we had, and I, tried to tell him, "You can't cut into a dam the way you're trying to do here. They just won't accept it, that's part of their rules." So that delayed the whole process for a year or two. And then -- and then, you know, we got serious about other things.

Q Why did he want to put a marina in there?

A Well, to -- that was one -- that was one idea, to develop a cash -- cash project for him or for Boyce Hydro. That was one of the other -- that was the first idea he had.

Q Did that idea spark concerns with you about whether Lee was competent to operate a dam?

A I won't say -- I won't say that, no. But because he relied on me and the consultant to basically tell him what was -- what the operations and requirements were, but that didn't

always mean he was going to follow it. I mean, he had some ideas about how -- of a lot of things he wanted to develop. He, you know, the -- I think that the projects partly were cash flow for him, for Boyce Hydro, for the trustees, or for the -- all the beneficiaries.

Q So why can't you just a dig a marina into an embankment?

A Well, you can't -- you introduce some serious concerns about dam failure. You can't -- that's the primary concern. Other people have tried that, other people have proposed the same thing, and I think Lee got that idea from talking to some other people. But we said that it's never going to fly, but he tried it.

Q Had any other clients you had worked with proposed doing something like that?

A I -- no one I had ever worked with, but I had heard that -- through the grapevine that a couple other people have tried to do something like that, and it didn't fly.

Q So getting to meeting number four, this is after FERC and Washington, D.C. basically threw Lee out of the meeting, as you put it?

A That was his words.

Q Okay. Really beginning in meeting number four is when you started to seriously look at just completely reconstructing --

A Yes.

been working on higher rates for years. And I think that after I left, they -- the hydro power producers -- the independent hydro power producers in Michigan did get a rate increase, and it might have been significant. I don't know -- I never did find out what the details were, maybe I was told at one time, but I can't remember. But it was a significant rate increase, and so it might have been possible with that. In fact, I think it would have been because -- I mean, we wasted a lot of money on things that could've gone towards this.

Q Like what sort of things?

A Oh, he spent almost a half a million dollars trying to put on a music festival one summer at the site, and just -- you know, he was -- we were working as a regular -- he was working as a regular contractor. He had dump trucks and bulldozer and skid steers and backhoes and a $50,000 sawmill. What do we need that for?

Q So what do you mean he was working as a regular contractor?

A Well, doing work on our property, on the Boyce property there. Building roads and cutting trees and regrading areas and just -- lot of money.

Q Were there other things you can think of that you thought were wasting money? So the first you mentioned was the failed music festival --

A Yeah.

Q -- and you said they had a bunch of equipment that you didn't think they needed.

A Oh, yeah. And after -- and then after he got the equipment he built this large, very nice pole barn to keep them in and haven't had people working on the equipment in the pole barn. The sawmill operated about a month or a year cutting up lumber that -- of trees they cut down, which I didn't really see the -- the need to cut them down in the first place. And filling -- a lot of earth moving time, a lot of earth. Plus, we had all the equipment for it. Building -- built a new park and -- built a new parking lot for fishermen that we already had a paved parking lot for, built a new one right beside it and stopped them from using the paved parking lot. Just a lot of stuff that, for years, that -- he had a regular contractor almost on our payroll.

Q Doing what sort of things, the regular contractor?

A Pardon?

Q What sort of things was the regular contractor doing?

A It was that kind of stuff.

Q Yeah?

A Yeah, that kind of stuff.

Q And did you raise concerns with him about spending all this money instead of dedicating it towards increasing the spillway?

A Yes; yes.

Q What was his response?

A He just kind of shook his shoulders. "I got to make" -- he said, you know -- I and others tried to tell him, "You're in the hydro business now, you got to pay attention here." And he said, "I'm in the money making business."

Q And who were some of the others, you said you and others tried to tell him?

A Well, I think a couple consultants he had, the soils consultant he had from Chicago, a friend of his that was also in the energy business, the -- and the people, all the people who worked there of course, saw that -- what was happening.

Q Yeah. And did the people who worked there express concerns to you?

A Yes.

Q Who were they; do you remember?

A Well, the operators, the -- the guys that were operating the facilities.

Q What sort of concerns did they express?

A Well, you know, "Why are we doing all this construction work?"

Q Were they the ones doing the work?

A No; no, we had a -- separate people working doing that. Although, he -- in the -- towards the end, he did have some of the operators doing construction work, yeah.

Q And the construction work was like regrading things, you said building a parking lot?

A Well, like trying -- like trying to develop this pond and subdivision at -- at --

Q Smallwood?

A Smallwood. The property was 30 feet above the lake level, so we -- they were trying to dig a pond 35 or 40 feet deep, so then they could dig a canal out into the -- out into the impoundment. And I tried to explain to him that you got to -- first of all, you got to go have -- you got to go to DEQ and get a permit to do this. I mean, you know, you can't just go -- just can't do this on your own without -- you know, you're disrupting the river, you're disrupting the groundwater.

Q What did he say to that?

A Nothing.

Q What year did he try to put the music festival on; do you remember?

A I can't remember what year that was. Maybe around 2008, something like that; 2008.

Q Okay. And when did he tell you that he was "in the money making business"? Do you remember what that exchange was like?

A No, I don't know what -- it was just some conversation -- some -- probably when I reminded him again that -- did you

-- you should concentrate on being in the hydro business, you got to pay attention to FERC. He said, "I'm not in the hydro business."

Q Yeah, he's in the money making business.

A Yeah.

Q Okay. So back to the transition from the full eight-year reconstruction of the spillways to now looking at auxiliary spillways that would be smaller.

A Uh-huh (affirmative).

MR. GAMBILL: Let's mark this as Exhibit 12.

(Plaintiff's Exhibit 12 marked)

(Witness reviews document)

A Uh-huh (affirmative). Okay.

Q So I noticed that -- okay. Well, Exhibit 12 is a letter dated September 3rd, 2013.

A Yes.

Q And it's signed by Lee Mueller.

A Yes.

Q And I noticed that you are not copied on that. Have you seen this letter before?

A I probably have. I probably helped him make out this schedule.

Q So it's not unusual that you wouldn't have been copied, you were involved --

A No, sometimes it never happened, but I'd get some copy

organizational chart near the end. So about two pages from the very end is where it is.

A **I don't seem to have that.**

Q All the way at the very end, the second to last --

A **Oh, at the very end? Okay.**

Q Yup, second to last page.

A **Okay. Okay.**

Q So the organizational chart on Exhibit 14 --

A **Uh-huh (affirmative).**

Q -- lists you as the project manager.

A **Right.**

Q And then by -- when is this? This is 2015. So the next year though, the organizational chart on Exhibit 17 lists Lee Mueller as the project manager.

A **Right.**

Q What happened?

A **I said, "I'm not going to get involved in this one." I said, "You're -- this is your design, I don't agree with it, and I'm not going to do any more design work for you. If you want to build this, you run it."**

Q I see. But you're still listed as the structural engineer?

A **I did the structural engineering, the structural calculations for his numerous retaining walls.**

Q So the reason that the leadership of the project changed is because of your decision to back out?

A Right; yup.

Q And the next page is the CV for Lee Mueller as architect. Do you think that Lee Mueller was qualified to be the project manager for this type of work?

A Oh, yes. I think he would have been, yeah. He was an experienced architect and he could've done it.

Q Okay. Again, for Exhibit 17 --

A Yes.

Q -- if you look at the second page, is the design report. And when you compare that to the design report for Exhibit 14, the one from Exhibit 14 says it was prepared by Christie Engineering and it no longer says that for Exhibit 17.

A Right.

Q And that's for the reason you just explained?

A Yes.

Q Okay. Do you know if the FERC was aware of Mr. Mueller's plan to put the mobile home park on the dam?

A I don't know whether he did -- whether they were or not. I don't know.

Q You don't know if he --

A I did have a conversation one time with Peter Chapman though about why don't -- why doesn't FERC get involved? It -- you know, the basic argument here is that Boyce doesn't have enough money. Why doesn't FERC get involved in determining that? And he just said, "Well, we normally don't do that

kind of stuff."

Q And when you say "determining that," you mean having Mr. Mueller prove --

A That he didn't have enough money, yeah.

Q And Mr. Chapman just said --

A He said, "Well," he said, "That's above my paygrade, but we normally just don't get involved in that kind of stuff."

Q So you raised that prospect to the FERC to Mr. Chapman. Is that because you had concerns about whether Mr. Mueller was being fully transparent about whether he could afford the work?

A Well, I -- you know, I saw all the other stuff he was spending money on, half a million dollars to put on a music festival. I could've built the spillway.

Q Yeah. And so you thought maybe an audit would have --

A I didn't -- I -- yeah, I -- exactly. I couldn't -- I didn't have access to any financial information, so I didn't know how much all this was costing. But I mean, I've been around enough construction to know that there was a lot of money being spent doing other things.

Q So do you remember the FERC at one point asking for monthly reports about the progress of the Tobacco auxiliary spillway?

A They probably did. I don't remember specifically, but they probably did.

A Yes.

Q What do you remember about that lawsuit?

A Very little, actually, 'cause I just wanted to stay away from it for -- in the beginning, 'cause I didn't have anything to do with it. But I remember that Lee had called -- he had a -- he had been working with an environmental consultant out of Chicago on another project in Illinois. And so he called him in, he got an attorney too, and he called this other environmental consultant in to try to organize a -- with the attorney, organize a defense. And that's about all I know about it. I don't even -- there are too many problems. I don't know which one it was concerning.

Q Did Lee ever say to you, "Look, because DEQ filed a lawsuit we can't build the spillway now"?

A I don't think so.

Q Do you remember him expressing that type of concern that we have to just stop work on the spillway because of this lawsuit?

A I don't remember that -- him saying that, no. Maybe he did, but I don't remember it.

Q Okay. So it sounds like the main impediments to getting the Tobacco auxiliary spillway constructed from your perspective were the power line and the gas line that needed to be moved?

A Yeah, those questions had to be answered. They had to be moved before we could begin construction.

Q Did that happen before you retired?

A No.

Q So when did you retire?

A In May of 2017.

Q So at that time, what was the status of the auxiliary spillway on the Tobacco side?

A I think it was still up in the air. I think it was still in -- still trying to get those two things resolved, and then they would -- would propose to go ahead with his design of that spillway.

Q And his design included the mobile home park?

A No, it didn't include the park itself, but it -- it's -- it contoured all of the land in that area so that he could move in and build his mobile home park after that was completed.

Q What do you mean by "contoured"?

A Well, he required -- you know, to have a mobile home park like that, you need a lot of fairly level land, and it wasn't -- the land wasn't very good that way. And so two things had to happen. He had to get some level -- some significant level land, and he had to protect that from the overflow spillway. If the water came over the spillway, you couldn't have any of the -- going into any of the mobile home area. So that would -- that's what all the big

retaining walls were for, to isolate the spillway flow and develop level land.

Q So it wasn't that his design included that mobile home park, but it laid the groundwork to construct it later?

A Yes; yes.

Q And that's a design that you didn't want to be a part of?

A Yes.

Q Okay.

A Because there was no reason for it. I mean, no reason for -- no reason to encumber the passage of flood by all that work.

Q And you made this very clear to Lee. Was there any confusion on his part about your opinion?

A No; no; no.

MR. GAMBILL: Let's mark this as Exhibit 20.

(Plaintiff's Exhibit 20 marked)

(Witness reviews document)

A And so the gas line -- the gas line was also Consumers.

Q Okay. So by -- well, first, do you -- this is a letter dated December 26th, 2016. Do you see that?

A Yes.

Q And you're copied on it, but it's from the FERC and it's directed to Mr. Lee Mueller. Do you see that?

A Yes.

Q Okay. And FERC is telling Mr. Mueller, "Please" -- well, I

can just read the words. It says, "The design of the auxiliary spillway should be finalized and submitted to FERC for review."

A Yeah, that was when Lee was working on the redesign.

Q And they are pressing him -- this is 2016, --

A Right.

Q -- so this is just about five, six months before you retire?

A Yeah.

Q So by the time you retired, had he actually --

A Well, this was -- well, this was a year -- a year and four months before I retired.

Q Didn't you retire in May 2017?

A Yeah.

Q So this is December 2016.

A Oh, I'm sorry. Yes, yes, yes. Six months, yeah. I'm sorry.

Q No, that's fine. And so by the time you retired, had Lee submitted --

A Nothing had happened that I knew about, no.

Q Okay. Other than the Consumers Energy problems, what was the holdup from Lee's perspective; do you know? Why didn't he just submit the design work?

A I don't know.

Q He didn't explain that to you?

A I have no idea. But I know that the design he was proposing

was significantly more than a half a million dollars, probably over a million dollars.

Q So it was much more expensive --

A Yeah.

Q -- because of the retaining walls and --

A And he didn't realize -- maybe he -- he might have been closing in on trying to -- he thinks -- he thought he was closing in on a deal with Consumers. Maybe he thought he was going to get that straightened out before he had to start building.

A I see.

Q So why did you retire when you did?

A Because of this kind of stuff. You know, specifically -- well, this is what I told Lee too. Specifically, I had been -- I had spent three months in Florida with my wife and I had come back -- I did work from down there, and I'd come back once a month for a week and see what was going on. And we had a problem with a head gate at Sanford, a gate that -- there are two big gates you could close and isolate the turbine from the impoundment, so there's no water in the turbine bay. Those gates had deteriorated, and I don't think they -- I can't remember whether we had already removed them or whether we determined that they wouldn't stand up if something hit them, if a tree hit them or something like that. And if the gates weren't there, it

would destroy the turbine and probably the generator because the flow would go through there, the flow would just -- there was no way that we could shut a -- let me back up. If something went wrong with the turbine and we had to shut it down, there's no -- like, the generator went offline, like, let's say we lost power with Consumers -- from Consumers. We couldn't give them power, we had to shut all the turbines down. If that -- and if we wanted to do any work on that turbine, we had -- we would close the gates and dry it out. If we did that, then the gates failed, it would -- the turbine would just run away, it would go way into overspeed. It was supposed to run at -- at I think it was 225 RPMs, could go to 6-, 7-, 800 RPMs, whatever. It would destroy the generator and probably the turbine. Major problem. So I -- we -- I had worked with -- before I -- before the end of the year, before December 22nd -- 26th -- I'd worked with the operators who got all the material we needed, or they know how -- they knew -- they were in the process of getting it, and they were to rebuild the two gates during the winter months when nothing else was going on, and we would get them back in as soon as possible. Whenever I went back that winter, nothing was happening on the gates. And I called Lee about it a couple times, and I said, "You know, we got to -- you know, we got to get this done. This is a dangerous situation." And he said, "Okay. Okay. Well,

I'll get them going on it." But every time I went back, they were digging this pond up at Sanford, not -- at Smallwood, and trying to get down and deep enough to dig a channel to the pond. And so when I got back -- when I got back full time, nothing had been done on the gates. So I said, "This is it." I said, "Enough problems. I mean there are a bazillion problems around here, but if they're not going to address the immediate concerns, I'm done."

Q So for you that was the tipping point?

A Yeah.

Q So your concern was that you had identified this major problem at Sanford, --

A Yeah.

Q -- informed Lee of the need to fix it, and instead of fixing it he was preoccupied with the Smallwood pond?

A He had the guys up there digging holes the first -- around Smallwood.

Q And for you, are you identifying that as the tipping point but also as just one example of many?

A One of many as I've described here today.

Q And the Tobacco auxiliary spillway for you was another example of --

A Yes.

Q -- why not just do it --

A Yeah.

Q -- and get it done? Instead Lee is preoccupied with the mobile home project idea.

A Yes; yes.

Q Can you think of other examples?

A Well, there were others too, yes. The -- this spending money on -- with all this construction activity. And everyone knew -- you know, everyone that worked there, you know, were just kind of shaking their heads. "Why are we putting on a music festival? Why are we building these roads and doing all this logging on some of the property we got?" Wasn't warranted.

Q Do you remember speaking with Ron Heilig about that?

A Who?

Q Ron Heilig, does that ring a bell?

A Oh, Ron. I'm sorry. I'm sorry. Ron, yeah; yeah; yeah.

Q I just pulled that name completely out of context.

A Yes; yeah. Those guys, Ron Heilig and --

Q Greg --

A -- and Greg Uhl, I mean, they brought this stuff up to me. You know, I didn't have to mention it to them. In fact, I went out of my way not to mention any of this stuff to any of the employees, but they would bring it up to me.

Q And what were their concerns?

A Same thing, you know. "Why are we doing this? You know, we should be -- we should be rewinding the number two generator

EXHIBIT G - BRIEF IN SUPPORT OF MOTION FOR SUMMARY JUDGMENT

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY, AND THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES,

Plaintiffs,

v

LEE MUELLER; BOYCE MICHIGAN, LLC; EDENVILLE HYDRO PROPERTY, LLC; BOYCE HYDRO POWER LLC; BOYCE HYDRO, LLC; WD BOYCE TRUST 2350; WD BOYCE TRUST 3649; AND WD BOYCE TRUST 3650,

Defendants.

No. 1:20-cv-528

HON. PAUL L. MALONEY

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DECLARATION OF DR. SCOTT M. OLSON UNDER 18 U.S.C. § 1746

1. My name is Dr. Scott M. Olson. I am a professor of civil engineering at the University of Illinois Urbana-Champaign and am an expert in, among other things, static liquefaction. "Static liquefaction" is a phenomenon that can occur in

loose soils within an earthen dam. To put it simply, the loose soil can suddenly lose strength and behave like a liquid rather than a solid because, among other triggering mechanisms, it becomes saturated with water under pressure.

2. My curriculum vitae is attached to this declaration.

3. I prepared a report in this case that summarizes my expert opinions related to aspects of the May 19, 2020 failures of the Edenville and Sanford dams. The report is attached to this declaration. It explains my opinions and the information I reviewed to reach them. I could testify about the contents of the report if needed.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: May 5, 2023

Dr. Scott M. Olson

LF: Dam-Mueller, Boyce Hydro (EGLE & DNR v)/AG# 2020-0291918-C-L/Declaration of Dr. Scott M. Olson 2023-05-03

Department of the Attorney General
The State of Michigan

Topic: Litigation related to May 19, 2020 failure of Edenville and Sanford dams
Expert opinions on static liquefaction, cause(s) of dams' failure, and civil engineering

Prepared for: Michigan Department of Attorney General
c/o Mr. Nathan Gambill
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Prepared by: Scott M. Olson, PhD, PE
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Submitted: December 7, 2022

This memorandum summarizes my expert opinions related to aspects of the May 19, 2020 failures of the Edenville and Sanford dams, located in central Michigan. Specifically, the Michigan Department of the Attorney General (Department) requested that I provide opinions on the following issues.

- The reliability of the Independent Forensic Team (IFT) report and their methodology
- The potential impact of water levels on triggering of static liquefaction in the Edenville embankment dam
- The potential impact of regrading, buttressing, or otherwise reinforcing the downstream slope on triggering of static liquefaction in the Edenville embankment dam

This work was authorized by the Department under an Agreement between the Department and Scott M. Olson, PhD, PE, executed on July 18, 2022. My fees are as follows: Consulting at $300/hr; Travel time at $300/hr; Deposition/Court Testimony at $300/hr; and expenses are billed at cost.

1.0 Documents reviewed

To prepare my opinions, I reviewed the following documents provided to me by the Department.

- Final report, Investigation of failures of Edenville and Sanford dams, Independent Forensic Team, dated May 2022

- Email correspondence between Lee Mueller and Irfan Alvi, dated November 2021
- 2005 Consultant's Safety Inspection Report, Edenville Hydroelectric Project, prepared by Mead & Hunt, dated December 2005
- 2010 Consultant's Safety Inspection Report, Edenville Hydroelectric Project, prepared by Mill Road Engineering, dated December 2010
- 2015 Consultant's Safety Inspection Report, Edenville Hydroelectric Project, prepared by Purkeypile Consulting, LLC, dated March 2016
- Supporting Technical Information Document, Edenville Hydroelectric Project, unknown author(s), undated (but after April 2015)
- Design Report, Dam Modifications for Upgrading Spillway Capacity, Edenville Hydroelectric Project, prepared by Christie Engineering, dated October 2012
- Embankment Underdrain Investigations, Sanford Hydroelectric Project, Edenville Hydroelectric Project, Smallwood Hydroelectric Project, prepared by Christie Engineering, dated November 2014
- Draft Labyrinth Weirs – Technical Memorandum, Edenville Hydroelectric Project, prepared by Purkeypile Consulting, LLC, dated February 2019
- 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, and 2018 FERC Dam Safety Inspection Reports for Edenville Hydroelectric Project

2.0 Opinions related to IFT Report

The IFT concluded that the "physical mechanism of the May 19, 2020 failure of Edenville Dam was static liquefaction…in a section of the [left] embankment, which resulted in instability failure of the downstream slope and then breach of the reservoir through the dam…When Edenville Dam failed, the resulting downstream flooding caused [the] overtopping failure of Sanford Dam." This interpretation was based on several factors, including the following.

- Historical construction records, photographs, and correspondence
- Interpretation of physical observations including photographs prior to failure, cell phone video of the failure, and eyewitness interviews
- Post-failure field and laboratory investigation of remaining embankment sections adjacent to the failed section
- Detailed hydrologic and hydraulic assessment of conditions preceding the failure
- Review of limited available (pre-failure) geotechnical data, including drainage conditions
- Evaluation of historical instrumentation data (chiefly data from observation wells/piezometers) and reservoir lake levels
- Conduct of geotechnical analyses including limit equilibrium slope stability analysis, stress state analysis (using finite element/finite difference methods), and post-liquefaction kinetics analysis
- Professional judgment paired with a thorough deductive reasoning process

Based on my review of the IFT report and all other documents listed in Section 1.0, it is my opinion that the IFT report is reliable and their conclusion that the failure of Edenville Dam was triggered by static liquefaction of a portion of the left embankment is the correct conclusion. Furthermore, I agree with the assessment of the IFT that the failure of Sanford Dam by overtopping essentially was inevitable given the breach of the Edenville Dam. As such, I will not provide any further opinions related to the Sanford Dam failure.

In my opinion, the deductive reasoning process employed by the IFT to eliminate other potential failure mechanisms of the Edenville embankment was reasonable and defensible. In addition to considering static liquefaction, the IFT systematically evaluated the potential for overtopping, internal erosion, and drained slope instability mechanisms to have triggered the Edenville embankment failure. These three potential failure mechanisms were found to be inconsistent with the eyewitness, photographic, and video observations, as well as the kinetics of failure. I agree with the arguments made by the IFT.

For static liquefaction to occur, at least three criteria must be met: (1) soils susceptible to liquefaction must be present in the embankment and/or foundation; (2) the static (pre-failure) shear stresses must exceed the available shearing resistance (including the liquefied shear strength) along a potential sliding surface; and (3) a triggering mechanism must be present to initiate (trigger) liquefaction in the susceptible soils. Each step of the IFT's analysis was important to show that these three criteria were met at the time of the failure; however, the key factors that led me to support the IFT's conclusion are as follows. [I note that I was not asked to perform any analyses to confirm the findings of the IFT report. My opinions below are based on my experience performing similar analyses for numerous similar structures.]

1. Loose, fine-grained, clean sand fill was present in the downstream shell above the foundation hardpan. Based on historical construction photographs and correspondence, this fill likely was dumped into place and likely received little to no compaction. A dumped-in-place, uncompacted, fine-grained, clean sand is likely to be contractive and brittle, and this response was tentatively confirmed by a limited number of consolidated-undrained triaxial compression tests. Furthermore, the downstream embankment shell further to the west (variously termed the right Edenville embankment, the right Tittabawassee embankment, and the central embankment) was described as being constructed using loose fill. Limited standard penetration test (SPT) blow counts suggested that the downstream Edenville embankment sandy fills often exhibited blow counts less than 10.

   Hydraulic conditions interpreted at the time of the flood as well as available historical piezometer data suggest that the lowest portion of the downstream Edenville embankment fill likely would have been saturated at the time of the failure.

   This evidence suggests that the downstream Edenville embankment fill was saturated, contractive, and brittle, i.e., susceptible to flow liquefaction.

2. The downstream Edenville embankment slope appeared to be steeper than the design 2H:1V slope, with the IFT estimating that the slope may have been as steep as 1.7H:1V in the area that failed. The IFT performed finite element analyses to estimate the in situ stresses in the downstream shell fill. These analyses indicated significant static shear stress ratios (τ/σ'_v, where τ = static shear stress and σ'_v = effective vertical stress) in the liquefiable soils may have been greater than about 0.30. Considering the relatively low values of SPT penetration resistance, the values of liquefied shear strength ratio [$s_u(liq)/\sigma'_v$] are likely to be smaller than about 0.10 (Olson and Stark 2002[1]).

   While this difference in τ/σ'_v and $s_u(liq)/\sigma'_v$ is distinct, this difference alone does not represent the shear stress and shearing resistance (including the liquefied shear strength) along an entire potential sliding surface. For a liquefaction flow failure to occur, the factor of safety (*FS*) for a potential sliding surface must be less than unity (1.0), where *FS* is defined in limit equilibrium analysis as:

$$FS = \frac{\sum Shearing\ resistance\ along\ entire\ sliding\ surface}{\sum Shear\ stress\ along\ entire\ sliding\ surface}$$

   The reconstructed geometry and hydraulic conditions of the Edenville embankment suggest that several potential sliding surfaces would exhibit *FS* less than unity if the liquefied shear strength were mobilized in the liquefiable soils. In my opinion, the results of the finite element analyses (to determine the initial state of stress) and limit equilibrium analyses (to estimate slope stability factors of safety) appear reasonable and defensible.

   This evidence and interpretation suggest that if liquefaction was triggered in the liquefiable soils, a liquefaction flow failure of the downstream Edenville embankment slope was likely to occur.

3. The IFT concluded that porewater pressure increase (i.e., a rising phreatic surface) in the downstream Edenville embankment fill could have served as a trigger for static liquefaction. While in some cases triggers for static liquefaction can be ambiguous, it is my opinion that a rising phreatic surface (i.e., constant deviator stress path) in the liquefiable fill soils is a plausible triggering mechanism for the Edenville embankment fill. Furthermore, this mechanism is not without precedent, with the best-known case involving static liquefaction triggered by a rising phreatic surface being the 1907 flow failure of the North Dike of Wachusett Dam in Massachusetts (Olson et al. 2000[2]).

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[1] Olson, S.M. and Stark, T.D. (2002). Liquefied strength ratio from liquefaction flow failure case histories. Canadian Geotechnical Journal, 39, 629-647.

[2] Olson, S.M., Stark, T.D., Walton, W.H., and Castro, G. (2000). Static liquefaction flow failure of the north dike of Wachusett dam. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 126(12), 1184-1193.

This historical precedent supports the IFT postulate that static liquefaction likely was triggered by a rising phreatic surface in the downstream Edenville embankment.

3.0 Opinions on potential impacts of various factors on static liquefaction triggering

In this section, I provide my opinions related to the potential impacts of reservoir water levels and regrading/buttressing/reinforcing the slope.

Reservoir water levels. Although the IFT identified a rising phreatic surface in the downstream Edenville embankment fill as the triggering mechanism for static liquefaction, they were unable to pinpoint the precise phreatic surface elevation and reservoir water level required to trigger static liquefaction. Even if the IFT had performed a suite of finite element analyses (i.e., a sensitivity analysis), it is my opinion that it still would not have been possible to confidently define the precise phreatic surface elevation and reservoir water level required to trigger static liquefaction. Some of the reasons for this ambiguity is that several factors that impact the analysis are not known with certainty. These include: (1) the exact stratigraphy of the embankment; (2) the geotechnical properties (permeability, stiffness, and strength) of the liquefiable and non-liquefiable embankment fill soils; (3) the efficiency of drains located adjacent to the failed zone; and (4) the freeboard height at the time of failure.

More importantly, the phreatic surface in the downstream portion of the embankment would have risen: (1) as the reservoir water level rose monotonically; and (2) as reservoir water levels were sustained at a high elevation. Furthermore, there were no piezometers or observation wells in the vicinity of the failure to calibrate hydraulic models prior to the failure. A properly calibrated hydraulic model would improve the forecasting of the phreatic surface in the embankment during the flood. Because of these issues, it is my opinion that it is not possible to precisely define the phreatic surface elevation and reservoir water level at which liquefaction would be triggered.

However, it is also my opinion that if reservoir water levels had been limited to historical highwater levels, static liquefaction would have been unlikely to occur. As discussed in the IFT report, an upgraded spillway system designed to handle the probable maximum flood (PMF) would have limited reservoir water levels to elevations lower than historical highwater levels (analyses suggested that this upgraded spillway would have resulted in no rise in reservoir water level) and would have prevented the May 19, 2020, static liquefaction flow failure.

Regrading/buttressing/reinforcing the slope. As discussed above, the steep downstream Edenville embankment slope (as steep as 1.7H:1V) and the attendant high static shear stresses were a prerequisite to static liquefaction failure. Any effort to reduce the static shear stresses in the downstream slope would have decreased the potential for triggering static liquefaction. The shear stresses in the slope would be reduced by flattening the downstream slope (i.e., regrading), constructing a downstream buttress (i.e., stabilizing berm) similar to that

constructed in other areas of the Edenville embankment (albeit, these berms were constructed for other reasons), or installing structural reinforcing elements (e.g., an anchored wall) or ground improvement (e.g., soil-cement mixing). Conventionally, structural reinforcing elements to mitigate a potential slope failure would involve relatively heavily loaded tieback anchors attached to a reinforced concrete drilled shaft wall installed at a target (design) location along the downstream slope of an embankment. Similarly, a significant volume of ground improvement would be required to mitigate a potential slope failure.

With rigorous geotechnical analysis, the details of the regrading, buttressing, or reinforcing could be defined. However, this analysis would involve some limitations as a result of the uncertainties identified above related to evaluating the effects of the reservoir water level. Nevertheless, a properly designed buttress (or alternative), to a reasonable degree of certainty, would have prevented static liquefaction failure regardless of the triggering mechanism.

I understand that the dam owner as part of Edenville (Tittabawassee) dam spillway repairs (construction/repair was considered in 2012 and 2018), the owner considered constructing over the entire length of the Edenville left embankment an upstream anchored bulkhead/sheet pile wall system that would widen the embankment dam crest at the east end of the Edenville spillway. The purpose of widening the Edenville left embankment in this area would be to allow for staging and construction access to the Edenville spillway from the left (east) abutment. Preliminary sketches of the anchored bulkhead/sheet pile wall system developed for the 2012 repair documents indicated that the sheet pile wall would be anchored to the existing sheet pile wall (and concrete cap) in the vicinity of the spillway. No sketches or details were available for the remainder of the Edenville left embankment; however, presumably this section of the anchored bulkhead/sheet pile wall system would have included a deadman anchor.

It is my opinion that an anchored bulkhead/sheet pile wall system similar to that devised in 2012 would have fulfilled three purposes: (1) creating additional crest width; (2) creating structural capacity; and (3) slowing seepage volumes through the embankment. As the failure occurred largely within the downstream portion of the embankment, creating additional upstream crest width would not have affected significantly the May 19, 2020, static liquefaction failure. Similarly, the added structural capacity from the sheet piles and any anchors that intersected the failure surface would be relatively minor and likely would not have been sufficient to preclude the May 19, 2020, failure. However, if the sheet piles were driven to the hardpan clay foundation, this would form a cutoff wall that would reduce and slow seepage through the embankment and any natural foundation sands present above the hardpan, particularly under the transient increases in reservoir water level during the May 2020 flood. In this scenario, I judge that the sheet pile wall would have been more likely than not to have prevented the failure.

4.0 Closure

Static liquefaction is known to be triggered by a variety of loading and unloading mechanisms. While several factors likely contributed to liquefaction triggering on May 19, 2020, the unprecedentedly high reservoir water level almost certainly was a primary factor.

Until a series of high-profile static liquefaction flow failures of tailings storage facilities occurred between 2014 and 2019, static liquefaction was not widely recognized or considered as a potential failure mode for hydropower dams. As a result, the potential for static liquefaction of the Edenville embankment was not recognized by the various dam owners, the owners' engineers, or regulators. Furthermore, the geotechnical characterization and instrumentation of the Edenville embankment was insufficient to assess properly the potential for static liquefaction along the full length of the embankment. However, as noted in the IFT report, a consultant was retained in 2001 to evaluate the stability of the Secord Dam embankment and this consultant did identify static liquefaction as a potential failure mode (although another consultant later disputed this conclusion). This consultant was not retained to perform a similar evaluation of the Edenville Dam embankment.

As discussed above, it is my opinion that it is not possible to precisely define the phreatic surface elevation and reservoir water level at which liquefaction would be triggered. However, it is also my opinion that if reservoir water levels had been limited to historical highwater levels, static liquefaction would have been unlikely to occur. As discussed in the IFT report, an upgraded spillway system designed to handle the probable maximum flood (PMF) would have limited reservoir water levels to elevations lower than historical highwater levels (analyses suggested that this upgraded spillway would have resulted in no rise in reservoir water level) and would have prevented the May 19, 2020, static liquefaction flow failure.

Furthermore, it is my opinion that a properly designed buttress, properly designed regrading of the downstream slope, or properly designed and robust structural reinforcement or ground improvement of the downstream slope, to a reasonable degree of certainty, would have prevented static liquefaction failure regardless of the triggering mechanism. Furthermore, in my opinion the proposed anchored bulkhead/sheet pile wall system, if properly designed and constructed as a seepage cut off wall (in addition to its proposed role to widen the dam crest), would have been more likely than not to have prevented the May 19, 2020, static liquefaction failure.

Scott M. Olson, PhD, PE

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Professional History

Dr. Olson is a Professor of Civil & Environmental Engineering at the University of Illinois, where he has been on the faculty since 2004. Prior to joining the faculty at Illinois, Scott worked for seven years as a project engineer for URS Corporation (2001-2005) and Woodward-Clyde Consultants (1995-1998). Dr. Olson has researched the triggering and consequences of liquefaction in sands, silts, and tailings, and geotechnical earthquake engineering in general, for 25+ years, and has been involved in dozens of research and consulting projects involving geotechnical earthquake engineering including seismic hazard assessment; ground motion evaluation; site response; liquefaction analysis; static, seismic, and post-liquefaction stability; and ground modification analyses and design. Dr. Olson also served as an Adjunct Associate Professor for the University of Missouri at Rolla (now Missouri University of Science and Technology) for the 2003-04 academic year.

Prof. Olson's research interests include liquefaction and geotechnical earthquake engineering; laboratory and centrifuge testing of sands, tailings, transitional soils, and clays; in situ testing; paleoliquefaction and geohazard analysis; and soil-foundation-structure interaction. To support this research, he has received over $9 million in grants from the National Science Foundation, U.S. Geological Survey, Army Research Office, Illinois Center for Transportation, U.S. Agency for International Development (USAID), Nuclear Regulatory Commission, and the Department of Energy.

Education

University of Illinois at Urbana-Champaign	Civil/Geotechnical Engineering	Ph.D.	2001
University of Illinois at Urbana-Champaign	Civil/Geotechnical Engineering	M.S.	1995
University of Illinois at Urbana-Champaign	Civil Engineering	B.S.	1993

Consulting Experience since 2004

Dr. Olson maintains close ties with industry to ensure that his research is relevant to practicing engineers and that his students are exposed to challenging, "real world" projects. The abridged list below provides an overview of his consulting experience on select recent projects. Representative clients include Kiewit Engineering, AECOM/URS Corporation, Vale S.A., ArcelorMittal, Cleveland Cliffs, Barr Engineering, AngloAmerican, Shell Oil Company, Teng and Associates, HNTB Corporation, the Montana Dept. of Natural Resources, the U.S. Dept. of Justice, and numerous law firms.

- Provided training for numerous civil engineering consulting firms related to in situ testing, cone penetration testing, instrumentation, seismic site response, and liquefaction analysis.
- Evaluated static and seismic stability of riverbank slopes encroaching on active and abandoned fly ash ponds/embankments.
- Served on International Board of Experts in Risk and Safety Management for a large mining firm to assist them in developing risk-informed methods to assess their tailings dam portfolio.
- Provided technical input for liquefaction triggering and post-triggering stability analyses (performed by others) for a large earth dam in Washington.
- Reviewed stability/liquefaction analyses (performed by others) for numerous tailings dams in U.S., Brazil, the Dominican Republic, South Africa, and elsewhere.
- Reviewed seismic analysis (ground motions, pseudo-static stability analyses, and liquefaction analyses) performed by others for a large earth dam in Montana.
- Evaluated property damage claims related to blasting-induced vibrations in southeastern Missouri.
- Evaluated ground motions, site response, liquefaction, lateral spreading, seismic stability, and ground improvement for new I-70 bridge over Mississippi River and approach interchanges in Illinois and Missouri.

- Evaluated ground motions, site response, liquefaction, lateral spreading, seismic stability, and ground improvement for numerous public utilities and private companies in the St. Louis region.
- Evaluated site response, liquefaction, seismic stability, and ground improvement analyses (performed by others) for new bridges over the Fraser River and Pitt River in British Columbia.
- Evaluated liquefaction and aging effects of tailings materials for a tailings dam facility expansion in Utah.
- Evaluated liquefaction and aging effects of tailings materials for a tar sands tailings facility in Alberta.

Professional Project Experience prior to 2004

Dr. Olson was involved in dozens of projects while employed by Woodward-Clyde Consultants and URS Corporation prior to joining the faculty at Illinois in 2004. The abridged list below provides a brief overview of his professional experience on select projects.

- Managed and led geotechnical, earthquake, and foundation engineering analyses and prepared final geotechnical report for new U.S. District Courthouse in Cape Girardeau, Missouri. Site challenges included very strong seismic shaking, liquefaction, karstic and fractured bedrock often with very soft clay infilling, and a shallow watertable. Provided contractor support for differing site condition claim.
- Designed 60-ft deep tieback wall system for perimeter walls of proposed parking garage as part of design-build project for University of Missouri, St. Louis, Missouri.
- Evaluated geotechnical properties of 80-foot thick soft clay deposit. Evaluated stability of and designed deep soil mixing remediation for 35-foot excavation for foundation of Baby Creek Wastewater Treatment Plant, Detroit, Michigan. Evaluated ground behavior and loads in very soft clay for 300-foot long, 102-inch diameter tunneled section of sewer replacement.
- Conducted geotechnical analyses for construction of two large-diameter (31 ft and 24 ft) tunnels through horizontally stratified, jointed dolomite and shale under high horizontal stress conditions for McCook Haul Tunnels, McCook, Illinois. Evaluated loads on tunnels, ground behavior, construction techniques, and potential difficulties. Prepared Geotechnical Data Report and Geotechnical Baseline Report for inclusion with Contract Documents.
- Conducted geotechnical design for construction of two stormwater tunnels through swelling and squeezing ground consisting of interbedded shales and limestones and residual clay soils for Lambert-St. Louis International Airport Expansion, St. Louis, Missouri. Evaluated loads on tunnels, ground behavior, construction techniques, and potential difficulties. Prepared Geotechnical Data Report and Geotechnical Baseline Report for inclusion with Contract Documents.
- Conducted vibration analysis for large pile-supported mat foundation for electric power turbine at Greater Des Moines Energy Center, Des Moines, Iowa. Evaluated auger-cast pressure-grouted displacement pile axial and lateral capacities, primary and secondary settlements, and liquefaction of loose fly ash layer.
- Conducted geotechnical analyses and designed support systems for 10-ft ID tunnel through soft tuff bedrock at Diamond Drive, Los Alamos, New Mexico. Designed permanent support systems for portal cuts greater than 50 feet in height. Prepared Geotechnical Interpretive Report, as well as construction plans and specifications for the tunnel.
- Conducted geotechnical analyses and designed foundations systems (shallow footings, drilled shafts, driven piles, and pin piles) for various proposed power plant improvements, including a 600-ft high stack at Tennessee Valley Authority Paradise Fossil Plant, Paradise, Kentucky. Managed geotechnical construction phase services.
- Conducted geotechnical analyses and designed foundations systems (shallow footings, drilled shafts, and auger-cast piles) for various improvements at ConocoPhillips Refinery, Wood River, Illinois.
- Performed field investigation, conducted geotechnical analyses, designed foundations systems, and managed project to construction foundation systems (shallow footings and auger-cast piles for improvements at Big River Zinc Foundry, Sauget, Illinois.
- Led efforts to evaluate primary and secondary settlement analysis and assisted with vertical drain and surcharge design for widened and new embankments up to 45-ft high for I-15 reconstruction in Salt Lake City, Utah. The embankments were constructed on soft, clayey soils and post-construction settlements were limited to 3 inches over 10 years. Also conducted static and seismic slope stability analyses, evaluated compressibility and strength properties using CPT data, and prepared interim and design reports.

- Reviewed static and seismic slope stability analysis for 150-ft high baled waste landfill in Indiana. Evaluated foundation failure, failure through waste, and geocomposite cover stability.
- Evaluated geotechnical properties for 60-ft thick deposit of soft clay in Chicago, Illinois. Conducted settlement and stability analyses for proposed new approach embankments. Provided shallow foundation, drilled shaft, and construction recommendations. Prepared preliminary geotechnical report.
- Evaluated geotechnical properties for municipal solid waste and soft clay in Ohio. Conducted and reviewed seismic and static slope stability analyses for 150-ft high final landfill slopes 80-ft interim waste slopes adjacent to 60-ft cuts in soft clay.
- Evaluated geotechnical properties for municipal solid waste and soft mine spoils in Ohio. Properties were used to conduct settlement and slope stability analyses for 190-ft landfill partly constructed over mine spoils. Evaluated deformation and integrity of geosynthetic bottom liner system.
- Evaluated geotechnical properties for municipal solid waste and construction debris in Ohio. Conducted and reviewed settlement calculations for 100-ft construction and demolition debris landfill constructed over existing 100-ft municipal solid waste landfill.
- Evaluated extensive laboratory and field testing programs to define geotechnical properties for very soft sludge and mixed waste, as well as natural alluvial soils. Conducted and reviewed static and seismic slope stability analyses for 50-ft sludge and mixed waste landfill in Ohio constructed near bank of a major river.
- Developed dam failure warning system activation logic based on liquefaction, seismic stability, and seismic deformation analyses performed by the U.S. Army Corps of Engineers for Tuttle Creek Dam, Manhattan, Kansas. Designed instrumentation system to monitor seismic performance of the dam. Managed field investigations and designed foundations for warning siren towers in the City of Manhattan.
- Assisted with managing project and prepared final report for geotechnical earthquake engineering for proposed new 1500-ft long cable-stay bridge over Mississippi River from Desha County, Arkansas to Bolivar County, Mississippi. Conducted liquefaction, seismic slope stability, lateral spreading, and site response analyses. Oversaw field investigation and interpreted all test results.
- Managed and conducted geotechnical earthquake engineering study for new research building for pharmaceutical firm, Missouri.
- Conducted and reviewed analyses for liquefaction potential, seismic site response, static and seismic slope stability including post-liquefaction stability and cover liner system stability, lateral spreading and deformation analysis, and post-liquefaction settlement analysis for landfill in Oregon.
- Conducted field investigation, seismic hazard, site response, liquefaction, lateral spread and flow failure stability analyses for seismic retrofit design for Interstate 57 bridge in Cairo, Illinois. Evaluated remedial options and recommended use of pin piles to retrofit bridge foundations and mitigate damage resulting from extensive liquefaction of alluvial deposits.

Publications

Based on Prof. Olson's research, he has published nearly 160 peer-reviewed book chapters (B), journal articles (J), conference papers (C), and technical reports (R), winning the 2002 best paper award (R.M. Quigley Award) from the Canadian Geotechnical Journal. These publications are listed below.

B3 Olson, S.M. (2015). Residual strength of liquefied soil. Chapter 15, Encyclopedia of Earthquake Engineering, M. Beer, I.A. Kougioumtzoglou, E. Patelli, and I.S.-K. Au, editors, Springer Publishing.

B2 Hashash, Y.M.A., Kim, B., Olson, S.M., and Moon, S. (2014). Geotechnical issues and site response in the central U.S. Chapter 6, Seismic Hazard Design Issues, J. Beavers, editor, ASCE Press, Reston, VA.

B1 Olson, S.M. (2009). Field evaluation of liquefaction susceptibility of soils with high fines content. Appendix, Paleoseismology, 2nd Edition, J.P. McCalpin, editor, Academic Press, San Diego, CA.

J66 Tsai, C.-C., Su, J.-W., and Olson, S.M. (2022). Prediction model for shear wave velocity of gravel and its application to liquefaction triggering assessment. submitted to ASCE Journal of Geotechnical and Geoenvironmental Engineering, accepted for publication.

J65 Numanoglu, O.A., Hashash, Y.M.A., Olson, S.M., Cerna-Diaz, A., Rutherford, C.J., Bhaumik, L., and Weaver, T. (2022). A practical three-dimensional constitutive model for dynamic shear and volumetric behavior of dense sands. Soil Dynamics and Earthquake Engineering, in press.

J64 Chen, J. and Olson, S.M. (2022). Closure to "SHANSEP-based interpretation of overconsolidation effect on monotonic shearing resistance of non-plastic soils." ASCE Journal of Geotechnical and Geoenvironmental Engineering, in press.

J63 Bhaumik, L., Rutherford, C.J., Olson, S.M., Hashash, Y.M.A., Numanoglu, O.A., Cerna-Diaz, A., and Weaver, T. (2022). A multidirectional cyclic direct simple shear device with bender elements for characterization of dynamic soil behavior. ASTM Geotechnical Testing Journal, in press.

J62 Chen, J. and Olson, S.M. (2022). Effect of overconsolidation on cyclic resistance of soils. submitted to ASCE Journal of Geotechnical and Geoenvironmental Engineering, 148(11), 15p.

J61 Gamez, J. and Olson, S.M. (2022). Compressibility-based interpretation of cone penetration calibration chamber tests and corresponding boundary effects. ASTM Geotechnical Testing Journal, 45(4), 778-796.

J60 Chen, J., Olson, S.M., Banerjee, S., Dewoolkar, M., and Dubief, Y. (2022). Water content of moist tamped nonplastic specimens for constant-volume direct simple shear testing. ASTM Geotechnical Testing Journal, 45(2), 10p.

J59 Chen, J. and Olson, S.M. (2021). SHANSEP-based interpretation of overconsolidation effect on monotonic shearing resistance of non-plastic soils. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 147(12), 14p.

J58 Kim, J.H. and Olson, S.M. (2021). Compressibility and vertical strain of saturated sands during earthquake shaking. ASTM Geotechnical Testing Journal, 44(6), 1863-1885.

J57 Olson, S.M., Muszynski, M.R., Hashash, Y.M.A., and Phillips, C. (2021). Mitigating lateral spreading forces on large foundations using ground deflection walls. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 147(11), 16p.

J56 Franke, K.W. and Olson, S.M. (2021). Practical considerations regarding the probability of liquefaction in engineering design. Journal of Geotechnical and Geoenvironmental Engineering, 147(8), 8p.

J55 Saye, S.R., Olson, S.M., and Franke, K. (2021). A common-origin approach to assess level-ground liquefaction susceptibility and triggering in CPT-compatible soils using Δ_Q. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 147(7), 14p.

J54 Cerna-Diaz, A., Olson, S.M., Hashash, Y.M.A., Numanoglu, O.A., Rutherford, C.J., Bhaumik, L., and Weaver, T. (2020). Response of dense sands to multidirectional cyclic loading in centrifuge tests. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 146(10), 16p.

J53 Bhaumik, L., Rutherford, C.J., Olson, S.M., Hashash, Y.M.A., Cerna-Diaz, A., Numanoglu, O.A., and Weaver, T. (2020). Effect of specimen preparation on volumetric behavior of sands under cyclic multidirectional shear. ASTM Geotechnical Testing Journal, 43(5), 1101-1119.

J52 Mei, X., Olson, S.M. and Hashash, Y.M.A. (2020). Evaluation of a simplified soil constitutive model considering implied strength and porewater pressure generation for 1-D seismic site response. Canadian Geotechnical Journal, 57, 974-991.

J51 Olson, S.M., Mei, X., and Hashash, Y.M.A. (2020). Nonlinear site response analysis with porewater pressure generation for liquefaction triggering evaluation. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 146(2), 17p.

J50 Mei, X., Olson, S.M., and Hashash, Y.M.A. (2018). Empirical porewater pressure generation model parameters in 1-D seismic site response analysis. Soil Dynamics and Earthquake Engineering, 141, 563-567.

J49 Oka, L.G., Dewoolkar, M., and Olson, S.M. (2018). Comparing laboratory-based liquefaction resistance of a sand with nonplastic fines with shear wave velocity-based field case histories. Soil Dynamics and Earthquake Engineering, 113(10), 162-173.

J48 Kozak, D.L., Luo, J., Olson, S.M., LaFave, J.M., and Fahnestock, L.A. (2017). Modification of ground motions for use in central North America. Journal of Earthquake Engineering, 22, https://doi.org/10.1080/13632469.2017.1387190.

J47 Saye, S.R., Santos, J., Olson, S.M., and Leigh, R. (2017). Linear trendlines to assess soil classification from cone penetration test data. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 143(9), 15p.

J46 Olson, S.M., Hashash, Y.M.A., Muszynski, M.R., and Phillips, C. (2017). Passive wedge formation and limiting lateral loads on large foundations during lateral spreading. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 143(7), 13p.

J45 Dewoolkar, M. and Olson, S.M. (2017) Closure to "Residual and post-liquefaction strength of a liquefiable sand." ASCE Journal of Geotechnical and Geoenvironmental Engineering, 143(5), 1943.

J44 Muszynski, M.R., Olson, S.M., Hashash, Y.M.A., and Phillips, C. (2016). Earth pressure measurements using tactile pressure sensors in a saturated sand during static and dynamic centrifuge testing. ASTM Geotechnical Testing Journal, 39(3), 20p.

J43 Dewoolkar, M., Hargy, J., Anderson, I., de Alba, P., and Olson, S.M. (2016). Residual and post-liquefaction strength of a liquefiable sand. J. Geotech. Geoenviron. Eng., ASCE, 142(2), 11p.

J42 Hashash, Y.M.A., Abrahamson, N.A., Olson, S.M., Hague, S., and Kim, B. (2015). Conditional mean spectra in site-specific hazard evaluation for a major river crossing in the central U.S. Earthquake Spectra, 32(1), 47-69.

J41 Muszynski, M.R., Olson, S.M., Hashash, Y.M.A., and Phillips, C. (2014). Repeatability of centrifuge tests containing a large, rigid foundation subjected to lateral spreading. ASTM Geotechnical Testing Journal, 37(6), 13p.

J40 Sadrekarimi, A. and Olson, S.M. (2014). Residual state of sands. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 140(4), 10p.

J39 Phillips, C., Hashash, Y.M.A., Olson, S.M., and Muszynski, M.R. (2012). Significance of small strain damping and dilation parameters in numerical modeling of free-field lateral spreading centrifuge tests. Soil Dynamics and Earthquake Engineering, 42, 161-176.

J38 Sadrekarimi, A. and Olson, S.M. (2012). Effect of sample preparation method on critical state behavior of sands. ASTM Geotechnical Testing Journal, 35(4), 15 p.

J37 Oka, L.G., Delwoolkar, M. and Olson, S.M. (2012). Uncertainties in evaluating liquefaction potential of cohesionless soils in the vicinity of large embankments. Soil Dynamics and Earthquake Engineering, 43, 33-44.

J36 Ledezma, C., Ashford, S., Hutchinson, T., Moss, R., Arduino, P., Kayen, R., and Olson, S. (2012). Effects of liquefaction-induced ground failure on bridges, roads, and railroads. Special Issue on 2010 Chile Earthquake, Earthquake Spectra, 28(S1), S119-143.

J35 Bray, J., Rollins, K., Hutchinson, T., Verdugo, R., Ledezma, C., Assimaki, D., Mylonakis, G., Montalya, G., Arduino, P., Olson, S., Kayen, R., Hashash, Y., and Candia, G. (2012). Effects of ground failure on buildings, ports, and industrial facilities. Special Issue on 2010 Chile Earthquake, Earthquake Spectra, 28(S1), S97-S118.

J34 Verdugo, R., Sitar, N., Frost, D., Bray, J.D., Candia, G., Eldridge, T., Hashash, Y., Olson, S.M., and Urzua, A. (2012). Seismic performance of earth structures: dams, levees, tailings dams and retaining walls. Special Issue on 2010 Chile Earthquake, Earthquake Spectra, 28(S1), S75-S96.

J33 Hashash, Y.M.A., Kim, B., Olson, S.M., and Ahmad, I. (2012). Seismic hazard analysis using discrete faults in Northwestern Pakistan: Part II - results of seismic hazard analysis. Journal of Earthquake Engineering, 16(8), 1161-1183.

J32 Hashash, Y.M.A., Kim, B., Olson, S.M., and Ahmad, I. (2012). Seismic hazard analysis using discrete faults in Northwestern Pakistan: Part I - methodology and evaluation. Journal of Earthquake Engineering, 16(7), 963-994.

J31 Seo, M.-W., Olson, S.M., Sun, C.-G., and Oh, M.-H. (2012). Evaluation of liquefaction potential index along western coast of South Korea using SPT and CPT. Marine Georesources and Geotechnology, 30, 234-260.

J30 Rathje, E.M., Bachhuber, J., Dulberg, R., Cox, B.R., Kottke, A., Wood, C., Green, R.A., Olson, S.M., Wells, D., and Rix, G. (2011). Damage patterns in Port-au-Prince during the 2010 Haiti earthquake. Earthquake Spectra, Special Issue, S117-S136.

J29 Olson, S.M., Green, R.A., Lasley, S., Martin, N., Cox, B.R., Rathje, E., Bachhuber, J., and French, J. (2011). Documenting liquefaction and lateral spreading triggered by the 12 January 2010 Haiti earthquake. Earthquake Spectra, Special Issue, S93-S116.

J28 Cox, B.R., Bachhuber, J., Rathje, E., Wood, C.M., Dulberg, R., Kottke, A., Green, R.A., and Olson, S.M. (2011). Shear wave velocity- and geology-based seismic microzonation of Port-au-Prince, Haiti. Earthquake Spectra, Special Issue, S67-S92.

J27 Green, R.A., Olson, S.M., Cox, B.R., Rix, G.J., Rathje, E., Bachhuber, J., French, J., Lasley, S., and Martin, N. (2011). Geotechnical aspects of failures at Port-au-Prince seaport during the 12 January 2010 Haiti earthquake. Earthquake Spectra, Special Issue, S43-S65.

J26 Sadrekarimi, A. and Olson, S.M. (2011). Yield strength ratios, critical strength ratios, and brittleness of sandy soils from laboratory tests. Canadian Geotechnical Journal, 48(3), 493-510.

J25 Sadrekarimi, A. and Olson, S.M. (2011). Critical state friction angle of sands. Geotechnique, 61(7), 771-783.

J24 Ha, I.-S., Olson, S.M., Seo, M.-W., and Kim, M.-M. (2011). Evaluating reliquefaction resistance using shaking table tests. Soil Dynamics and Earthquake Engineering, 31(4), 682-691.

J23 Borello, D.J., Andrawes, B., Hajjar, J.F., Olson, S.M., and Hansen, J.R. (2010). Experimental and analytical investigation of bridge timber piles under eccentric loads. Engineering Structures, 32(8), 2237-2246.

J22 Sadrekarimi, A. and Olson, S.M. (2010). Particle damage observed in ring shear tests on sands. Canadian Geotechnical Journal, 47(5), 497-515.
J21 Seo, M.-W. and Olson, S.M. (2010). Sequential analysis of ground movements at three deep excavation sites. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 136(5), 656-668.
J20 Sadrekarimi, A. and Olson, S.M. (2010). Shear band formation observed in ring shear tests on sandy soils. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 136(2), 366-375.
J19 Olson, S.M. and Johnson, C.I. (2009). Closure to "Use of liquefied strength ratios for analysis of lateral spreads." ASCE Journal of Geotechnical and Geoenvironmental Engineering, 135(12), 2011-2012.
J18 Seo, M.-W., Ha, I.S., Kim, Y.-S., and Olson, S.M. (2009). Behavior of concrete faced rockfill dams during initial impoundment. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 135(8), 1070-1081.
J17 Sadrekarimi, A. and Olson, S.M. (2009). A new ring shear device to measure the large displacement shearing behavior of sands. ASTM Geotechnical Testing Journal, 32(3), 12p.
J16 Olson, S.M. and Johnson, C.I. (2008). Use of liquefied strength ratios for analysis of lateral spreads. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 134(8), 1035-1049.
J15 Olson, S.M. and Mattson, B.B. (2008). Mode of shear effects on yield and liquefied strength ratios. Canadian Geotechnical Journal, 45, 574-587.
J14 Olson, S.M. (2006). Liquefaction analysis of Duncan Dam using strength ratios. Canadian Geotechnical Journal, 43, 484-499.
J13 Olson, S.M., Green, R.A., and Obermeier, S.F. (2005). Revised magnitude bound relation for the Wabash Valley seismic zone of the central United States. Seismological Research Letters, 76(6), 756-771.
J12 Obermeier, S.F., Olson, S.M., and Green, R.A. (2005). Field occurrences of liquefaction-induced features: a primer for engineering geologic analysis of paleoseismic shaking. Engineering Geology, 76, 209-234.
J11 Olson, S.M., Green, R.A., and Obermeier, S.F. (2005). Geotechnical analysis of paleoseismic shaking using liquefaction effects: a major updating. Engineering Geology, 76, 235-261.
J10 Green, R.A., Obermeier, S.F., and Olson, S.M. (2005). Engineering geologic and geotechnical analysis of paleoseismic shaking using liquefaction effects: field examples. Engineering Geology, 76, 263-293.
J9 Olson, S.M. and Stark, T.D. (2003). Use of laboratory data to confirm yield and liquefied strength ratio concepts. Canadian Geotechnical Journal, 40(6), 1164-1184.
J8 Olson, S.M. and Stark, T.D. (2003). Yield strength ratio and liquefaction analysis of slopes and embankments. ASCE Journal of Geotechnical and Geoenvironmental Engineering, 129(8), 727-737.
J7 Olson, S.M. and Stark, T.D. (2002). Liquefied strength ratio from liquefaction case histories. Canadian Geotechnical Journal, 39, 629-647.
J6 Obermeier, S.F., Pond, E.C., Olson, S.M., and Green, R.A. (2002). Paleoliquefaction studies in continental settings. Invited paper in Ancient Seismites, F.R. Ettensohn, N. Rast, and C.E. Brett, eds., Geological Society of America Special Paper 359, 13-27.
J5 Olson, S.M., Stark, T.D., Walton, W.H., and Castro, G. (2002). Closure to "1907 static liquefaction flow failure of the north dike of Wachusett Dam." ASCE Journal of Geotechnical and Geoenvironmental Engineering, 128(9), 801.
J4 Olson, S.M., Obermeier, S.F., and Stark, T.D. (2001). Interpretation of penetration resistance for back-analysis at sites of previous liquefaction. Seismological Research Letters, 72(1), 46-59.
J3 Olson, S.M., Stark, T.D., Walton, W.H., and Castro, G. (2000). 1907 Static liquefaction flow failure of the north dike of Wachusett Dam. ASCE Journal of Geotechnical and Geoenv. Engineering, 126(12), 1184-1193.
J2 Long, J.H., Olson, S.M., Stark, T.D., and Samara, E.A. (1998). Differential movement at embankment-bridge structure interface in Illinois. Transportation Research Record No. 1633: Liquefaction, Differential Settlement, and Foundation Engineering, Transportation Research Board, National Research Council, 53-60.
J1 Stark, T.D. and Olson, S.M. (1995). Liquefaction resistance using CPT and field case histories. ASCE Journal of Geotechnical Engineering, 121(12), 856-869.
C72 Chen, J. Olson, S.M., Banerjee, S., Dewoolkar, M.M., and Dubief, Y. (2022). Overburden normalization for in-flight centrifuge miniature cone penetration testing. Proc., 2022 GeoCongress, Charlotte, NC.
C71 Thomason, J.F., Kim, J.H., Anderson, A.C., and Olson, S.M. (2021). Geotechnical properties of glacial sediments using cone-penetrometer testing. Proc., Geological Society of America Connects 2021, Portland, OR.
C70 Macedo, J., Bray, J., Olson, S., and Bareither, C. (2020). TAILENG mine tailings database. Proc., Tailings and Mine Waste '20, November.

C69 Chen, J., Olson, S.M., Banerjee, S., and Dewoolkar, M.M. (2020). Effect of shear strain rate on undrained shearing resistance of a clean silica sand measured in direct simple shear tests. Proc., Tailings and Mine Waste '20, November.

C68 Taukoor, V., Rutherford, C.J., and Olson, S.M. (2020). Characterization of a Gulf of Mexico clay from the Walker Ridge area. Proc., 6th International Conference on Geotechnical and Geophysical Site Characterization, Budapest, Hungary.

C67 Taukoor, V., Rutherford, C.J., and Olson, S.M. (2019). Cyclic behavior of a reconstituted Gulf of Mexico clay. Proc., Geo-Congress 2019 8th Int'l Conf on Case Histories in Geotechnical Engineering, Philadelphia, PA.

C66 Taukoor, V., Rutherford, C.J., and Olson, S.M. (2019). A semi-empirical relationship for the small-strain shear modulus of soft clays. Proc., 7th International Symposium on Deformation Characteristics of Geomaterials, Glasgow, UK.

C65 Numanoglu, O.A., Cerna-Diaz, A., Bhaumik, L., Olson, S.M., Rutherford, C.J., Hashash, Y.M.A., and Weaver, T. (2019). Numerical simulation of dense sand behavior under multi-directional seismic loading using a 3-D constitutive model. Proc., 7th International Conference on Earthquake Geotechnical Engineering, Rome, Italy.

C64 Cerna-Diaz, A., Bhaumik, L., Numanoglu, O.A., Olson, S.M., Rutherford, C.J., Hashash, Y.M.A., and Weaver, T. (2019). Comparing bidirectional shaking-induced settlements in the free-field and below buildings founded on dense sands with available simplified procedures. Proc., 7th International Conference on Earthquake Geotechnical Engineering, Rome, Italy.

C63 Bhaumik, L., Cerna-Diaz, A., Numanoglu, O.A., Olson, S.M., Rutherford, C.J., Hashash, Y.M.A., and Weaver, T. (2019). Effect of shaking history on volumetric response of sands from bidirectional direct simple shear and centrifuge tests. Proc., 7th International Conference on Earthquake Geotechnical Engineering, Rome, Italy.

C62 Banerjee, S., Chen, J., Hitt, D.L., Dewoolkar, M., and Olson, S.M. (2019). Computational fluid dynamics-based modeling of liquefied soils. Proc., 7th International Conference on Earthquake Geotechnical Engineering, Rome, Italy.

C61 Taukoor, V., Rutherford, C.J., and Olson, S.M. (2019). Behavior of a Gulf of Mexico clay under variable-strain cyclic loads. Proc., 7th International Conference on Earthquake Geotechnical Engineering, Rome, Italy.

C60 Bhaumik, L., Cerna-Diaz, A., Numanoglu, O.A., Olson, S.M., Rutherford, C.J., Hashash, Y.M.A., and Weaver, T. (2018). Shear response of dense sands in dynamic centrifuge tests versus laboratory direct simple shear tests and semi-empirical estimates. Proc., Geotechnical Earthquake Engineering and Soil Dynamics V, Austin, TX.

C59 Taukoor, V., Rutherford, C.J., and Olson, S.M. (2018). Post-cyclic behavior of a Gulf of Mexico clay. Proc., Geotechnical Earthquake Engineering and Soil Dynamics V, Austin, TX.

C58 Numanoglu, O.A., Hashash, Y.M.A., Cerna-Diaz, A., Olson, S.M., Bhaumik, L., Rutherford, C.J., and Weaver, T. (2017). Nonlinear 3-D modeling of dense sand and simulation of soil-structure system under multi-directional loading. Proc., 2017 GeoCongress, Orlando, FL.

C57 Mei, X., Olson, S.M., and Hashash, Y.M.A. (2017). Evaluation of a simplified soil constitutive model considering implied strength and porewater pressure generation for 1-D seismic site response. Proc., 2017 GeoCongress, Orlando, FL.

C56 Bhaumik, L., Rutherford, C.J., Cerna-Diaz, A., Olson, S.M., Numanoglu, O.A., Hashash, Y.M.A., and Weaver, T. (2017). Volumetric strain in non-plastic silty sand subject to multi-directional cyclic loading. Proc., 2017 GeoCongress, Orlando, FL

C55 Kim, J.H. and Olson, S.M. (2017). Evaluation of earthquake-induced free-field settlement under partially drained conditions from dynamic centrifuge tests. Proc., 2017 GeoCongress, Orlando, FL.

C54 Sibley, E.L.D., Olson, S.M., and Polito, C.P. (2017). A framework for evaluating the effects of drained cyclic preshearing on the liquefaction resistance of Ottawa sand. Proc., 2017 GeoCongress, Orlando, FL.

C53 Cerna-Diaz, A., Olson, S.M., Numanoglu, O.A., Hashash, Y.M.A., Bhaumik, L., Rutherford, C.J., and Weaver, T. (2017). Free-field cyclic response of dense sands in dynamic centrifuge tests with 1D and 2D shaking. Proc., 2017 GeoCongress, Orlando, FL.

C52 Kim, J.H. and Olson, S.M. (2016). Compressibility of saturated coarse-grained soils from dynamic centrifuge and 1g shaking table tests. Proc., Geotechnical & Structural Engineering Congress, Phoenix, AZ.

C51 Numanoglu, O., Hashash, Y., Cerna-Diaz, A., Olson, S., Bhaumik, L., Rutherford, C., and Weaver, T. (2016). Seismic performance evaluation of nonlinear soil-structure system under multidirectional shaking. Proc., Geotechnical & Structural Engineering Congress, Phoenix, AZ.

C50 Cerna-Diaz, A., Bhaumik, L., Numanoglu, O., Olson, S.M., Rutherford, C., and Hashash, Y. (2015). Experimental and numerical investigation of cyclic response of dense sand under multi-directional shaking. Proc., 6th International Conference on Earthquake Geotechnical Engineering, Christchurch, New Zealand.

C49 Green, R.A. and Olson, S.M. (2015). Interpretation of liquefaction case histories for use in developing liquefaction triggering curves. Proc., 6th International Conference on Earthquake Geotechnical Engineering, Christchurch, New Zealand.

C48 Mei, X., Olson, S.M., and Hashash, Y. (2015). Empirical curve-fitting parameters for a porewater pressure generation model for use in 1-D effective stress-based site response analysis. Proc., 6th International Conference on Earthquake Geotechnical Engineering, Christchurch, New Zealand.

C47 Cerna-Diaz, A. and Olson, S.M. (2013). Comparison of liquefaction triggering methods for sloping ground using two flow failures from the 2010 Haiti earthquake. Proc., 2013 GeoCongress, San Diego, CA.

C46 Olson, S.M., Muszynski, M.R., Hashash, Y.M.A., and Phillips, C. (2013). Downslope ground movements during liquefaction-induced lateral spreading in centrifuge testing. Proc., 2013 GeoCongress, San Diego, CA.

C45 Olson, S.M. (2011). Liquefaction-induced damage in the January 2010 Haiti and February 2010 Chile earthquakes. Proc., Seismological Society of America (SSA) Annual Meeting, Memphis, TN.

C44 Sadrekarimi, A. and Olson, S.M. (2011). Undrained brittleness of sand in triaxial compression and ring shear tests. Proc., 2011 PanAm CGS Geotechnical Conference, Montreal, Canada.

C43 Green, R.A., Obermeier, S.F., Olson, S.M., Carpenter, C.K., Gyurisin, S.J., Harrington, T.J., and Higgins, N. (2011). Clastic dikes in the ancient glacial Lake Missoula flood sediments. Proc., Seismological Society of America (SSA) Annual Meeting, Memphis, TN.

C42 Kim, B., Hashash, Y.M.A., Olson, S.M., and Ahmad, I. (2011). Probabilistic seismic hazard analysis for Islamabad and Peshawar in Pakistan using fault zones. Proc., 5th International Conference on Earthquake Geotechnical Engineering, Paper No. 8347, Santiago, Chile.

C41 Obermeier, S.F., Olson, S.M., Vaughn, J. Green, R.A., and Counts, R. (2011). Clastic dikes and ground fractures: seismic or not? Proc., Seismological Society of America (SSA) Annual Meeting, Memphis, TN.

C40 Borello, D.J., Andrawes, B., Hajjar, J.F., and Olson, S.M. (2010). Experimental and analytical forensic investigation of bridge timber piles under eccentric loads. Proc., ASCE 2010 Structures Congress, Orlando, FL.

C39 Moreno-Torres, O., Hashash, Y.M.A., and Olson, S.M. (2010). A simplified coupled soil-pore water pressure generation for use in site response analysis. Proc., ASCE GeoCongress (GeoFlorida), West Palm Beach, FL.

C38 Olson, S.M., Muszynski, M., Hashash, Y., Phillips, C., and Polito, C. (2010). Using tactile pressure sensors to measure lateral spreading-induced earth pressures against a large, rigid foundation. Proc., 5th International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, San Diego, CA.

C37 Olson, S.M., Hashash, Y.M.A., Phillips, C., Muszynski, M.R., and Polito, C. (2010). Preliminary results of physical and numerical modeling of lateral spreading against large, rigid foundations. Proc., 2010 QuakeSummit, San Francisco, CA.

C36 Wells, D.L., Rathje, E., Bachhuber, J., Cox, B., French, J., Green, R., Olson, S., Rix, G., Suncar, O., Pena, L., Mundaray, T. (2010). Ground deformation effects of the 12 January 2010 earthquake in Haiti. Proc., Seismological Society of America (SSA) Annual Meeting, Portland, OR.

C35 Olson, S.M. (2009). Strength ratio approach for liquefaction analysis of tailings dams. Proc., 57th Annual Geotechnical Engineering Conference, Keynote Lecture & Paper, Minnesota Geotechnical Society, Minneapolis, MN, 37-46.

C34 Olson, S.M. (2009). Quantifying uncertainties in paleoliquefaction studies. Proc., Central and Eastern United States Seismic Source Characterization Project Workshop No. 2, Electric Power Research Institute, February, Palo Alto, CA.

C33 Sadrekarimi, A. and Olson, S.M. (2009). Measuring the true critical state of sands. Proc., International Conf. on Performance-based Design in Earthquake Geotechnical Engineering – from Case History to Practice, Tsukuba, Japan.

C32 Sadrekarimi, A. and Olson, S.M. (2009). Defining the critical state line using triaxial compression and ring shear tests. Proc., 17th International Conference on Soil Mechanics and Geotechnical Engineering, Cairo, Egypt.

C31 Sadrekarimi, A. and Olson, S.M. (2008). The importance of mineralogy and grain compressibility in understanding field behavior of failures. Proc., 6th International Conference on Case Histories in Geotechnical Engineering, Arlington, VA.

C30 Sadrekarimi, A., Huvaj-Sarihan, N., and Olson, S.M. (2008). Invigorating geotechnical engineering education at the University of Illinois. Proc., ASCE GeoCongress, New Orleans, LA.

C29 Obermeier, S.F. and Olson, S.M. (2007). Sills as indicators of strength of seismic shaking. Proc., 56th Annual Meeting, SE Section of the Geological Society of America, Savannah, GA.

C28 Olson, S.M. and Obermeier, S.F. (2007). Seismic shaking source for deformations in marine sediments. Proc., 56th Annual Meeting, SE Section of the Geological Society of America, Savannah, GA.
C27 Olson, S.M. and Obermeier, S.F. (2007). The role of hydraulic fracturing in forming clastic dikes and implications for hazard assessment. Proc., 56th Annual Meeting, SE Section of the Geological Society of America, Savannah, GA.
C26 Olson, S.M., Muhammad, K., Wen, Y.K., and Song, J. (2007). Uncertainties in paleoliquefaction analysis: preliminary findings. Proc., Geo-Denver, Denver, CO.
C25 Olson, S.M. and Mattson, B.B. (2007). Effects of mode of shear on yield shear strength of contractive sandy soils. Proc., 4th Intl. Conf. on Earthquake Geotechnical Engineering, Thessaloniki, Greece.
C24 Sadrekarimi, A. and Olson, S.M. (2007). Development of an improved ring shear device to measure liquefied shear strength of sands. Proc., 4th Intl. Conf. on Earthquake Geotechnical Engineering, Thessaloniki, Greece.
C23 Sadrekarimi, A. and Olson, S.M. (2007). Review of the October 9, 1963 failure of the Vaiont reservoir slope. Proc., Geo-Denver, Denver, CO.
C22 Green, R.A., Olson, S.M., and Polito, C. (2006). "A comparative study of the influence of fines on the liquefaction susceptibility of sands: field versus laboratory." Proc., 8th National Earthquake Engineering Conference (1906 Centennial), San Francisco, CA.
C21 Newman, E.J., Stark, T.D., and Olson, S.M. (2006). Level ground liquefaction resistance from CPT. Proc., 8th National Earthquake Engineering Conference (1906 Centennial), San Francisco, CA.
C20 Olson, S.M., Sacks, A., Mattson, B., and Servigna, D. (2006). Evaluating liquefaction of sloping ground. Proc., 8th National Earthquake Engineering Conference (1906 Centennial), San Francisco, CA.
C19 Olson, S.M. Sacks, A., Mattson, B., and Servigna, D. (2006). Role of numerical modeling in simplified liquefaction analysis of sloping ground. Proc., ASCE GeoCongress, Atlanta, GA.
C18 Berry, K.M., Lauer, R.G., Miller, A., and Olson, S.M. (2004). Landslide at bridge abutment in St. Louis, Missouri. Proc., Geo-Institute Conf. on Geotechnical Engineering for Transportation Projects (Geo-Trans 2004), July 27-31, Los Angeles, CA.
C17 Cooling, T.L., Olson, S.M., and Hague, S.T. (2004). Site response and spatial incoherency analysis for the Great River Bridge. Proc., 4th National Seismic Conf. and Workshop on Bridges and Highways, February 9-11, Memphis, TN.
C16 Green, R.A., Obermeier, S.F., and Olson, S.M. (2004). The role of paleo-liquefaction studies in performance-based earthquake engineering in the Central-Eastern United States. Proc., 13th World Conf. on Earthquake Engineering, August 1-6, Vancouver, B.C., Canada.
C15 Olson, S.M., Cooling, T.L., Hague, S.T. (2004). In situ testing and site characterization for site response analysis at the Great River Bridge. Proc., 2nd International Conf. on Geotechnical Site Characterization, September 19-22, 2004, Porto, Portugal.
C14 Olson, S.M., Miller, A., Berry, K.M., and Bestgen, J. (2004). Landslide stabilization at Missouri Route K bridge over Blackwater River. Proc., 5th International Conf. on Case Histories in Geotechnical Engineering, April 13-17, 2004, New York, NY.
C13 Olson, S.M. (2003). Strength ratio-based liquefaction analysis of sloping ground. Proc., 12th Panamerican Conf. on Soil Mechanics and Geotechnical Engineering, Paper No. 271, June 23-26, Boston, MA.
C12 Obermeier, S.F., Pond, E.C., Olson, S.M., and Green, R.A. (2002). Paleoliquefaction studies in continental settings. Invited paper in Ancient Seismites, F.R. Ettensohn, N. Rast, and C.E. Brett, eds., Geological Society of America Special Paper 359, 13-27.
C11 Olson, S.M. and Obermeier, S.F. (2002). Use of the cyclic stress method for paleoseismic analysis. Geological Society of America, 36th Annual Meeting, North-Central Section and 51st Annual Meeting, Southeastern Section, April 3-5, Lexington, KY.
C10 Olson, S.M. and Stark, T.D. (2001). Liquefaction analysis of Lower San Fernando Dam using strength ratios. Proc., Fourth Int. Conf. on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, paper 4.05, San Diego, CA.
C9 Obermeier, S.F. and Olson, S.M. (2001). Often-overlooked aspects of back-calculating ground shaking from paleoliquefaction features. 2001 Annual Meeting of the Eastern Section of the Seismological Society of America, University of South Carolina, Columbia, SC.
C8 Obermeier, S.F., Brack, J., Van Arsdale, R., and Olson, S.M. (2000). Depth of water table for paleoseismic back-analysis. Geological Society of America Annual Meeting, November.

C7 Manyando, G.M.S., Cooling, T.L., Olson, S.M., and Zdankiewicz, J. (1999). Geotechnical seismic retrofit evaluation: I-57 Bridge over Illinois State Route 3. Proc., 2nd International Conf. on Earthquake Geotechnical Engineering, Lisbon, Portugal, 21-25 June, Vol. 1, 591-597.

C6 Berry, K.M., Olson, S.M., and Lamie, M. (1998). Cone penetration testing in the mid-Mississippi River valley. Proc., International Conf. on Site Characterization (ISC '98), Vol. 1, April 17-21, Atlanta, GA, 983-987.

C5 Olson, S.M. (1998). Current research on liquefaction resistance and shear strength of liquefied soil from CPT. Proc., Current Earthquake Engineering Research in the Central United States (CEERICUS '98), April 4, Urbana, IL, II-9 - II-16.

C4 Olson, S.M. (1998). Post-liquefaction shear strength from laboratory and field tests: field tests. Proc., Workshop on Post-Liquefaction Shear Strength of Granular Soils, T.D. Stark, S.M. Olson, S.L. Kramer, and T.L. Youd, eds., University of Illinois at Urbana-Champaign, Urbana, IL, 130-152.

C3 Olson, S.M. and Stark, T.D. (1998). CPT based liquefaction resistance of sandy soils. Proc., Geotechnical Earthquake Engineering and Soil Dynamics Specialty Conf., ASCE Geo-Institute Geotechnical Special Publication No. 75, Vol. 1, August 3-6, Seattle, WA, 325-336.

C2 Stark, T.D., Olson, S.M., Kramer, S.L., and Youd, T.L. (1998). Shear strength of liquefied soils. Proc., Workshop on Post-Liquefaction Shear Strength of Granular Soils, University of Illinois at Urbana-Champaign, Urbana, IL, April 17-18, 1997, 350 p.

C1 Stark, T.D., Olson, S.M., Kramer, S.L., and Youd, T.L. (1998). Shear strength of liquefied soils. Proc., Geotechnical Earthquake Engineering and Soil Dynamics Specialty Conf., ASCE Geo-Institute Geotechnical Special Publication No. 75, Vol. 1, August 3-6, Seattle, WA, 313-324.

R17 Athanasopoulos-Zekkos, A., Bohnhoff, G., Kavazanjian, E., Leshchinsky, B., Olson, S., Qiu, T., Rollins, K., Rutherford, C., Sample-Lord, K. and Swan, C. (2020). Report on Results from the Annual Geo-Engineering Graduate Programs Survey. United States University Council for Geotechnical Education and Research (USUCGER).

R16 Green, R.A. and Olson, S.M. (2019). Interpretation of field case histories for use in developing liquefaction triggering curves. Pacific Earthquake Engineering Research (PEER) Center Report.

R15 Olson, S.M., Rutherford, C., Hashash, Y., Bhaumik, L., Cerna Diaz, A., and Numanoglu, O. (2018). Dynamic response of soil under multidirectional loading: experimental investigation and modeling, NUREG report, Nuclear Regulatory Commission.

R14 Kozak, D.L., Luo, J., Olson, S.M., LaFave, J.M., and Fahnestock, L.A. (2017). Modification of ground motions for use in Central North America: southern Illinois surface ground motions for structural analysis. Report No. NSEL-048, Newmark Structural Laboratory (NSEL) Report Series (ISSN 1940-9826; https://www.ideals.illinois.edu/handle/2142/3520).

R13 Olson, S.M., Holloway, K.P., Buenker, J.M., Long, J.H., and LaFave, J.M. (2012). Thermal behavior of IDOT integral abutment bridges and proposed design modifications. Final Report, Illinois Center for Transportation Project R27-55, June.

R12 Olson, S.M. and Hashash, Y.M.A. (2010). Instrumentation for measuring response to potential liquefaction and lateral spreading at Bill Emerson Memorial Bridge, Cape Girardeau, MO. Final Report, U.S. Geological Survey Grant No. 06CRGR0006, 85p.

R11 Arduino, P., Ashford, S., Assimaki, D., Bray, J., Eldridge, T., Frost, D., Hashash, Y., Hutchinson, T., Johnson, L., Kelson, K., Kayen, R., Ledezma, C., Moss, R., Mylonakis, G., Olson, S., Rollins, K., Sitar, N., Stewart, J., Urzua, A., Verdugo, R., Witter, R., and Zoa, N. (2010). Geo-Engineering Reconnaissance of the February 27, 2010 Maule, Chile Earthquake. GEER Association Report No. GEER-022, 347 p.

R10 Rathje, E., Bachhuber, J., Cox, B., French, J., Green, R., Olson, S., Rix, G., Wells, D., and Suncar, O. (2010). Geotechnical Engineering Reconnaissance of the 2010 Haiti Earthquake. GEER Association Report No. GEER-021, 97 p.

R9 Borello, D.J., Andrawes, B., Hajjar, J.F., Olson, S.M., Hansen, J.R., and Buenker, J. (2009). DeKalb County bridge SN019-5010 collapse investigation. Final Report, Illinois Center for Transportation Project R27-SP12, March.

R8 Olson, S.M., Hansen, J.R., Long, J.H., LaFave, J.M., Renekis, D., and Kreh, S. (2009). Modification of IDOT integral abutment design limitations and details. Final Report, Illinois Center for Transportation Project R27-25, May.

R7 Olson, S.M., Wen, Y.K., Song, J., Johnson, C.I., and Muhammad, K. (2007). Quantifying uncertainties in paleoliquefaction studies. Final Report, USGS NEHRP Award No. 06HQGR0013, December.

R6 Olson, S.M., Green, R.A., and Obermeier, S.F. (2004). Geotechnical analysis of paleoseismic shaking using liquefaction features: part I. Major updating of techniques for analysis. USGS Open File Report 03-307, 47 p.

R5 Green, R.A., Obermeier, S.F., Olson, S.M. (2004). Geotechnical analysis of paleoseismic shaking using liquefaction features: part II. Field examples. Report No. UMCEE-04-08, Dept. of Civil and Environmental Engineering, University of Michigan, Ann Arbor, 85 p.

R4 Olson, S.M. (2001). Liquefaction analysis of level and sloping ground using field case histories and penetration resistance. Ph.D. Thesis, University of Illinois-Urbana-Champaign, Urbana, IL, 549 p.

R3 Obermeier, S.F., Pond, E.C., and Olson, S.M., with contributions by Green, R., Stark, T.D., and Mitchell, J. (2001). Paleoliquefaction studies in continental settings – geologic and geotechnical factors in interpretation and back-analysis. USGS Open File Report 01-29.

R2 Stark, T.D., Olson, S.M., Kramer, S.L., and Youd, T.L. (1998). Shear strength of liquefied soils. Proc., Workshop on Post-Liquefaction Shear Strength of Granular Soils, University of Illinois at Urbana-Champaign, Urbana, IL, April 17-18, 1997, 350 p.

R1 Stark, T.D., Olson, S.M., and Long, J.H. (1995). Differential movement at the embankment/structure interface–mitigation and rehabilitation. Contract Report ITRC-IAB-H1, Illinois Department of Transportation, Springfield, IL, 297 p.

Teaching and Mentoring

Prof. Olson teaches undergraduate and graduate courses in geotechnical engineering, including *CEE 380 Introduction to Geotechnical Engineering*, *CEE 484 Applied Soil Mechanics*, *CEE 580 Excavations and Support Systems, CEE 586 Rock Mechanics and Behavior*, *CEE 587 Applied Rock Mechanics* and *CEE 590 Geotechnical Field Measurement*. Prof. Olson developed *CEE 590* as a new graduate course, completely revamped *CEE 586* and *CEE 587* as the courses had not been offered in over six years and 15 years, respectively, and redeveloped *CEE 580*. Olson's classes are well-received by his students, and he has been listed on the University of Illinois' *Instructors Ranked as Excellent* in 32 out of 36 semesters to date. While serving as an adjunct Professor at the University of Missouri at Rolla (UMR), Prof. Olson developed the courses *CE 316 Soil Dynamics I* and *CE 416 Soil Dynamics II*, receiving the 2005 UMR Outstanding Teaching Commendation Award.

Dr. Olson has also advised (or is currently advising) 20 Ph.D. candidates, 15 M.S. students, 1 post-doctoral researcher, and has served on the Ph.D. committees for 27 other doctoral candidates. In addition, Prof. Olson has served as a faculty mentor for three Engineers without Borders projects, one Bridge to China project, and 15 Geo-Institute "GeoChallenge" teams.

Professional Activities and Service

In addition to University committees, Prof. Olson is actively engaged in professional organizations, including the: (a) American Society of Civil Engineers (ASCE) Geo-Institute (G-I) Earthquake Engineering and Soil Dynamics Committee; (b) G-I Embankments, Dams, and Slopes Committee, including chairing the 2013 and 2019 Geo-Congresses and creating and chairing the GeoPrediction student competition (2010-2014); (c) ASCE Journal of Geotechnical and Geoenvironmental Engineering editorial board; (d) chairing the Earthquake Engineering Research Institute (EERI) Student Activities Committee (2009-2012) and serving as liaison for the EERI Student Leadership Council; (e) Secretary of the Transportation Research Board (TRB) AFF50(1) Geoseismic Issues for Bridge Foundations Committee; (f) TRB AFS30 Foundations of Bridges and Other Structures; and (g) the Canadian Geotechnical Society. In 2020, Prof. Olson became a founding Steering Committee member of the Tailings and Industrial Waste Engineering (TAILENG) Center, and in 2021, he became an Advisory Board member for the Geotechnical Extreme Events Reconnaissance (GEER) Association.

To recognize his research and teaching, Prof. Olson has received many awards, including the ASCE Huber Research Prize (2012), ASCE Student Chapter Outstanding Instructor Award (2009), National Science Foundation Early Career (CAREER) Award (2009), ASCE Arthur Casagrande Professional Development Award (2004), and Canadian Geotechnical Society R.M. Quigley Award (2002).

Dr. Olson has also served on the Missouri Seismic Safety Commission; served as a resource expert on liquefaction to the Electric Power Research Institute, Nuclear Regulatory Commission, and the National Academy of Sciences; and participated in three post-earthquake reconnaissance missions (funded through the National Science Foundation and the Geo-Engineering Extreme Event Reconnaissance organization).

Professional Seminars and Invited Lectures

Prof. Olson has delivered over 150 professional seminars, keynote and invited lectures, and short courses in 26 states, 15 countries, and 6 continents. These lectures and seminars have been received by thousands of engineers, scientists, policy makers, and students.

EXHIBIT H - BRIEF IN SUPPORT OF MOTION FOR SUMMARY JUDGMENT

FEDERAL ENERGY REGULATORY COMMISSION
Office of Energy Projects
Division of Dam Safety and Inspections
888 First Street, NE
Washington, DC 20426
(202) 502-6314 Office – (202) 219-2731 Facsimile

May 20, 2020

In reply refer to:
P-2785
P-10809
P-10810

Mr. Lee Mueller
Boyce Hydro Power, LLC
4132 S. Rainbow Blvd. #247
Las Vegas, Nevada 89103

Subject: Emergency Response and Forensic Investigation for Boyce Hydro Dam Incidents

Dear Mr. Mueller:

Boyce Hydro owns and operates three dams under FERC jurisdiction, Sanford Dam, Project 2785, Secord Dam, Project 10809, and Smallwood Dam, Project 10810. Boyce Hydro also owns and operates the Edenville Dam, which is under the jurisdiction of the State of Michigan. At approximately 5:45 EDT on May 19, 2020, you informed the Chicago Regional Engineer that high inflows were resulting in breaching of the Edenville Dam. You indicated that the Michigan Department of Environment, Great Lakes, and Energy (EGLE) was aware and that the Emergency Action Plans had been activated with evacuations underway downstream of both Edenville and the Sanford Dam. You indicated that the Edenville breach flows could imperil the stability of the Sanford Dam and may lead to a cascading failure scenario. Further discussions later on May 19, 2020, identified that the Smallwood Dam, was experiencing extremely high flows, but had not failed. Additionally, upstream of Smallwood Dam, you indicated that Secord Dam, was safely passing flood flows.

Following the breach of the Edenville Dam, the Sanford Dam was overtopped by the increased inflow from the upstream breach. The overtopping flows led to a declaration of imminent failure by local authorities and triggered additional evacuation efforts. Due to the extensive damage to the projects and the region as a result of the

floodwaters and the Edenville breach, you are directed to fully lower the reservoirs behind Sanford Dam, Smallwood Dam, and Secord Dam in a safe manner as flows recede. You are also directed to perform a dam safety inspection of these dams immediately and within 3 days after the flows recede. You must provide a copy of the inspection reports within 3 days of the inspection but provide a verbal summary of findings immediately upon completion to the Chicago Regional Engineer. You must also maintain fully lowered reservoirs and develop an interim plan to safely pass flows until a safe reservoir elevation can be established and implemented.

You are also directed to immediately begin formation of a fully Independent Forensic Investigation Team to focus on the Sanford Dam, Smallwood Dam, and Secord Dam. Since the Edenville Dam is not under FERC jurisdiction, we will be reaching out to ELGE regarding coordination for investigation of the Edenville breach. Once convened, the team should develop a plan of action for the forensic analysis consisting of, but not limited to:

1. Reviewing project operations, before, during and after the event. This should include activation and effectiveness of the Emergency Action Plan (EAP). It should also include spillway operations.
2. Performing field investigations.
3. Reviewing project documents, including the EAPs, Potential Failure Mode Analyses, Part 12D Independent Consultant Inspection Reports, Owner's Dam Safety Program, and the Supporting Technical Information Documents.
4. Developing any additional information or analyses deemed appropriate by the Team.
5. Preparing and submitting the Forensic Analysis Report. The analysis should discuss the root cause of the overtopping damage to Sanford Dam as well as any other contributing causes and should be submitted directly to FERC from the team.

The team must consist of dam safety experts well versed in the following disciplines: Hydraulics and Hydrology, Geotechnical Engineering, Structural Engineering, Reservoir Operations, Emergency Action Planning, and Organizational/Human Factors. The team members must not have worked on any of the Boyce Hydro Projects in the past. You must also take care to preserve or record any information that may be useful to the Forensic Investigation Team.

You must eFile a letter with the Commission which provides a copy of each proposed Forensic Investigation Team member's resume within 7 days from the date of

this letter. The letter should be addressed to the Director, Division of Dam Safety and Inspection (D2SI) for review and approval at the address shown below with a copy to the D2SI-Chicago Regional Engineer.

David E. Capka, P.E.
Director, D2SI
Federal Energy Regulatory Commission
888 First Street, N.E. Routing Code: PJ-13
Washington, D.C. 20426

If you have any questions regarding this letter, please call me at 202-502-6314.

Sincerely,

David E. Capka, P.E.
Director
Division of Dam Safety and Inspections

cc:
Mario Fusco Jr., MS, P.E., Supervisor
Hydrologic Studies & Dam Safety Unit
Water Resources Division
Box 30458
Lansing, MI
48909-7958

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY, AND THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES,

Plaintiffs,

v

LEE MUELLER; BOYCE MICHIGAN, LLC; EDENVILLE HYDRO PROPERTY, LLC; BOYCE HYDRO POWER LLC; BOYCE HYDRO, LLC; WD BOYCE TRUST 2350; WD BOYCE TRUST 3649; AND WD BOYCE TRUST 3650,

Defendants.

No. 1:20-cv-528

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DECLARATION OF DR. JEFF JOLLEY UNDER 18 U.S.C. § 1746

1. My name is Dr. Jeff Jolley. I am a Fisheries Supervisor within the Fisheries Division of the Michigan Department of Natural Resources.

2. I prepared a report in this case that summarizes my expert opinions related to the damage to the fisheries of Wixom and Sanford Lakes caused by the May 19, 2020 failures of the Edenville and Sanford dams. The report is attached to this declaration. It explains my opinions and the information I reviewed to reach them. I could testify about the contents of the report if needed.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: 5/3, 2023

Dr. Jeff Jolley

LF: Dam-Mueller, Boyce Hydro (EGLE & DNR v)/AG# 2020-0291918-C-L/Declaration of Dr. Jeff Jolley 2023-05-03

The Fish Community and Fishery Damage Assessment Resulting from the Tittabawassee River Dam Failures in 2020

The purpose of this document is to describe estimated fish mortality and monetary damages to recover the fishery in Sanford and Wixom lakes following dam failure and significant flooding impacts on the Tittabawassee River. Our estimate includes total replacement costs for all assumed fish species lost, costs associated with restocking the reservoirs with fish that can be reared in traditional fish production facilities, and lost angler use.

The Michigan Department of Natural Resources (MDNR) Fisheries Division conducted a fisheries damage assessment of the Sanford and Wixom reservoirs in June 2020 after the dam failures in May 2020. Using a combination of fisheries data, recreational and tournament angling data, and standardized methods, we estimate a conservative overall damage assessment of over $21 million in fish replacement costs and lost recreational angling revenue over 5 years. The lost recreational angling revenue is over $2 million annually and will accrue every year that the fishery is not restored to its former status prior to dam failures.

Site description

The Tittabawassee River watershed (Figure 1) is the fifth largest watershed in Michigan encompassing 2,471 square miles across thirteen counties. Within the watershed, 621 miles of tributaries drain into the 91-mile mainstem of the Tittabawassee River (Schrouder et al. 2009). The mainstem of the Tittabawassee River has four major hydroelectric dams that created impoundments. The mainstem of the Tittabawassee River begins as three branches: East, Middle, and West. The East Branch and Middle Branch join north of Secord Lake, in Gladwin County. The West Branch flows into the impounded area of Secord Lake.

Secord Dam, the uppermost of four hydroelectric dams, is located approximately five miles north of the Village of Wooden Shoe, Gladwin County. Secord Dam, an earth-gravity type dam, was constructed in 1925 (Schrouder et al. 2009). Secord Dam spans 2,085 feet, with a dam height of 55 feet, and a hydraulic head of 46 feet. At normal pool height (750.8 ft National Geodetic Vertical Datum (NGVD)) Secord Dam impounds 895 acres to create 69 miles of shoreline which forms Secord Lake. Secord Dam has one reinforced multiple arch spillway with an ogee crest and two tainter gates (Schrouder et al. 2009). In combination with the dam, is one

powerhouse which is equipped with a Francis vertical-axis turbine generator with an installed capacity of 1.2 MW (FERC 1998a). Leading to the powerhouse is a 47-foot-long intake. Secord Dam was most recently licensed under the Federal Energy Regulatory Commission (FERC) in 1998 and will be up for relicensing in 2028 (Schrouder et al. 2009).

Ten miles downstream of Secord Dam, is Smallwood Dam, the second hydroelectric dam located in the village of Wooden Shoe, Gladwin County. Constructed in 1925, Smallwood Dam is an earth-gravity type dam and is the smallest of the four dams with a height of 36 feet and a hydraulic head of 28 feet. At normal pool height (704.8 feet NGVD) Smallwood Dam impounds 402 acres to create 25 miles of shoreline which forms Smallwood Lake (Schrouder et al. 2009). Smallwood Dam has a reinforced concrete hollow gravity spillway with two steel tainter gates. In combination with the dam, there is one powerhouse with a single turbine with an installed capacity of 1.2 MW (FERC 1998b). Leading to the powerhouse is a 25-foot-long intake. Smallwood Dam was most recently licensed by FERC in 1998 and will be up for relicensing in 2028 (Schrouder et al. 2009).

Thirteen miles downstream of Smallwood Dam is Edenville Dam, which impounded the Tittabawassee River and Tobacco River to create Wixom Lake. Edenville Dam, an earth-gravity type dam, was the first of the four hydroelectric dams on the system constructed in 1924. Edenville Dam, located in the village of Edenville (Gladwin County), has a width of 6,600 feet, a height of 54.5 feet, and a hydraulic head of 44 feet (Schrouder et al. 2009). Edenville Dam at full pool (675.8 ft NGVD) impounded the largest volume of water of the four dams creating the 2,600-acre Wixom Lake with 49 miles of shoreline. A powerhouse with an installed capacity of 4.8 MW and a 50-foot-long intake is associated with Edenville Dam (FERC 1998c). The hydroelectric capacities at Edenville Dam was licensed in 1998 by FERC; however, in September 2018 FERC revoked the license for Edenville Dam (Order Revoking License September 10, 2018). The project has two spillways, one across the Tittabawassee River arm and one across the Tobacco River arm, which creates a 0.4 mile reach bypassed reach before the confluence with the Tittabawassee River mainstem downstream.

Finally, ten miles downstream of Edenville Dam is Sanford Dam, located in the Village of Sanford, Midland County. Sanford Dam, an earth-gravity type dam, was built in 1925. It has

a height of 36 feet, hydraulic head of 26 feet, controlled crest length of 1,579 feet, and spill width of 139 feet (Schrouder et al. 2009). Sanford Dam at full pool impounded 1,528 acres to form Sanford Lake. Sanford Dam was licensed in 1987 but amended to be included in relicensing at the same time as the three other dams in 2028 (FERC 1998d; FERC 2004).

All four dams (Secord, Smallwood, Edenville, Sanford) were owned and operated by Boyce Hydro, LLC and are listed as high hazard dams by the Federal Energy Regulatory Commission. This listing is given to dams in which failure or mis-operation would probably result in loss of life and extensive property damages (FEMA 2004). All four dams had the same operational specifications: except during emergencies and winter drawdowns, water levels may not fluctuate more than 0.4 feet below or 0.3 feet above normal pool elevation for each reservoir.

Fish Population Description

The Tittabawassee River basin has a diverse fauna of fish typical to the area and the impacted area supports coldwater, coolwater, and warmwater species assemblages. The impoundments are actively managed by the MDNR Fisheries Division through supplemental fish stocking and management surveys (Table 1). The impoundments are dominated by centrarchids which include Black Crappie, Largemouth Bass, Smallmouth Bass, Bluegill, Pumpkinseed, and Rock Bass. Other important gamefish include Northern Pike, Muskellunge, Walleye, and Yellow Perch. Other species present are Blacknose Dace, Creek Chub, Redhorse sucker species, White Sucker, Black Bullhead, Brown Bullhead, Yellow Bullhead, and Channel Catfish. Table 2 shows a list of species found in the basin as reported through recent surveys (Schrouder et al. 2009; Schrouder 2014, 2016).

Wixom Lake was last surveyed in 2014 as part of the Status and Trends standardized survey protocol. The most abundant gamefish captured in 2014 was Black Crappie. One thousand and five Black Crappie were captured. They varied in size from 4.0 inches to 17.4 inches with an average length of 8.1 inches. Age and growth analyses was conducted on 112 fish, and eight age classes of Black Crappie were present in Wixom Lake. On average, Black Crappie were growing slightly slower (0.2 deviations) when compared to statewide growth rates. Black Crappie provided a year-round fishery in Wixom Lake especially when cold winters allowed for safe ice for ice fishing. With 79% of the Black Crappie captured in 2014 being at least 7 inches in length, this fishery was well known and well utilized. In addition to Black

Crappie, 948 Bluegill were also captured in the 2014 survey. Bluegill varied in length from 1.0 inches to 9.0 inches with an average length of 4.9 inches. One hundred and twelve Bluegill were analyzed for age and growth. Eight-year classes of Bluegill were present in Wixom Lake and on average Bluegill were growing slightly faster (0.4 deviations) compared to statewide averages.

Other gamefish species that were captured in Wixom Lake included: Channel Catfish, Largemouth Bass, Northern Pike, Muskellunge, Pumpkinseed, Rock Bass, Smallmouth Bass, Walleye, White Bass, and Yellow Perch. Like the upstream reservoirs, MDNR stocks Muskellunge and Walleye on a regularly basis (Table 1). The high diversity of gamefish in Wixom Lake presented many opportunities for anglers to target various species year-round.

Largemouth Bass and Smallmouth Bass (collectively referred to as bass) generated relatively high tournament interest on Wixom Lake. From 2016 through 2019, there were 47 registered bass tournaments on Wixom Lake. This averaged out to 12 tournaments annually with each tournament having 35 anglers. The number of tournaments held on Wixom Lake was tied for the 60th most popular destination in the State of Michigan for bass tournaments from 2016-2019 as reported through the MDNR Tournament Registration System (https://www.mcgi.state.mi.us/fishingtournaments/). Success rates at Wixom Lake were high in the tournaments with 101 bass caught that were at least four pounds in weight and the average weight of bass was 2.27 pounds.

The last fisheries survey at Sanford Lake was in 2017 and it specifically targeted Muskellunge and collected data on Walleye secondarily. The 2017 survey was a night electrofishing survey that was split into two reaches. The first reach was from Edenville Dam downstream one mile to the Curtis Road Bridge. The second reach was from the Verity Road area downstream to and including the impounded Black River embayment to River Road. No Muskellunge were captured during this survey; however, 18 Walleye were captured and varied in size from 6.4 inches to 21.1 inches. Prior to 2017, a reservoir-wide Status and Trends survey was completed in 2015 on Sanford Lake. This survey was completed using a variety of gears to get a representative sample of the entire fish assemblage. Bluegill were the most abundant gamefish captured in the 2015 survey with 711 captured. Bluegill varied from 1.0 inches to 8.0 inches with an average length of 5.3 inches. Sixty-one percent of the Bluegill captured were at least six inches in length or larger. Other panfish species captured in the 2015 survey included Black

Crappie (209 fish), Pumpkinseed (243 fish), Yellow Perch (108 fish), and Rock Bass (35 fish). In addition to the panfish, other gamefish species included Largemouth Bass, Smallmouth Bass, Muskellunge, Northern Pike, and Walleye. The MDNR stocks Muskellunge and Walleye in Sanford Lake regularly (Table 1). In addition, the MDNR operated and maintained a Northern Pike marsh used to rear Northern Pike for stocking in other area inland lakes. The ability to capture Northern Pike annually from Sanford Lake to place in the rearing marsh for natural reproduction to raise fingerlings demonstrates the robust Northern Pike population in Sanford Lake.

Similar to Wixom Lake, Sanford Lake is also a popular bass tournament fishery. From 2016 to 2019, 32 bass tournaments were registered and occurred on Sanford Lake. On average eight bass tournaments with 38 anglers occurred annually on Sanford Lake. In addition to bass tournaments, Sanford Lake is also a popular Muskellunge fishing destination. From 2014-2019 the Esocid Committee, an internal MDNR committee specifically focused on Esocid species, used an online angler survey to gather information about Muskellunge anglers. In 2019, Sanford Lake was the 17th most popular Michigan inland waterbody for Muskellunge anglers. Furthermore, Walleye fishing was known to be outstanding in Sanford Lake. Sanford Lake was also recognized as one of the top 25 inland Walleye fishing destinations in Michigan (Herbst et al. *draft*).

In conclusion, the four reservoirs on the Tittabawassee River provided exceptional year-round fishing opportunities for anglers. The reservoirs were actively managed through stocking of Walleye and Muskellunge and regular management surveys. Data gathering, interactions with anglers and the general public, and angler harvest information all illustrate the popularity of these fisheries.

The Incident

This report is in response to an incident that occurred from 16 May to 19 May 2020. The area around the Tittabawassee River watershed in the north-central portion of the lower peninsula of Michigan including Gladwin, Midland, Saginaw, and Ogemaw counties received 6-8 inches of rain in a 48-hour period from 16 May to 18 May. Gladwin and Midland counties declared States of Emergency on 18 May in response to localized flooding from the heavy rainfall. The Edenville Dam, which impounds Wixom Reservoir, was breached on 19 May 2020

at 1730 and the Sanford Dam, which impounds Sanford Reservoir, was breached on 19 May 2020 at 1930. The dam breaches resulted in the nearly complete draining of Wixom and Sanford reservoirs and the equivalent of a 500-year flood through the cities of Sanford, Midland, and downstream to Saginaw. The Tittabawassee River crested at Midland on 20 May at over 35 feet and at Saginaw on 22 May at 22.61 feet. The upstream dam of Smallwood was also damaged and both Smallwood and Secord reservoirs were subsequently drawn down for safety and further inspection. Smallwood and Secord dams, as well as Ross Dam on the Tobacco River which is a tributary to the Tittabawassee River may have been damaged and inspections and assessments are underway.

Observations

Staff from MDNR Fisheries Division conducted site visits at locations on Wixom and Sanford reservoirs to document reports of dead, dying, or stranded fish on 21, 22, 27, 28, 29 May and 3, 4, 5, and 17 June, 2020. Inspections took place on Boyce Hydro, LLC property (reservoir bottomlands), resident properties, public properties, and roadways or rights-of-way. Residents were interviewed and 65 photographs were taken.

A variety of degraded habitat conditions were observed ranging from completely de-watered, small, and disconnected pools, larger disconnected canals, and side lagoons with connectivity to the river. Substrates observed were mostly sand and unconsolidated sediments. Water was stagnant and had heavy algal coverage.

Evidence of live fish could be seen in some isolated or disconnected pools and canals through surface disturbances and fins breaking the surface of the water. Definitive species of live fish observed were abundant Common Carp. Dead fish observed were Black Crappie, Yellow Perch, Largemouth Bass, Northern Pike, Smallmouth Bass, Bluegill, Pumpkinseed, and Warmouth.

As of September 10, 2020, there was an approximately 1 mile reach of river from the Tobacco Arm of Edenville Dam tailrace down to the confluence with the Tittabawassee River that was no longer supplied with water from upstream. When the Edenville Dam breached, a new channel formed from the Tittabawassee Arm and flowed through the breached area. In September, 2020, we recommended actions to provide water to the isolated stretch of the

Tobacco River; indicating that, without fresh inflows of water, it was likely that stranded fish would not survive.

Damage assessments

A complete loss of the reservoir fisheries was assumed in our damage estimates because those reservoirs effectively no longer existed. Fish replacement costs and loss recreational angling revenue were the two factors used to estimate a total economic loss of the fisheries of Wixom and Sanford reservoirs. The estimated fish density of each reservoir was calculated using the values of expected fish species densities for reservoirs in the Midwest reported by Carlander (1955). Replacement costs (per pound, by species) were estimated using values reported in Southwick and Loftus (2017).

Expected density by species was given by:

(expected pounds/acre) * (reservoir surface acreage at full pool) = total estimated pounds per reservoir.

Estimated fish replacement cost by species was given by:

(total estimated pounds per reservoir) * (per pound replacement cost) = total estimated replacement cost

Pooled species density estimates were used for suckers and redhorse, minnows, sunfishes, bullheads, and crappies. A predicted Muskellunge density of 0.21 fish/acre was used (D. Isermann, U.S. Geological Survey, personal communication) to expand the total number of Muskellunge in each reservoir. The mean weight of Muskellunge from past surveys was used to estimate the total biomass in a reservoir.

Lost recreational value estimates were generated using creel data generated for Sanford Reservoir in June-August 2015 and expanded to 12 months. Reported tournament data for Wixom and Sanford reservoirs from 2016-2019 was used to estimate the average annual number of tournaments (https://www.mcgi.state.mi.us/fishingtournaments/). The total number of angling trips, for both tournament and recreational fishers used to express annual recreational economic loss, includes both single angler and multiple angler trips with an average of 1.6818

anglers per trip. We used an economic value of $45.65 per angling trip, a value adjusted for inflation from $39 reported in 2011 (U.S. Department of Interior, et al. 2011).

Conclusion

Fish replacement costs in Sanford Reservoir was $3.4 million and was $6.4 million in Wixom Reservoir, owing to a larger surface acreage (Table 3). Total number of estimated annual angling days was over 25,000 in both reservoirs amounting to $1.2 million in lost recreational value in Sanford and Wixom reservoirs ($2.3 million combined). The total combined economic loss of fish replacement costs and lost recreational value projected over 5 years, a conservative estimate of when the reservoirs might be restored, is over $21 million (Table 4). This is likely a conservative estimate for a variety of reasons. Replacement costs of some species were unavailable and cost of rare, threatened, or endangered species is difficult to estimate. Ecological value and ecosystem services provided by species is not included. Estimation of staff costs for assessment was not included.

References

Carlander, K.D. 1955. The standing crop of fish in lakes. Journal of the Fisheries Research Board of Canada, 12(4): 543-570.

Environmental Science & Engineering Consultants. 1983. Aquatic assessment of the Tittabawassee River in the vicinity of Midland, Michigan. Pearl River, N.Y.

FEMA (Federal Emergency Management Agency). 2004. Federal guidelines for dam safety: hazard potential classification systems for dams. Interagency Committee on Dam Safety, U.S. Department of Homeland Security, Washington D.C.

FERC (Federal Energy Regulatory Commission). 1998a. Project No. 10809-000. Order issuing minor license. Washington D.C.

FERC (Federal Energy Regulatory Commission). 1998b. Project No. 10810-000. Order issuing minor license. Washington D.C.

FERC (Federal Energy Regulatory Commission). 1998c. Project No. 10808-00. Order issuing original license. Washington D.C.

FERC (Federal Energy Regulatory Commission). 1998d. Project No. 2785-002, 008 and 009. Order on rehearing and amending on license order. Washington D.C.

FERC (Federal Energy Regulatory Commission). 2004. Project Nos. 2785-046, 10808-026, 10809-021, and 10810-024. Order approving transfer of licenses. Docket # P-2785-046. Washington D.C.

Herbst, S., D. Hayes, K. Wehrly, C. LeSage, D. Clapp, J. Johnson, P. Hanchin, E. Martin, and F. Lupi. *In preparation*. Management Plan for Walleye in Michigan's Inland Waters. Michigan Department of Natural Resources, Fisheries Division, Lansing, Michigan.

Schrouder, K.S., R.N. Lockwood, and J.P. Baker. 2009. Tittabawassee River Assessment. Michigan Department of Natural Resources, Fisheries Special Report 52. Ann Arbor, Michigan.

Schrouder, K.S. 2014. Wixom Lake Status and Trends Survey. Michigan Department of Natural Resources, Fisheries Division, Bay City, Michigan.

Schrouder, K.S. 2015. Sanford Lake Status of the Fishery Report. Michigan Department of Natural Resources, Fisheries Division, Bay City, Michigan.

Southwick, R.I. and A.J. Loftus, editors. 2017. Investigation and Monetary Values of Fish and Freshwater Mollusk Kills. American Fisheries Society Special Publication 35, Bethesda, Maryland.

U.S. Department of Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2011. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Washington, D.C.

Table 1. Stocking history of Tittabawassee River impoundments and lower river in Michigan, 2015-2019.

Reservoir	Year	Month	Species	Stage	Number
Secord	2015	Oct	Muskellunge	Fall fingerlingling	1,223
	2018	Nov	Muskellunge	Fall fingerlingling	1,223
	2016	Jun	Walleye	Spring fingerling	49,956
	2018	Jun	Walleye	Spring fingerling	65,465
Smallwood	2015	Oct	Muskellunge	Fall fingerlingling	348
	2018	Nov	Muskellunge	Fall fingerlingling	348
	2015	Jun	Walleye	Spring fingerling	26,831
	2017	Jun	Walleye	Spring fingerling	21,603
	2019	Jun	Walleye	Spring fingerling	24,819
Wixom	2016	Oct	Muskellunge	Fall fingerlingling	3,000
	2016	Jun	Walleye	Spring fingerling	119,114
	2016	Jun	Walleye	Spring fingerling	32,411
	2018	Jun	Walleye	Spring fingerling	90,675
	2018	Jun	Walleye	Spring fingerling	35,562
	2018	Jun	Walleye	Spring fingerling	37,772
	2018	Jun	Walleye	Spring fingerling	103,107
Sanford	2015	Oct	Muskellunge	Fall fingerlingling	1,875
	2018	Nov	Muskellunge	Fall fingerlingling	1,223
	2019	Nov	Muskellunge	Fall fingerlingling	2,500
	2015	Jun	Walleye	Spring fingerling	70,103
	2015	Jun	Walleye	Spring fingerling	24,969
	2018	Jun	Walleye	Spring fingerling	104,095
	2019	Jun	Walleye	Spring fingerling	48,339
	2017	Jun	Walleye	Spring fingerling	58,780

Table 2. List of fishes in the Tittabawassee River watershed. Origin: N = Native, C = colonized, I = introduced. Status: O = extirpated, P = recent observations, U = historic record-current status unknown. Data from: University of Michigan records; Michigan Department of Natural Resources, Fisheries Division records; Michigan Department of Environmental Quality, Surface Water Quality Division records, Environmental Science & Engineering Consultants (1983); United States Fish and Wildlife Service records.

Common name	Scientific name	Origin	Status
Lampreys			
Northern Brook Lamprey	*Ichthyomyzon fossor*	N	P
American Brook Lamprey	*Lampetra appendix*	N	P
Sea Lamprey	*Petromyzon marinus*	C	P
Eels			
American Eel	*Anguilla rostrata*	N	P
Sturgeons			
Lake Sturgeon	*Acipenser fulvescens*	N	P
Gars			
Longnose Gar	*Lepisosteus osseus*	N	P
Bowfins			
Bowfin	*Amia calva*	N	P
Herrings			
Alewife	*Alosa pseudoharengus*	C	P
Gizzard Shad	*Dorosoma cepedianum*	N	P
Carps and minnows			
Central Stoneroller	*Campostoma anomalum*	N	P
Goldfish	*Carassius auratus*	I	P
Grass Carp	*Ctenopharyngodon idealli*	I	P
Spotfin Shiner	*Cyprinella spiloptera*	N	P
Common Carp	*Cyprinus carpio*	I	P
Brassy Minnow	*Hybognathus hankinsoni*	N	P
Common Shiner	*Luxilus cornutus*	N	P
Redfin Shiner	*Lythrurus umbratilis*	N	U
Pearl Dace	*Margariscus nachtriebi*	N	P
Hornyhead Chub	*Nocomis biguttatus*	N	P
River Chub	*Nocomis micropogon*	N	P
Golden Shiner	*Notemigonus crysoleucas*	N	P
Pugnose Shiner	*Nortopis anogenus*	N	P
Emerald Shiner	*Nortropis atherinoides*	N	P
Blackchin Shiner	*Notropis heterodon*	N	P
Blacknose Shiner	*Notropis heterolepis*	N	P

Table 2. – Continued

Common name	Scientific name	Origin	Status
Spottail Shiner	*Notropis hudsonius*	N	P
Rosyface Shiner	*Nortrois rubellus*	N	P
Sand Shiner	*Notropis stramineus*	N	P
Mimic Shiner	*Notropis volucellus*	N	P
Northern Redbelly Dace	*Phoxinus eos*	N	P
Finescale Dace	*Phoxinus neogaeus*	N	P
Bluntnose Minnow	*Pimephales notatus*	N	P
Fathead Minnow	*Pimephales promelas*	N	P
Longnose Dace	*Rhinichthys cataractae*	N	P
Blacknose Dace	*Rhinichthys obtusus*	N	P
Creek Chub	*Semotilus atromaculatus*	N	P
Suckers			
Quillback	*Carpoides cyprinus*	N	P
Longonse Sucker	*Catostomus catostomus*	N	P
White Sucker	*Catostomus commersonii*	N	P
Lake Chubsucker	*Erimyzon sucetta*	N	P
Northern Hog Sucker	*Hypentelium nigricans*	N	P
Silver Redhorse	*Moxostoma anisurum*	N	U
Black Redhorse	*Moxostoma carinatum*	N	P
Golden Redhorse	*Moxostoma erythrurum*	N	P
Shorthead Redhorse	*Moxostoma macrolepidot*	N	P
Greater Redhorse	*Moxostoma valenciennesi*	N	U
Bullhead catfishes			
Black Bullhead	*Ameiurus melas*	N	P
Yellow Bullhead	*Ameiurus natalis*	N	P
Brown Bullhead	*Ameiurus nebulosus*	N	P
Channel Catfish	*Ictalurus punctatus*	N	P
Stonecat	*Noturus flavus*	N	P
Tadpole Madtom	*Noturus gyrinus*	N	P
Flathead Catfish	*Pylodictus olivaris*	C	P
Pikes			
Grass Pickerel	*Esox americanus*	N	P
Northern Pike	*Esox lucius*	N	P
Muskellenge	*Esox masquinongy*	N	P
Mudminnows			
Central Mudminnow	*Umbra limi*	N	P

Table 2. – Continued

Common name	Scientific name	Origin	Status
Trouts			
Lake Herring	*Coregonus artedi*	N	O
Lake Whitefish	*Coregonus clupeaformis*	N	U
Rainbow Trout	*Oncorhynchus mykiss*	I	P
Coho Salmon	*Oncorhynchus kisuth*	I	P
Chinook Salmon	*Oncorhynchus tshawytsch*	I	P
Brown Trout	*Salmo trutta*	I	P
Brook Trout	*Salvelinus fontinalis*	I	P
Lake Trout	*Salvelinus namaycush*	N	P
Trout-perches			
Trout-perch	*Percopsis omiscomaycus*	N	P
Pirate Perches			
Pirate Perch	*Apredoderus sayanus*	N	P
Killifishes			
Banded Killifish	*Fundulus diaphanus*	N	P
Silversides			
Brook Silverside	*Labidesthes sicculus*	N	P
Sticklebacks			
Brook stickleback	*Culaea inconstans*	N	P
Sculpin			
Mottled Sculpin	*Cottus bairdi*	N	P
Smelt			
Rainbow Smelt	*Osmerus mordax*	C	P
Temperate basses			
White Perch	*Morone americana*	C	P
White Bass	*Morone chrysops*	N	P
Sunfishes			
Rock Bass	*Ambloplites rupestris*	N	P
Green Sunfish	*Lepomis cyanellus*	N	P
Pumpkinseed	*Lepomis gibbosus*	N	P
Bluegill	*Lepomis macrochirus*	N	P
Longear Sunfish	*Lepomis peltastes*	N	P
Redear Sunfish	*Lepomis mcrilophus*	I	P
Smallmouth Bass	*Micropterus dolomieu*	N	P
Largemouth Bass	*Micropterus salmoides*	N	P
White Crappie	*Pomoxis annularis*	N	P
Black Crappie	*Pomoxis nigromaculatus*	N	P

Table 2. – Continued

Common name	Scientific name	Origin	Status
Perches			
Rainbow Darter	*Etheostoma caeruleum*	N	P
Iowa Darter	*Etheostoma exile*	N	P
Least Darter	*Etheostoma mircoperca*	N	P
Fantail Darter	*Etheostoma flabellare*	N	P
Johnny Darter	*Etheostoma nigrum*	N	P
Yellow Perch	*Perca flavescens*	N	P
Northern Logperch	*Percina caprodes*	N	P
Blackside Darter	*Percina maculata*	N	P
Walleye	*Sander vitreus*	N	P
Drums			
Freshwater Drum	*Aplodinotus grunniens*	N	P
Gobies			
Round Goby	*Neogobius melanostomus*	I	P

Table 3. Predicted fish densities and replacement costs in Wixom and Sanford reservoirs. Species or group-specific fish density are from Carlander (1955) and replacement costs are from Southwick and Loftus (2017).

			Sanford Reservoir		Wixom Reservoir	
Species	Replacement cost/lb	Predicted biomass (lb/ac)	Predicted total biomass (lb)	Total	Predicted total biomass (lb)	Total
Bowfin	0.45	21.6	33,005	$ 14,852.16	56,160	$ 25,272.00
Channel Catfish	3.71	13.9	21,239	$ 78,797.43	36,140	$ 134,079.40
Common Carp	0.52	73.3	112,002	$ 58,241.25	190,580	$ 99,101.60
Golden Shiner	2.36	42.9	65,551	$ 154,700.83	111,540	$ 263,234.40
Largemouth Bass	6.64	19.2	29,338	$ 194,801.66	49,920	$ 331,468.80
Muskellunge	50.66	-	706	$ 35,762.72	11,794	$ 597,463.78
Northern Pike	19.28	8	12,224	$ 235,678.72	20,800	$ 401,024.00
Smallmouth Bass	33.46	4.2	6,418	$ 214,732.90	10,920	$ 365,383.20
Walleye	12.32	6.2	9,474	$ 116,714.75	16,120	$ 198,598.40
White Bass	3.32	3.2	4,890	$ 16,233.47	8,320	$ 27,622.40
Yellow Perch	6.27	5	7,640	$ 47,902.80	13,000	$ 81,510.00
All bul heads	6.29	60.3	92,138	$ 579,550.54	156,780	$ 986,146.20
All crappie	3.62	30.9	47,215	$ 170,919.02	80,340	$ 290,830.80
All minnows	5.57	39.4	60,203	$ 335,331.82	102,440	$ 570,590.80
All suckers and redhorse	15.88	37.6	57,453	$ 912,350.46	97,760	$1,552,428.80
All sunfishes	3.71	46.2	70,594	$ 261,902.26	120,120	$ 445,645.20
Total				$3,428,472.80		$6,370,399.78

Table 4. Fish replacement costs (i.e., one-time replacement cost) and lost recreational angling economic value (i.e., cumulative over each year) for the fisheries of Wixom and Sanford reservoirs.

Reservoir	Fish replacement value	Annual angling value	Total (1 year)	2 years	3 years	4 years	5 years
Sanford	$3,428,473	$1,157,319	$4,585,792	$5,743,110	$6,900,429	$8,057,748	$9,215,067
Wixom	$6,370,400	$1,162,614	$7,533,014	$8,695,628	$9,858,242	$11,020,857	$12,183,471
		Grand total	**$12,118,806**	**$14,438,739**	**$16,758,672**	**$19,078,605**	**$21,398,538**

List of Figures.

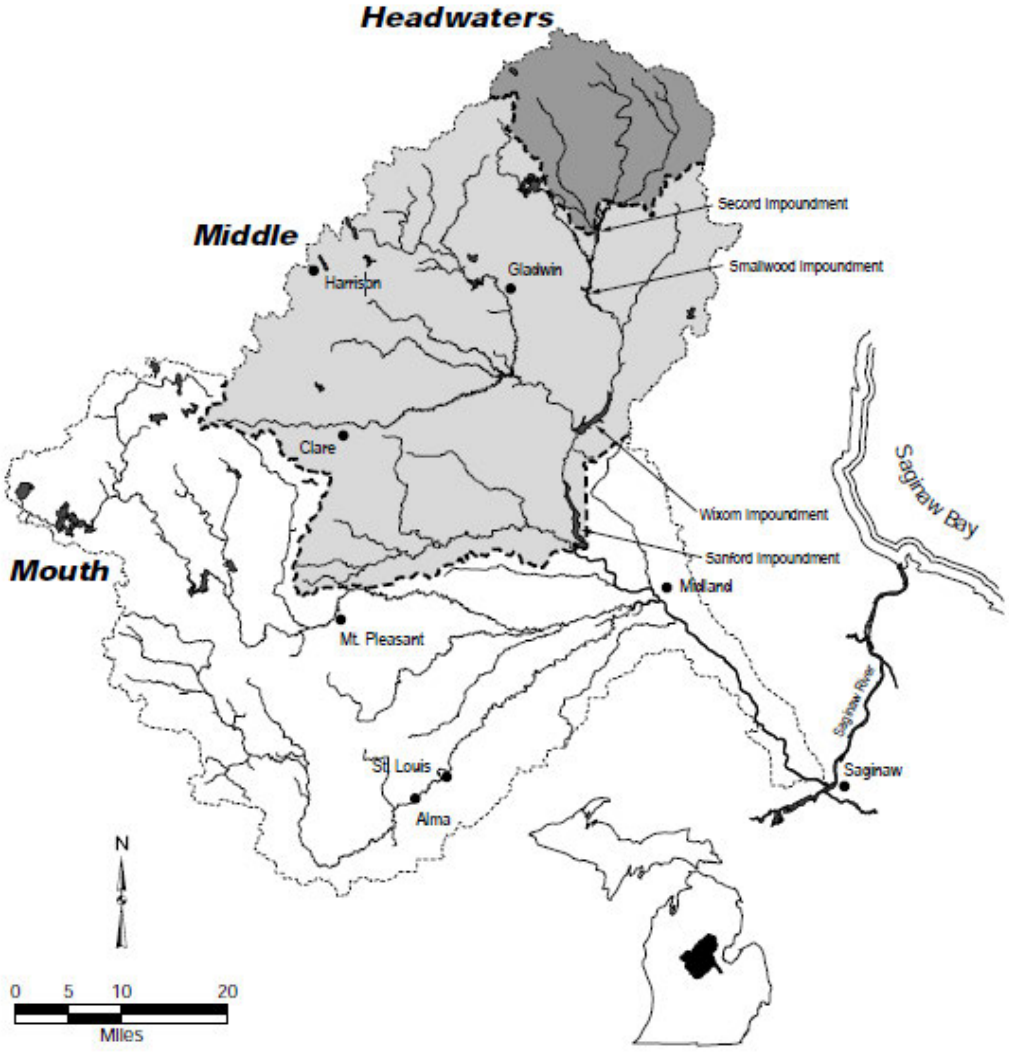
Headwaters
Middle
Mouth
Secord Impoundment
Smallwood Impoundment
Harrison
Gladwin
Clare
Wixom Impoundment
Sanford Impoundment
Midland
Mt. Pleasant
St. Louis
Alma
Saginaw
Saginaw River
Saginaw Bay
N
0 5 10 20
Miles

Figure 1.

Witness information

I have 21 years of experience in the field of conservation and natural resources and a doctorate in Wildlife and Fisheries Sciences. I have worked on research and management of many fish and aquatic species throughout North America for the U.S. Fish and Wildlife Service, the U.S. Geological Survey, and the Michigan Department of Natural resources.

BS – Zoology - North Dakota State University, 1997

MS – Fisheries - Auburn University, 2003

PhD - Fisheries Science - South Dakota State University, 2009

I have not previously testified as an expert at trial or by deposition. I am preparing this material in my capacity as a state employee and am being compensated in the same manner as my other work as a Fisheries Supervisor for Michigan DNR Fisheries Division.

Publications from last 10 years:

Hessler, T.M., D.C. Chapman, C.P. Paukert, J.C. Jolley, and M.E. Byrne. 2021. Winter habitat selection and efficacy of telemetry to aid grass carp removal efforts in a large reservoir. North American Journal of Fisheries Management DOI: 10.1002/nafm.10693.

Harris, J.E., G.S. Silver, R.D. Nelle, J.C. Jolley, and T.A. Whitesel. 2019. A stepwise approach to assess the occupancy state of larval lampreys in streams. Journal of Fish and Wildlife Management 11:226-237.

Jackson, A.D, M.L. Moser, S.T. Onjukka, S. LaPatra, K. Lujan, C. Samson, M.G. White, M. Blair, L. Rhodes, R. Lampman, and J.C. Jolley. 2019. Occurrence of pathogens in Pacific lamprey (*Entosphenus tridentatus*). Reviews and Fish Biology and Fisheries 29.

Jolley, J.C., and K. Lujan. 2019. Potential infectious agents of Pacific Lamprey discovered through routine fish health screenings. Journal of Fish and Wildlife Management 10:517-524.

Ostberg, C.O., D.M. Chase, M.S. Hoy, J.J. Duda, M.C. Hayes, J.C. Jolley, G.S. Silver, and C. Cook-Tabor. 2019. Evaluation of environmental DNA surveys for identifying occupancy and spatial distribution of Pacific Lamprey (*Entosphenus tridentatus*) and *Lampetra* spp. in a Washington coast watershed. Environmental DNA 1:131-143.

Byrd, C.G., D.C. Chapman, and E.K. Pherigo, and J.C. Jolley. 2018. Tag retention and survival of small bighead carp implanted with a dummy acoustic tag at three temperatures. Journal of Applied Ichthyology.

Jolley, J.C., G.S. Silver, J.E. Harris, and T.A. Whitesel. 2018. Pacific lamprey recolonization of a Pacific Northwest river following dam removal. River Research and Applications 34:44-51.

Jolley, J.C., C.T. Uh, G.S. Silver, and T.A. Whitesel. 2017. Low mortality of larval lampreys from electrofishing, suction-pumping, anesthesia, and handling. Journal of Fish and Wildlife Management 8(2):640-647.

Clemens, B., R. Beamish, K. Coates, M.F. Docker, J. Dunham, A. Gray, J. Hess, J. Jolley, R. Lampman, B. McIlraith, M. Moser, J. Murauskas, D. Noakes, H. Schaller, C. Shreck, S. Starvevich, B. Strief, S. van de Wetering, J. Wade, L. Weitkamp, L. Wyss. 2017. Conservation challenges and research needs for Pacific Lamprey in the Columbia River Basin. Fisheries 42(5):268-280.

Harris, J.E. and J.C. Jolley. 2017. Occupancy, density, and abundance of larval lampreys in tributary river mouths upstream of dams on the Columbia River, Washington and Oregon. Canadian Journal of Fisheries and Aquatic Sciences. Doi:10.1139/cjfas-2016-0212.

Docker, M.F., G.S. Silver, J.C. Jolley, and E.K. Spice. 2016. Simple genetic assay distinguishes lamprey genera *Lampetra* and *Entosphenus* and shows lower size limit to morphological identification accuracy. North American Journal of Fishery Management 36:780-787.

Hampton, S. and coauthors (including J.C. Jolley). 2016. Ecology under lake ice. Ecology Letters. Doi:10.1111/ele.12699.

Harris, J.E, J.C. Jolley, G.S. Silver, H. Yuen, and T.A. Whitesel. 2016. Catch-depletion abundance estimates of larval lamprey in a wadeable stream: an experimental evaluation of catchability using backpack electrofishing. Transactions of the American Fisheries Society 146:1006-1017.

Jolley, J.C., G. Kovalchuk, and M.F. Docker. 2016. River lamprey (*Lampetra ayresii*) outmigrant upstream of the John Day Dam in the Mid-Columbia River. Northwestern Naturalist 97:48-52.

Kaemingk, M.A., J.C. Jolley, C.P. Paukert, D.W. Willis, R.S. Holland, G.A. Wanner, and M. Lindvall. 2016. Can invasive species cause a catastrophic ecosystem shift? Marine and Freshwater Research: http://dx.doi.org/10.1071/MF15068

Jackson, A.D., M.L. Moser, S.T. Onjukka, S. LaPatra, K. Lujan, C. Samson, M.G. White, M. Blair, L. Rhodes, R. Lampman, J.C. Jolley, and A. Wildbill. 2019. Prevalence of pathogens in Pacific Lamprey of the Pacific Northwest. Journal of Aquatic Animal Health.

Jolley, J.C., J.E. Harris, G.S. Silver, and T.A. Whitesel. 2018. Recolonization and changes in habitat use by Pacific lamprey after the removal of a large dam. River Research and Applications 34:44-51.

Jolley, J.C., C.T. Uh, G.S. Silver, and T.A. Whitesel. 2017. High survival of larval lampreys *Entosphenus* and *Lampetra* spp. to electrofishing, suction pumping, anesthesia, and handling in the Pacific Northwest. Journal of Fish and Wildlife Management 8(640-674).

Dawson, H.A., B.R. Quintella, P.R. Almeida, A.J. Treble, and J.C. Jolley. 2015. The ecology of larval and metamorphosing lamprey. Pages 75-118 i*n* M.F. Docker, editor. Lampreys: biology conservation and control, Volume 1. Springer, New York.

Jolley, J.C., M.C. Satter, G.S. Silver, and T.A. Whitesel. 2015. Evaluation of methods to measure condition in Pacific Northwest larval lampreys. Northwest Science 89:270-279.

Jolley, J.C., C.T. Uh, G.S. Silver, and T.A. Whitesel. 2015. Larval Pacific lamprey feeding and growth in captive reared environments. North American Journal of Aquaculture 77:449-459.

Jolley, J.C., E.S. Albin, M.A. Kaemingk, and D.W. Willis. 2013. A survey of aquatic invertebrate communities in Nebraska Sandhill lakes reveals potential alternative ecosystem states. Journal of Fish and Wildlife Management 4:151-162.

Jolley, J.C. M.A. Kaemingk, D.W. Willis, and R.S. Holland. 2013. Overwinter mortality of sympatric juvenile bluegill and yellow perch in mid-temperate Sandhill lakes, Nebraska, USA. The Open Fish Science Journal 6:58-70.

Kaemingk, M.A., K.J. Stahr, J.C. Jolley, R.S. Holland, and D.W.Willis. 2013. Evidence for bluegill spawning plasticity obtained by disentangling complex factors related to recruitment. Canadian Journal of Fisheries and Aquatic Sciences 71:93-105.

Kurath, G., J.C. Jolley, T.M. Thompson, D. Thompson, T.A. Whitesel, S. Gutenberger, and J.R. Winton. 2013. Pacific lamprey *Entosphenus tridentatus* are not susceptible to common fish rhabdoviruses of the Pacific Northwest. Journal of Aquatic Animal Health 25:274-280.

Jolley, J.C., G.S. Silver, and T.A. Whitesel. 2012. Occupancy and detection of larval Pacific lampreys and *Lampetra* spp. in a large river: the Lower Willamette River. Transactions of the American Fisheries Society 141:305-312.

Kaemingk, M.A., J.C. Jolley, D.W. Willis, and S.R. Chipps. 2012. Priority effects among young-of-the-year fish: reduced growth of bluegill sunfish (*Lepomis macrochirus*) caused by yellow perch (*Perca flavescens*)?" Freshwater Biology 57:654-665.

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY, AND THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES,

Plaintiffs,

v

LEE MUELLER; BOYCE MICHIGAN, LLC; EDENVILLE HYDRO PROPERTY, LLC; BOYCE HYDRO POWER LLC; BOYCE HYDRO, LLC; WD BOYCE TRUST 2350; WD BOYCE TRUST 3649; AND WD BOYCE TRUST 3650,

Defendants.

No. 1:20-cv-528

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DECLARATION OF ELLE GULOTTY UNDER 18 U.S.C. § 1746

1. My name is Elle Gulotty. I am a Resource Analyst within the Fisheries Division of the Michigan Department of Natural Resources.

2. I prepared a report in this case that summarizes my expert opinions related to the damage to the freshwater mussel ecosystems of Wixom and Sanford Lakes caused by the May 19, 2020 failures of the Edenville and Sanford dams. The report is attached to this declaration. It explains my opinions and the information I reviewed to reach them. I could testify about the contents of the report if needed.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: May 3, 2023

Elle Gulotty

LF: Dam-Mueller, Boyce Hydro (EGLE & DNR v)/AG# 2020-0291918-C-L/Declaration of Elle Gulotty 2023-05-03

DNR Fisheries Division, Elle Gulotty December 1, 2022

Estimated Mortality and Damage Assessment of Freshwater Mussels in Sanford Lake and Wixom Lake 2020

Overview

Native freshwater mussels are important to Michigan's aquatic environment and provide multiple ecosystem services where their communities are intact. Loss of freshwater mussels, whether at a single site or throughout a watershed, is cause for concern as there is a great need to protect existing populations. In North America, freshwater mussels are identified as the most imperiled of any major group of animals with up to 75% considered at risk of extinction (Williams et al. 1993[1]; Master et al. 2000[2]; Strayer 2008[3]). Many of Michigan's freshwater mussel populations represent fractions of their historic numbers or are declining and have other characteristics that make them vulnerable.

Mussel surveys in Wixom Lake in 2019 and 2018 demonstrated presence of freshwater mussels, including rare and sensitive species, in the vicinity of the Boyce properties. Department of Natural Resources (DNR) Fisheries Division staff were tasked with estimating mussel mortality in Sanford and Wixom Lake impoundments caused by the Tittabawassee River dam failures. I lead the development of the sampling strategy and analytical approach, using resources developed by DNR staff familiar with GIS and smartphone apps, and techniques developed by mussel experts like Strayer and Smith 2003[4] and Vaughn 1997[5] and members of the American Fisheries Society and Freshwater Mollusk Conservation Society. I applied lessons learned from participating in mussel surveys led by others, mussel surveys I conducted independently, and mussel plans and reports I have reviewed through my work in fisheries habitat management, especially in regard to hydropower and other activities in Michigan (see Author information).

I developed a sampling strategy designed to be scalable and representative of the entire effected community of freshwater mussels. Mussels are often patchily distributed, and it was important to me that the survey efforts not focus on areas we knew mussels had been, since this would possibly skew the analysis and results. I anticipated that many areas would be inaccessible and did not know how many

[1] Williams, J D., M. L. Warren Jr., K. S. Cummins, J. L. Harris, and R. J. Neves. 1993. Conservation status of freshwater mussels of the United States and Canada. Fisheries 18(9):6-22.
[2] Master, L. L., B. A. Stein, L. S. Kutner, and G. A. Hammerson. 2000. Vanishing assets: Conservation status of U.S. species. Pages 93-118 in B. A. Stein, L. S. Kutner, and J. S. Adams editors. Precious heritage: The status of biodiversity in the United States. Oxford University Press, New York.
[3] Strayer, D. L. 2008. Freshwater mussel ecology: A multifactor approach to distribution and abundance. University of California Press, Berkeley.
[4] Strayer D.L., and Smith D.R. 2003. A Guide to Sampling Freshwater Mussel Populations. American Fisheries Society Monograph. Volume 8.
[5] Vaughn, C.C., Taylor, C.M., and Eberhard, K.J. 1997. A comparison of the effectiveness of timed searches vs. quadrat sampling in mussel surveys. In Conservation and management of freshwater mussels II. Initiatives for the future. Edited by K.S. Cummings, A.C. Buchanan, C.A. Mayer, and T.J. Naimo. Upper Mississippi River Conservation Committee, Rock Island, Illinois. pp. 157-162. Available from Illinois Natural History Survey, 607 East Peabody Drive, Champaign, Illinois 61820 USA.

people would be available to survey and for how long, so designed a strategy that would maximize the usefulness of information gathered given practical and safety limitations.

Typically, in aquatic systems where mussels are present, mussels occur both at and surface and below the substrate surface. Many live mussels are often found buried in the substrate, not visible when visually scanning the surface of the substrate. Quadrats are dug to detect subsurface mussels and develop density estimates so that the total number of mussels which were not visible during timed-searches can still be estimated. Quadrats are very labor intensive, and often miss rare species, so in order to capture the entire community effected, both surface (timed-search) and subsurface (quadrats) were surveyed. Timed-search surveys involve staff systematically searching the substrate surface and recording freshwater mussels found and the mussel condition.

DNR Fisheries Division worked with staff from Department of Energy, Great Lakes & Energy (EGLE), as well as faculty and students from Central Michigan University (CMU) to conduct surveys at Wixom Lake and Sanford Lake. Mortality-focused surveys were conducted on June 3, 4, 5, 8, and 9, 2020. Surveys specifically focused on characterizing substrate condition were conducted on June 5 and 15, 2020.

Timed-search surveys were conducted at 10 access sites across Sanford and Wixom Lakes and included 15 meter by 15 meter cells where searches were conducted for mussels visible on the surface. Survey design called for access sites to receive similar search effort (4.5 person-hours). For quadrats and cells searched, mussel condition was assessed to differentiate mussels impacted by the failure from those that died due to other causes.

Eleven species of mussels were identified in the 2020 mortality surveys (Creek Heelsplitter, Fatmucket, Giant Floater, Kidney-shell, Mucket, Paper Pondshell, Plain Pocketbook, Rainbow, Spike, Wabash Pigtoe, White Heelsplitter). Table 9 includes a full list of species found in the recent Tittabawassee River mortality surveys (2018-2020) and their conservation status.

The density estimates developed from the cells and quadrats were applied to a limited portion of the footprint of habitats impacted by the dam failure. The calculated densities were applied to the areas they were representative of, excluding habitats impacted by allowed dam operations. For Wixom Lake, habitat within the 3 to 8 foot depth contour was used rather than the entire dewatered area. Because GIS analysis of the dewatering event at Sanford Lake had not been conducted, we used 625 acres to represent dewatered habitat by taking half of the typical surface area (i.e., about 1250 acres/2) in the calculations as a conservative estimate, even though there was likely more available habitat prior to the dewatering event. The operating bandwidth at Sanford Lake is relatively narrow, 0.7 feet vertically, and winter drawdowns were limited to no more than 3 feet below normal pool with the same bandwidth. Additionally, due to the nature of the disaster (flooding, dewatering), mussel mortality estimates are likely underestimated due to the presence of scoured lakebed and sediment deposition (Appendix A).

This report focuses only on fresh dead mussels found during mortality surveys in 2020 and does not describe rescue efforts conducted immediately after the dam failures. Damage estimation followed

American Fisheries Society guidelines[6] (hereafter "AFS Guidelines"), which is widely regarded as the definitive resource for mussel kill valuations. The actual number of fresh dead mussels found was extrapolated to include the estimated surface area exposed due to the dam failures. This number of mussels was then multiplied by the AFS Guidelines replacement value per genus. My estimate of mussels killed is 2,991,682 across Wixom and Sanford Lakes, with a calculated replacement value of $91.7 million

Roles and Responsibilities

I was the primary staff person responsible for survey strategy, data review, and analysis for DNR Fisheries Division. Kesiree Thiamkeelakul, DNR Fisheries Division, was the on-site coordinator for survey efforts. Kesiree Thiamkeelakul worked with local fisheries management staff and others to deploy surveyors to available access points, ensure sampling strategies were followed, and records of data collected were accurate and complete and that all aspects of on-the-ground data collection were a success. Mussel identification was confirmed on-site by Joe Rathbun, DNR volunteer, and Dr. Daelyn Woolnough and graduate students from Central Michigan University, who contributed substantially to staffing the survey effort. Substantial resources, including a digital mobile app and grid system were developed by Mike Rubley, DNR Forest Resources Division, and Joe Nohner, DNR Fisheries Habitat Management Unit.

Background

Boyce Hydro owned and operated four dams on the Tittabawassee River in Gladwin and Midland County, Michigan. On May 19, 2020, Edenville Dam (Wixom Lake) failed and Sanford Dam was damaged due to high inflows from a multi-day precipitation event. On May 20, 2020, FERC ordered Boyce Hydro to fully lower the impoundments behind Sanford, Secord, and Smallwood dams in a safe manner as flows recede.

[6] Southwick, R. I., and A. J. Loftus, editors. 2017. Investigation and monetary values of fish and freshwater mollusk kills. American Fisheries Society, Special Publication 35, Bethesda, Maryland. "AFS Guidelines"

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List of Figures and Tables

1. Determining Mussel Injury

Survey effort, GIS analysis, and statistical methodology were used to assess the extent of freshwater mussel injury.

a. Survey effort

This survey effort was based on a stratified random approach and was considerably limited by the availability of access points, work restrictions due to COVID-19, and general safety considerations related to working within a disaster area. The areas covered were representative of the range of habitat conditions prior to the dewatering events and included natural lakebed, scoured lakebed, and areas with recently deposited sediments (Appendix A). Rather than selecting areas where mussels were readily observed, as could happen with haphazard sampling, surveyors were randomly assigned cells to search. Because the area of the Tobacco arm of Wixom Lake near Dale Road was sampled repeatedly in 2018 and 2019, these sites were not prioritized. A timed-search method was used. Within each impoundment, quadrats were dug to capture the subsurface population.

A total of 10 access sites across Sanford Lake and the Wixom Lake areas were searched. In Sanford Lake, 79 cells across 5 access sites were searched (Figure 1). In the Wixom Lake area, 13 cells were searched in the Tobacco arm and 40 cells were searched in the Tittabawassee arm across 5 access sites (Figure 2).

Cells were 15 meters by 15 meters (50 by 50 feet) except where portions of the cells were inundated or inaccessible. Although surveyors noted occasions where only part of a cell was searched, for the sake of simplicity the reduction in search area was not incorporated into the analysis (note that this will contribute to a conservative estimate or underestimate of mussels injured).

The purpose of quadrats is to estimate the density of mussels below the exposed surface. In a healthy mussel community, many live mussels will be burrowed in the substrate. To estimate damages to subsurface mussels, a 1 meter by 1 meter square is marked, any mussels on the surface are cleared, and sediments are dug several inches down to search for mussels.

Only fresh dead mussels were counted in the mussel mortality estimate. Fresh dead was defined as those with tissue or those without tissue but with a shiny nacre and valves attached, as fresh dead mussels lacking tissue could be indicative of scavenger activity because of exposure from the drawdown.

b. GIS analysis

The areas used for the mortality estimate for Wixom Lake was based on prior GIS work conducted to analyze the 2018 drawdown event (Figure 3). While the dam failure means that the effective head elevation of Edenville Dam was largely eliminated and the impoundment was drawn down below the 8 foot contour (therefore a much larger area was dewatered), the area exposed within the 3 to 8 foot contour allowed for a conservative estimate of exposed area (described in detail in 1.c Statistical methods). Across each impoundment, cells were assigned priority levels based on a number of factors anticipated to be of interest, including areas that would be representative by accessing known or newly acquired access points (Figure 4).

Figure 1 Overview of Sanford Lake survey sites

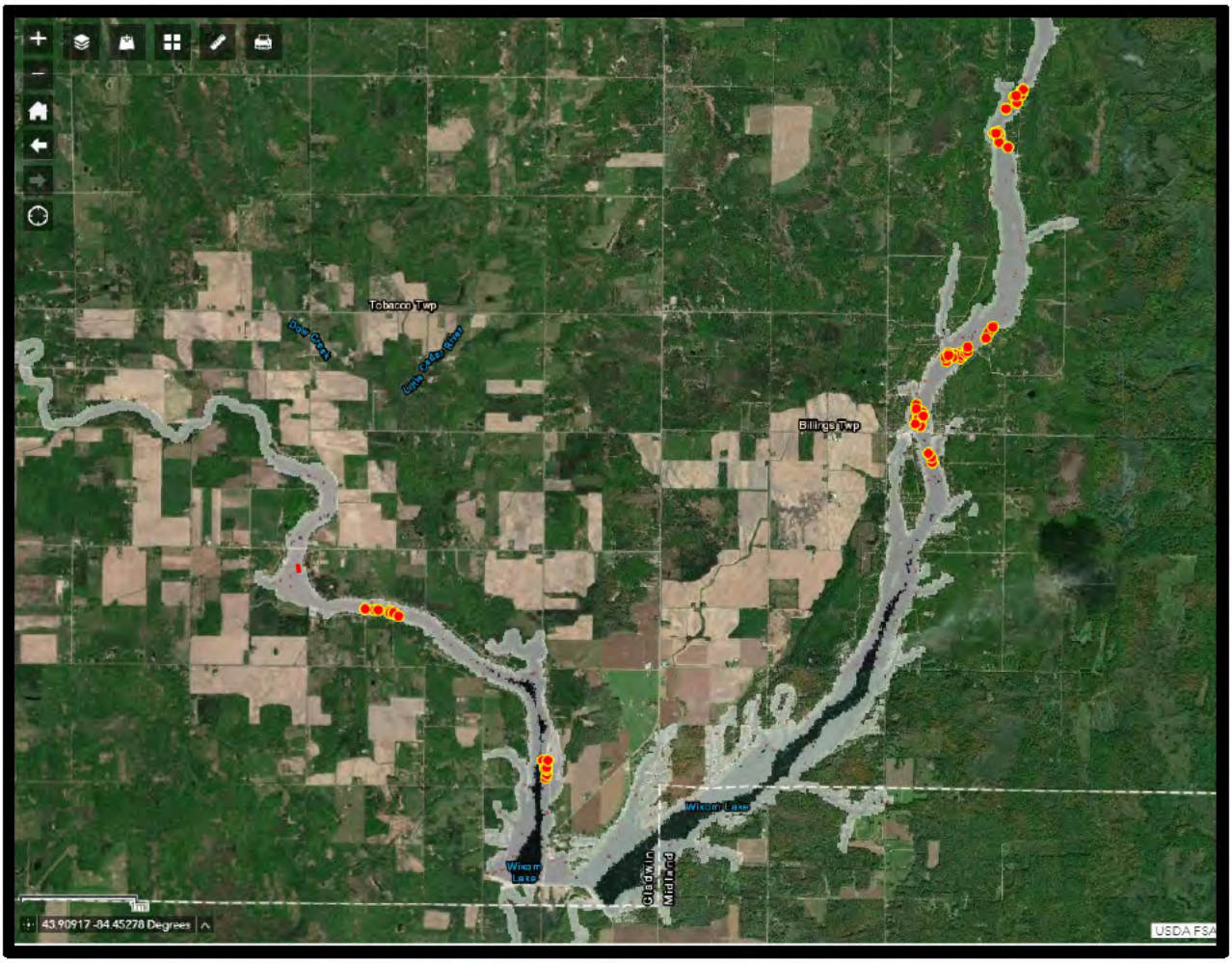

Figure 2 Overview of Wixom Lake survey sites

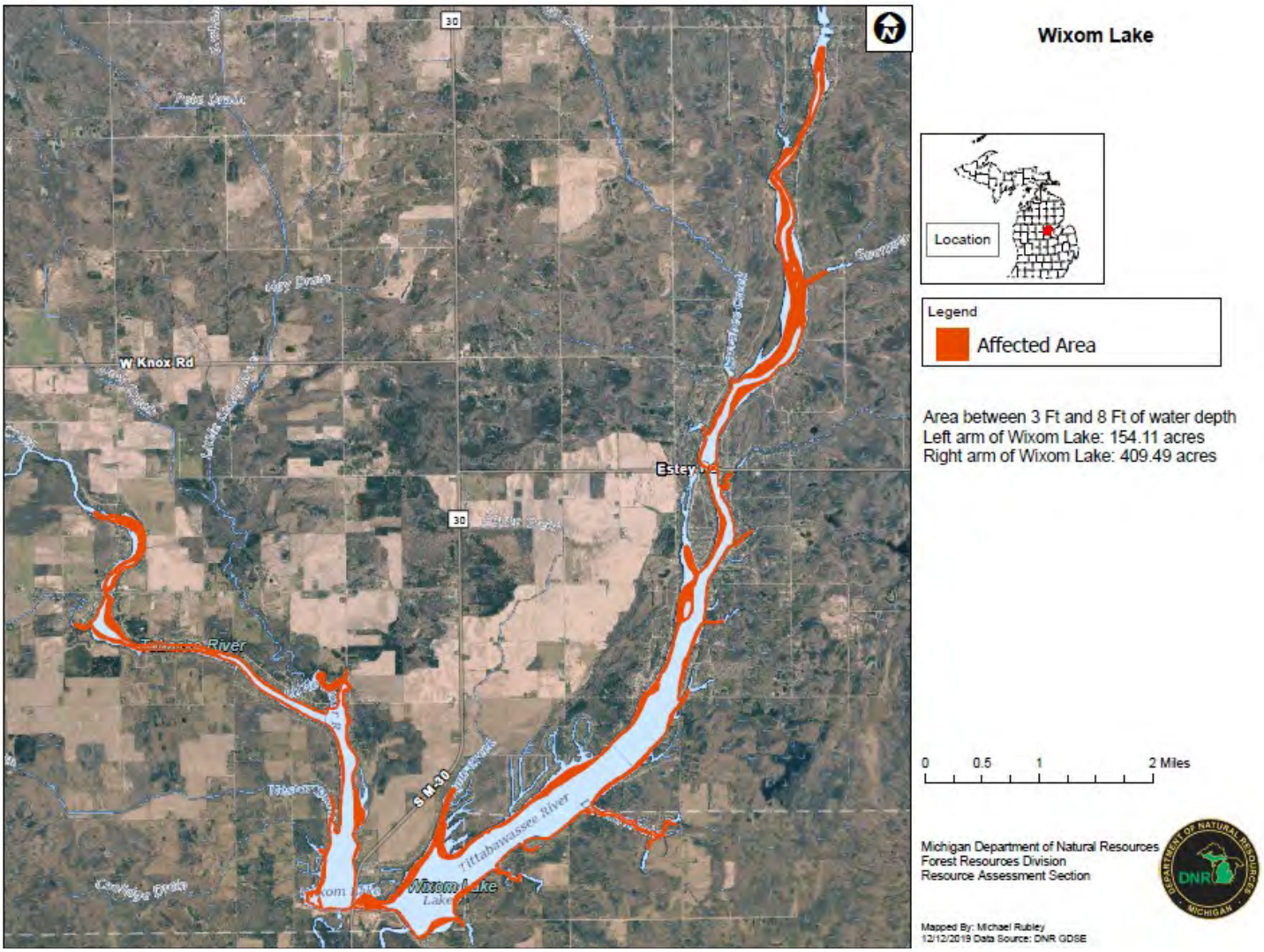

Figure 3 Wixom Lake contour map

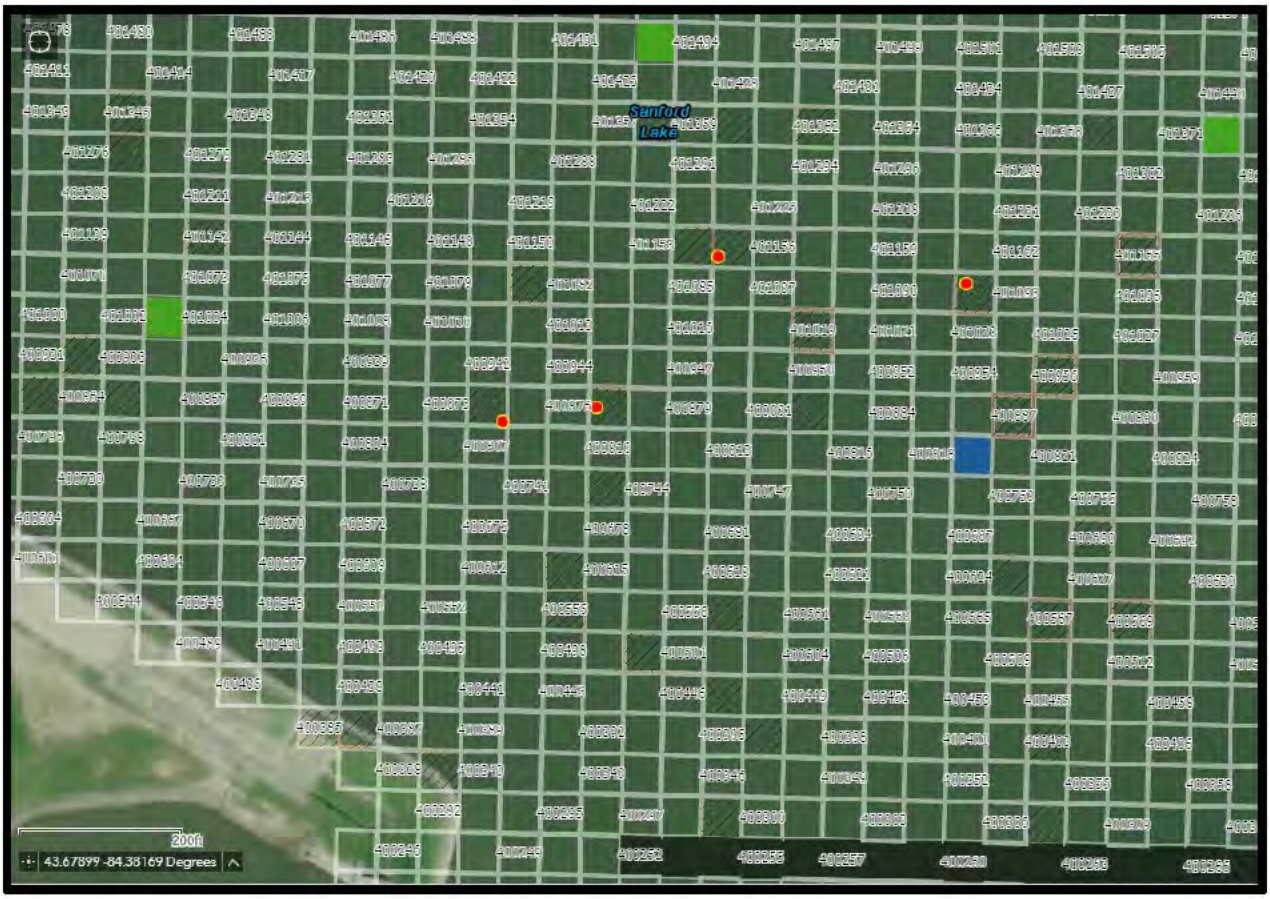

Figure 4 Example of cell selection using grids

c. Statistical methods and calculations

The sections below describe subsampling, density calculations, and extrapolation, as well as a calculation of the mortality factor associated with attempting to replace freshwater mussels.

i. Subsampling

The use of subsampling is a widely accepted practice by which data from representative locations are extrapolated out to larger areas in circumstances when a full census is impractical. The Sanford Lake and Wixom Lake data analysis was based on remote sensing data and stratified random survey efforts. Only fresh dead mussels were counted in the analysis. Data are presented for two survey types: timed-search (Table 1) and quadrat surveys (Table 2). Timed-search estimates the number of mussels killed on the surface while quadrat surveys estimates the number of mussels killed while buried in substrate.

Table 1 Timed-search cell count per access site

Access Site	Cell Count
Sanford Lake	79
Sanford Lake	77
Edenville Kayak Launch	2

Wixom Lake - Tobacco arm	13
Rock Trail_Wixom	3
Tobacco_Wixom	4
Wixom Tobacco_Dundas	6
Wixom Lake – Tittabawassee arm	40
Arapahoe	16
Wixom Norma	13
WT_Wixom Etsey	11

Table 2 Quadrat count per access site

Access Site	Quadrat Count
Sanford Lake	18
Sanford	16
Edenville Kayak Launch	2
Wixom Lake - Tobacco arm	5
Tobacco_Wixom	3
Wixom Tobacco_Dundas	2
Wixom Lake – Tittabawassee arm	12
Wixom Arapahoe	4
Wixom Norma	5
WT_Wixom Etsey	3

(1) Quadrat surveys

Quadrat surveys were conducted at several sites in Sanford and both arms of Wixom Lake.

Table 3 Quadrat survey results

Sanford Lake	Mussel Count	Mussels per quadrat	Quadrat Count
Giant Floater	1	0.06	18
Wixom Lake - Tobacco arm			
Fatmucket	1	0.2	5
Plain Pocketbook	1	0.2	5
Wixom Lake – Tittabawassee arm			

(2) Timed-search

A timed-search effort was conducted at several sites in Sanford Lake and both arms of Wixom Lake.

Table 4 Timed-search survey results

Sanford Lake	Mussel Count	Mussels per cell	Cell Count
Fatmucket	11	0.14	79
Giant Floater	54	0.68	79
Mucket	1	0.013	79
Plain Pocketbook	1	0.013	79
Spike	2	0.025	79
Wabash Pigtoe	2	0.025	79
White Heelsplitter	7	0.089	79
Wixom Lake - Tobacco arm			
Creek Heelsplitter	2	0.154	13
Fatmucket	18	1.385	13
Giant Floater	139	10.692	13
Kidney-shell	2	0.154	13
Paper Pondshell	1	0.077	13
Plain Pocketbook	5	0.385	13
Rainbow	2	0.154	13
Spike	7	0.538	13
Wabash Pigtoe	26	2	13
Wixom Lake – Tittabawassee arm			
Fatmucket	1	0.025	40
Giant Floater	23	0.575	40
White Heelsplitter	1	0.025	40

ii. Density calculation and extrapolation

The timed-search estimates were used to develop average densities which were applied across the areas surveyed to develop an overall estimate. Densities of mussels killed in 2020 based on quadrat data ranged from 0/m^2 to 0.2/m^2 and timed-search data yielded averaged density estimates from 0/m^2 to 0.047/m^2. The densities from quadrat data for the 2020 sites were averaged within the broad geographic area of Sanford Lake, Wixom Lake - Tobacco arm, and Wixom Lake - Tittabawassee arm. The total mussel estimated killed represents average density from the timed-searches (mussels at surface, Table 5) averaged across cells and multiplied by a subset of surface area exposed, plus the average density of the quadrat searches (mussels below surface, Table 6) multiplied by the same footprint as used for surface mussels.

Pre-failure mortality surveys in Wixom Lake provide useful context. A search within the Tobacco Arm of Wixom Lake in 2019 north of Dale Road had quadrat densities ranging from 0/m^2 to 3.83/m^2 and timed-search data yielded averaged density estimates from 0/m^2 to 0.29/m^2. The highest average density for a species in the timed-search data from 2019 was spike 0.533/m^2. In 2018, surveys covered sites within both arms of Wixom Lake, and averaged quadrat data ranged from 0/m^2 to 1/m^2. 2018 timed-search data yielded site-based density estimates of up to 0.258/m^2 and an across site average density of 0.13/m^2 for Wabash Pigtoe.

When the densities from quadrats and timed-searches are extrapolated, an estimate of mussels killed is as follows.

(1) Mussels killed

Table 5 Timed-search (surface mussels killed)

Sanford Lake	Mussel Count	Cell Count	Mussels per m^2	Area (m^2)	Estimated mussels killed
Fatmucket	11	79	0.000618847	2529285.5	1565.24
Giant Floater	54	79	0.003037975	2529285.5	7683.905
Mucket	1	79	5.62588E-05	2529285.5	142.2945
Plain Pocketbook	1	79	5.62588E-05	2529285.5	142.295
Spike	2	79	0.000112518	2529285.5	284.5891
Wabash Pigtoe	2	79	0.000112518	2529285.5	284.589
White Heelsplitter	7	79	0.000393812	2529285.5	996.069
Wixom Lake - Tobacco arm					
Creek Heelsplitter	2	13	0.000683761	623661.04	426.4349
Fatmucket	18	13	0.006153846	623661.04	3837.914
Giant Floater	139	13	0.047521368	623661.04	29637.23
Kidney-shell	2	13	0.000683761	623661.04	426.4349
Paper Pondshell	1	13	0.00034188	623661.04	213.2175
Plain Pocketbook	5	13	0.001709402	623661.04	1066.087
Rainbow	2	13	0.000683761	623661.04	426.4349
Spike	7	13	0.002393162	623661.04	1492.522
Wabash Pigtoe	26	13	0.008888889	623661.04	5543.654
Wixom Lake – Tittabawassee arm					
Fatmucket	1	40	0.000111111	1657147.2	184.1278
Giant Floater	23	40	0.002555556	1657147.2	4234.932
White Heelsplitter	1	40	0.000111111	1657147.2	184.1275

Table 6 Quadrat search (buried mussels killed)

Sanford Lake	Mussel Count	Quadrat Count	Mussels per m^2	Area (m^2)	Estimated mussels killed
Giant Floater	1	18	0.055555556	2529285.5	140515.9
Wixom Lake - Tobacco arm					
Fatmucket	1	5	0.2	623661.04	124732.2
Plain Pocketbook	1	5	0.2	623661.04	124732.2
Wixom Lake – Tittabawassee arm					
No mussels found in quadrats searched in Tittabawassee arm					

Table 7 Total estimated mussels killed. Note that searches did not detect mussels killed for species noted with "-".

Sanford Lake	Timed-search	Quadrat search	Combined estimated mussels killed
Fatmucket	10,434.93	-	10,434.93
Giant Floater	51,226.04	936,772.41	987,998.44
Mucket	948.63	-	948.63
Plain Pocketbook	948.63	-	948.63
Spike	1,897.26	-	1,897.26
Wabash Pigtoe	1,897.26	-	1,897.26
White Heelsplitter	6,640.41	-	6,640.41
Wixom Lake – Tobacco arm			
Creek Heelsplitter	2,842.90	-	2,842.90
Fatmucket	25,586.09	831,548.06	857,134.15
Giant Floater	197,581.50	-	197,581.50
Kidney-shell	2,842.90	-	2,842.90
Paper Pondshell	1,421.45	-	1,421.45
Plain Pocketbook	7,107.25	831,548.06	838,655.31
Rainbow	2,842.90	-	2,842.90
Spike	9,950.15	-	9,950.15
Wabash Pigtoe	36,957.69	-	36,957.69
Wixom Lake – Tittabawassee arm			
Fatmucket	1,227.52	-	1,227.52
Giant Floater	28,232.88	-	28,232.88
White Heelsplitter	1,227.52	-	1,227.52

2. Monetary Damages

Below is a description of the approach to calculating a monetary representation of the injury in Wixom and Sanford lakes.

a. Replacement cost of mussels

The AFS Guidelines[7] provide methods for calculating replacement costs as a means of valuing mussels killed. The natural reproduction scenario outlined in the AFS Guidelines is the best fit for the conditions in Wixom and Sanford lakes. In this scenario, monetary damages are calculated using replacement costs, which include production costs, restocking costs, and investigation, monitoring, and administration costs. According to the AFS Guidelines, even though replacement costs will likely underestimate the long-term ecological and use values that were diminished in response to the mussel kill, replacement cost methods provide alternative, conservative, damage estimates.

The AFS Guidelines advise that the components of restitution value from a mussel kill should include ecological (ecosystem services), use (habitat for fish and other benthic organisms) and non-use values. Wherever possible, ecological and non-use values should be incorporated when they can be reliably quantified. For Wixom and Sanford lakes, we have limited information on mussel ecological, use, and non-use values, so replacement costs provide a *conservative* method of determining restitution for killed mussels.

AFS Guidelines also include a Mortality Factor which is applied to reflect additional costs required due to mortality of propagated mussels prior to reaching maturity comparable to the population lost. In broad terms, the effect of applying a mortality factor is to increase the replacement cost estimate by approximately 6 times (dividing by 0.15). Our estimate of replacement cost does not include a multiplier to reflect the Mortality Factor. However, because this contributes substantially to the degree to which the estimated replacement costs are conservative, how the Mortality Factor would apply under AFS Guidelines is described further in Appendix B.

It should be emphasized that replacement values will never adequately address the ecological loss resulting from a mussel kill for listed species or species for which propagation measures have not been developed, a situation true for most freshwater mussel species in Michigan.

The range of per-mussel costs in the AFS Guidelines is $22.93 to $129.30 and is organized by genus. The replacement cost of mussel species encountered in Wixom Lake and Sanford Lake range from $25.00 to $67.71 per mussel (Table 8).

[7] Southwick, R. I., and A. J. Loftus, editors. 2017. Investigation and monetary values of fish and freshwater mollusk kills. American Fisheries Society, Special Publication 35, Bethesda, Maryland. “AFS Guidelines”

Table 8 Applying AFS replacement cost per mussel by species to estimated mussels killed

Sanford Lake	Timed-search	Quadrat search	Combined estimated mussels killed	AFS cost per mussel	Total cost of mussels killed
Fatmucket	10434.93	0	10434.93	$ 27.20	$ 283,830.18
Giant Floater	51226.04	936772.4	987998.4	$ 34.01	$ 33,601,827.04
Mucket	948.6303	0	948.6303	$ 25.97	$ 24,635.93
Plain Pocketbook	948.6303	0	948.6303	$ 27.20	$ 25,802.74
Spike	1897.261	0	1897.261	$ 50.90	$ 96,570.56
Wabash Pigtoe	1897.261	0	1897.261	$ 60.99	$ 115,713.92
White Heelsplitter	6640.412	0	6640.412	$ 62.72	$ 416,486.64
Wixom Lake – Tobacco arm					
Creek Heelsplitter	2842.899	0	2842.899	$ 62.72	$ 178,306.65
Fatmucket	25586.09	831548.1	857134.2	$ 27.20	$ 23,314,048.92
Giant Floater	197581.5	0	197581.5	$ 34.01	$ 6,719,746.96
Kidney-shell	2842.899	0	2842.899	$ 30.00	$ 85,286.98
Paper Pondshell	1421.45	0	1421.45	$ 34.01	$ 48,343.50
Plain Pocketbook	7107.248	831548.1	838655.3	$ 27.20	$ 22,811,424.31
Rainbow	2842.899	0	2842.899	$ 67.71	$ 192,492.71
Spike	9950.148	0	9950.148	$ 50.90	$ 506,462.52
Wabash Pigtoe	36957.69	0	36957.69	$ 60.99	$ 2,254,049.60
Wixom Lake – Tittabawassee arm					
Fatmucket	1227.516	0	1227.516	$ 27.20	$ 33,388.45
Giant Floater	28232.88	0	28232.88	$ 34.01	$ 960,200.21
White Heelsplitter	1227.516	0	1227.516	$ 62.72	$ 76,989.83
				Total	$ 91,745,607

b. Total Damage Estimate

The Damage Estimate described below (Table 9) is limited to the estimated per mussel replacement cost.

Table 9 Total Damage Estimate based on replacement cost of mussels

Wixom Lake and Sanford Lake Mussel Kill Valuation	
Scenario: Natural Reproduction Will Be the Means for the Resource to Repair Itself (AFS Guidelines)	
From field investigation, estimate of total number of mussels killed are	
391,814 (surface) + 2,599,868 Quadrat (subsurface)	2,991,682
Using Southwick and Loftus (2017) Appendix F, the estimated cost to produce taggable-size mussels is	

$ 14,649,763.77 Timed-search (surface) + $77,095,843.89 quadrat (subsurface)	$91,745,607.67
Total Damage Estimate	**$91.7 million**

Discussion

This report presents a conservative estimate of mussels killed as a result of the dam failures at Wixom and Sanford lakes. Data from 2018 and 2019 drawdowns were considered in determining the appropriateness of our estimates. While there are likely fewer mussels in Wixom Lake after the mussel kills associated with unpermitted winter drawdowns in 2018 and 2019, we regard the low density of fresh dead mussels and overall low density of mussels in both impoundments to be exacerbated by the nature and scale of the disturbance to the sites. Both impoundments experienced widespread sediment scouring and deposition that would remove or bury mussels in the surveyed areas, as described in Appendix A. As a result of the widespread sediment disturbance, we believe that many more mussels died because of the dam failures than we were able to observe.

The mussel densities in quadrats and time searches in 2020 were far lower than what was observed in 2018 and 2019. As stated earlier, a search within the Tobacco Arm of Wixom Lake in 2019 north of Dale Road had quadrat densities ranging from $0/m^2$ to $3.83/m^2$ and timed-search data yielded averaged density estimates from $0/m^2$ to $0.29/m^2$. The highest average density for a species in the timed-search data from 2019 was spike with $0.533/m^2$. In 2018, surveys covered sites within both arms of Wixom Lake, and averaged quadrat data ranged from $0/m^2$ to $1/m^2$. 2018 timed-search data yielded site-based density estimates of up to $0.258/m^2$ and an across site average density of $0.13/m^2$ for Wabash Pigtoe. Mussel densities in impoundments from peer-reviewed and grey literature range from $0/m^2$ to $200/m^2$. For example, during a drawdown of the Mississippi River near Buffalo City, Wisconsin, mussel surveyors found $0.57/m^2$ (live) and $0.40/m^2$ (dead) on the exposed shoreline surface. The mussel density results for all years are well-within the range observed in available literature, and 2020 shows a significant drop where previously higher densities were likely present.

Conclusion

The estimate of mussels killed is 2,991,682 across Wixom and Sanford Lakes, representing significant harm to trust resources. The replacement value calculated ($91.7M) represents a conservative estimate of the monetary value of mussels killed.

Witness information

I have worked as a Resource Analyst for the State of Michigan, Department of Natural Resources-Fisheries Division since February 2016. My work in natural resources prior to that was associated with my education including a Bachelor of Science degree (2013) and Master of Science degree (2019) in Fisheries and Wildlife from Michigan State University. I completed my Master's degree course work and research in 2015, and completed my thesis later while working for the DNR.

I have not previously testified as an expert at trial or by deposition. I am preparing this material in my capacity as a state employee and am being compensated in the same manner as my other work as a Resource Analyst for Michigan DNR Fisheries Division.

Professional Progression in Natural Resources:

Resource Analyst, Habitat Management Unit Michigan Department of Natural Resources, Fisheries Division	February 2016-Present
Master of Science, Fisheries and Wildlife - thesis accepted Michigan State University Department of Fisheries and Wildlife	April 2019
Graduate Research Assistant	January 2014-February 2016
Bachelor of Science, Fisheries and Wildlife	December 2013
Student Research Assistant	Spring-Summer 2013
Lab Technician	June-August 2013
Field technician	May-June 2013

I do not have any publications in academic journals. I have authored or substantially contributed to:

- Michigan Mussel Committee's Michigan Mussel Rescue and Relocation Protocols for Reservoir Drawdowns
- Fisheries Division and Department internal briefings and policies
- Numerous comment letters to the Federal Energy Regulatory Commission, including its rulemaking and proceedings regarding financial assurance measures (RM21-9-000), and regarding licensing and compliance for many FERC regulated hydropower facilities
- DNR's July 29, 2021 comments on EPA's Intention to Reconsider and Revise the Clean Water Act Section 401 Certification Rule.
- Interim Drawdown Plan and methodology for stranded organism rescue at Menominee and Park Mill Dams 2019
- Development of analytical resources for reviewing classifications of streams relating to Michigan's water withdrawal program

Freshwater mussel surveys:

- Survey and relocation at Menominee and Park Mill Hydroelectric facility Park Mill Power Canal before and during drawdown, and reconnaissance for relocation sites in the adjacent impoundment August-September 2019 (P-2744) informal resurvey of relocation areas September 2021

- Assisted with post-failure and rebuild surveys at Marquette Board of Light and Power's Tourist Park impoundment and survey for comparison at upstream Forestville impoundment, to assess mussel population recovery (P-2589) 2017, 2020
- Surveys at Chalk Hill Dam (P-2394), Big Quinnesec Hydroelectric Facility (P-1980), informal surveys at Grand Rapids Hydroelectric Facility impoundment during drawdown (P-2433), Au Train Hydroelectric Facility impoundment during drawdown (P-10856), Cataract Hydroelectric Facility tailrace (P-10854), Escanaba River downstream of Boney Falls facility of the Escanaba Hydroelectric Project (P-2506)
- Survey at EGLE-regulated dams: Black River Lake Dam impoundment and tailwater, Greenwood Reservoir
- Survey of Tobacco Arm of Wixom Lake, during drawdown December 2019 (formerly Edenville P-10808).
- Occasional surveys of free-flowing streams and road stream crossing sites, as well as a couple natural lakes
- Reviewed numerous plans and reports from mussel survey and relocation efforts, inventory surveys and similar efforts (Bond Falls including Victoria tailrace, Bond Falls control dam and Roselawn canal, P-1864; Tower and Kleber mussel survey for relicensing; Boyne mussel survey for relicensing; Saxon and Superior Falls relicensing surveys; Twin Falls coffer dam dewatering and powerhouse rebuild surveys P-11831; Ontonagon watershed mussel survey report by Lake Superior State University, mussel survey reports associated with pipeline projects)

Presentations:
AFS Portland 2015, Midwest Fish and Wildlife Conference 2016, Midwest Hydro Users Group October 2018, Michigan Chapter of AFS Stream Habitat Workshop: Exploring Fish Habitat Concepts and Management June 2019, Water Use Advisory Council October 2019, Michigan AFS Mussel presentation March 2020, WUAC Data Committee May 2020, Mussel Workshop for Michigan Chapter of AFS September 2022, Michigan Naturalist September 2022

Appendix A - Reservoir Bed Condition

Primary author: Kesiree O'Brien

Purpose

The purpose of the Reservoir Bed Condition Plan is to assess how the Tittabawassee River dam failures affected the ability to accurately assess freshwater mussel mortality. On June 3-9, 2020, staff from Department of Natural Resources, Department of Environment, Great Lakes, and Energy, and Central Michigan University conducted freshwater mussel mortality assessments. To gain a better understanding of how reservoir bed conditions may affect mussel mortality estimates at each survey site, staff collected additional information on occurrences of sedimentation, scouring, and natural reservoir bed on June 15, 2020 based on known indicators of reservoir bed condition (Attachment A).

Background

Boyce Hydro owns and operates four dams on the Tittabawassee River in Gladwin and Midland County, Michigan. On May 19, 2020, Edenville Dam failed and Sanford Dam was damaged due to high inflows from a multi-day precipitation event. On May 20, 2020, FERC ordered Boyce Hydro to fully lower the impoundments behind Sanford, Secord, and Smallwood dams in a safe manner as flows recede. Staff were charged with estimating mussel mortality caused by the Tittabawassee River dam failures.

Results and Interpretation

Each mussel mortality assessment site was also assessed for reservoir bed conditions. Results are shown in Attachment B. Overall and as expected, each site had a mix of natural reservoir bed, scouring, and recent deposition. We conclude that mussel mortality estimates are likely to be underestimated due to mussels either being 1) washed away due to reservoir bed scouring or 2) buried due to sediment deposition.

Attachment A - Indicators of Reservoir Bed Condition

Under certain circumstances a drawdown may scour or deposit sediment on the reservoir bed. Either situation may result in an underestimation of mussel density, to an unknown degree, and identifying scouring or deposition can assist with interpreting mussel density data. Table 1 lists the indicators used to distinguish natural reservoir bed from scoured reservoir bed or sediment deposition. It is important to note that it is not uncommon for sediment deposition and/or scouring to occur adjacent to normal reservoir bed (Figure 1). In this case it is useful to characterize bed conditions within each surveyed cell rather than for the entire access area/site.

Aquatic macrophytes (particularly submersed macrophytes), typically rooted near the sediment surface (Figure 2A) can be indicators of the natural pre-drawdown reservoir bed. Rooted macrophytes will be absent from deeper portions of the reservoir.

Saturated fine-grained sediment (silt or sand) will often have a light-colored oxidized surficial layer over a dark-colored anoxic layer (Figure 2B), which is also an indicator of natural lakebed. The dark color is the result of reduced iron and manganese sulfide precipitates, and sometimes smells like rotten eggs due to cooccurrence with hydrogen sulfide gas. This dark anoxic layer will not be present in coarse-grained sediment (gravel or cobble) or in sediment that was recently deposited and will eventually disappear from sediment that has dried out. The underside of large rocks will also sometimes be coated with dark sulfide deposits.

If zebra mussels occur in the reservoir, they will colonize solid substrates from near the ordinary high watermark down to within a few centimeters of the normal reservoir bed (Figures 3A and B). If the lower limit of the zebra mussels is more than a few centimeters above the lakebed, sediment scouring may have occurred (Figure 3C). Such scouring may only be a local phenomenon or may indicate larger-scale scouring. Conversely, if the lower limit of zebra mussels is beneath the current sediment surface, sediment deposition has occurred.

Significant scouring may be visually apparent (Figure 4). Indicators of scour include the absence of zebra mussels from hard substrates where they would be expected to occur, large rocks that have been flipped over (e.g., zebra mussels on the underside and dark anoxic iron or manganese sulfide deposits on the upper side; Figures 3D and 5D), debris deposited on infrastructure that is above the ordinary high water mark (Figures 5A and B), or damage to infrastructure that is above the ordinary high water mark (Figure 5C).

Recent sediment deposition due to the drawdown can be more difficult to identify than the natural reservoir bed or scouring. Indicators include a lack of an anoxic layer in saturated fine-grained sediments, and zebra mussels buried below the current sediment surface.

Table 1 Indicators of natural reservoir bed, scoured lakebed, or sediment deposition.

Pre-drawdown reservoir bed	• Rooted macrophytes at/near the sediment surface • Anoxic sediment zone close to the sediment surface (a few centimeters) • Lower limit of zebra mussels just above the sediment surface (appropriate substrate not always available)
Scoured reservoir bed	• Appearance indicates recent scouring • Nearby elevated infrastructure (e.g. bridges) contains flood debris well above the ordinary high-water mark • Large substrates (e.g. cobble) that are expected to be covered in zebra mussels, do not – indicating that substrate was buried before drawdown and has been exposed • Rocks turned upside down/relocated - zebra mussels on underside, black anaerobic indicators on upper side • Tree root flare is excessively exposed
Sediment deposition	• Sediment deposits, elevated above natural lakebed • Moist sediment deposits lack dark subsurface anoxic zone • Buried zebra mussels

Figure 1 Combination of sediment deposition (left side of picture) and normal reservoir bed (upper right).

(A)

(B)

Figure 2 Indicators of undisturbed reservoir bed. (A) Rooted aquatic macrophyte at bed surface. (B) Dark anoxic sediment layer within a few centimeters of the bed surface.

Figure 3 Zebra mussel indicators of reservoir bed condition. (A) and (B) Zebra mussels within a few centimeters of the sediment surface, indicating normal reservoir bed. (C) Zebra mussels about 4 feet above the sediment surface indicating sediment scour, and (D) Zebra mussels on the underside of a large rock, indicating the rock was flipped over by hydraulic conditions during the reservoir drawdown.

Figure 4 Reservoir bed scouring.

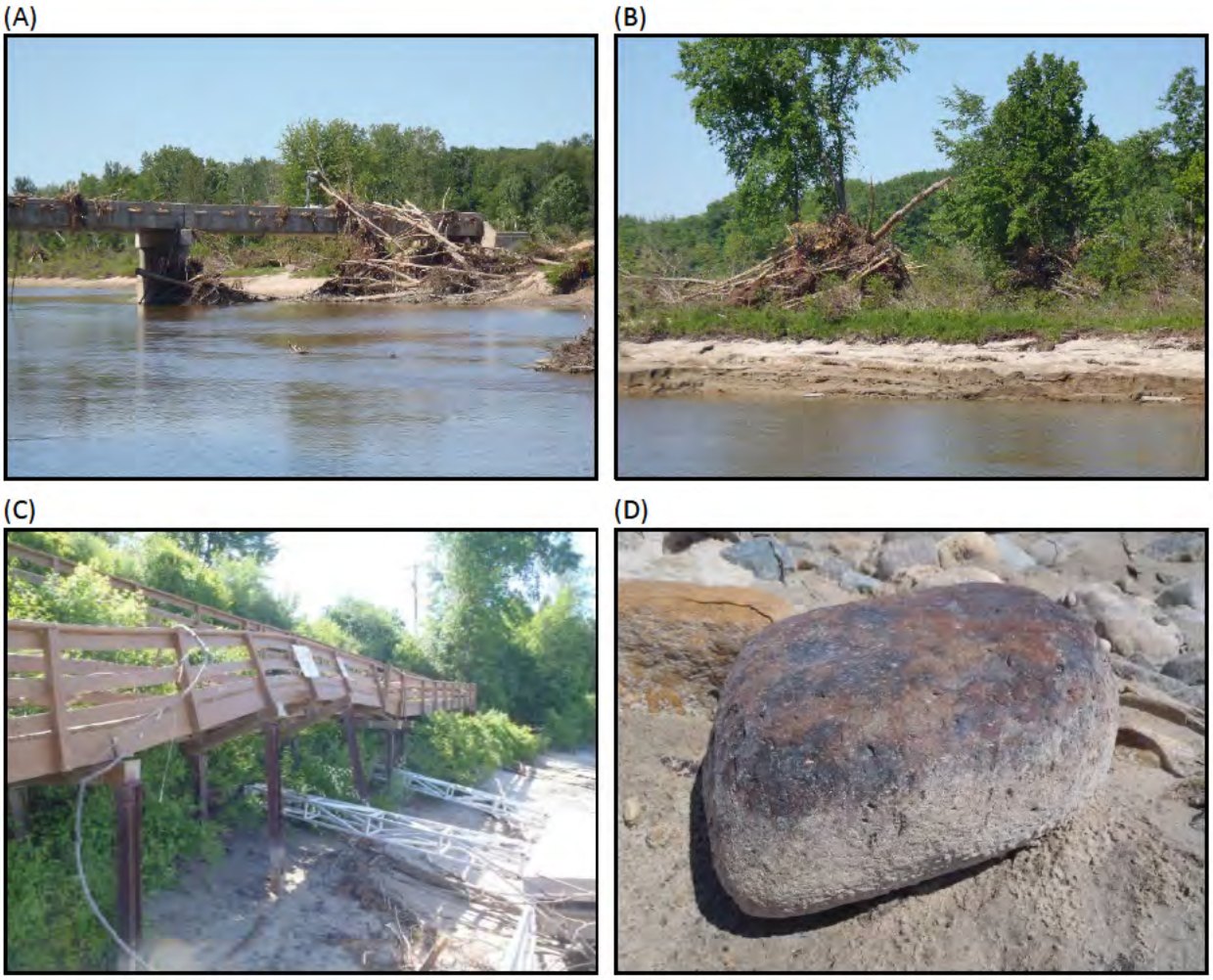

Figure 5 Indicators of reservoir bed scour. (A) and (B) flood debris above the regular reservoir water level. (C) Damage to infrastructure, above the regular reservoir water level. (D) Dark iron or manganese sulfide coating on the upper side of a large rock, indicating the rock was flipped over by hydraulic conditions during the reservoir drawdown.

Attachment B – Results

Sanford Lake

Indicators	Site Name				
	Sanford Public Boat Launch	Sanford Lake Bar & Grill	Verity Shores	North Sanford Beach Drive	Edenville Kayak Launch
Natural Reservoir Bed					
Rooted macrophytes at surface	X	X			
Anoxic zone close to sediment surface			X		
Zebra mussels above sediment surface					
Scoured Reservoir Bed					
Appearance/topography				X	
Flood debris					X
Zebra mussels lacking from large substrate				X	
Rocks upside down				X	X
Tree root flare excessively exposed					
Recent Deposition					
Sediment deposits				X	
Anoxic zone lacking					
Zebra mussels buried					

Wixom Lake

Indicators	Site Name				
	Birch Lane	Estey Road	Dundas Road DNR Boat Launch	Norma Road	Arapahoe Court
Natural Reservoir Bed					
Rooted macrophytes at surface		X			
Anoxic zone close to sediment surface					X
Zebra mussels above sediment surface	X	X	X		
Scoured Reservoir Bed					
Appearance/topography		X	X	X	X
Flood debris					
Zebra mussels lacking from large substrate	X				X
Rocks upside down	X				

Tree root flare excessively exposed					
Recent Deposition					
Sediment deposits		X		X	X
Anoxic zone lacking					
Zebra mussels buried					

Appendix B - Mortality Factor

AFS Guidelines also include a Mortality Factor which is applied to reflect additional costs due to mortality of propagated mussels prior to reaching maturity comparable to the population lost. In broad terms, the effect of applying a mortality factor is to increase the replacement cost estimate by approximately 6 times (dividing by 0.15). Our estimate of replacement cost does not include a mortality factor. However, because this represents another way in which the estimated replacement costs are conservative, the AFS Guidelines are described further.

This survivorship/mortality factor is incorporated into the cost of restoring a population to pre-injury condition. Because we do not have mussel survival rates specific to Wixom or Sanford lakes or the state of Michigan, we would use the mortality estimates available from the Freshwater Mollusk Conservation Society, developed as a best expert opinion as noted in the AFS Guidelines. The mortality factor was developed following best available science, beginning with the mean survival rate. The Freshwater Mollusk Conservation Society determined that the mean survival rate for propagated mussels for 11 different species from the time of stocking at 2 months of age to 5 years of age is 15% (Table 10) (Haag 2012[8]).

Table 10 Species included in survival rate estimate for stocked mussels

Fragile Papershell	*Leptodea fragilis*
Alabama Moccasinshell	*Medionidus acutissimus*
Fawnsfoot	*Truncilla donaciformis*
Bleufer	*Potamilus purpuratus*
Threeridge	*Amblema plicata*
Southern Pocketbook	*Lampsilis ornata*
Alabama Spike	*Elliptio arca*
Threehorn Wartyback	*Obliquaria reflexa*
Gulf Pigtoe	*Fusconaia cerina*
Southern Clubshell	*Pleurobema decisum*
Pimpleback	*Quadrula pustulosa*

The 17 species observed in Wixom and Sanford lakes between 2018 and 2020 (Table 11) overlap with Haag's list (Table 10) in terms of genus for 4 of the 17 species (Lampsilis, Fusconaia, Pleurobema), and the initial list used by Haag is diverse and a good approximation of the survivorship for mussels.

[8] Haag, Wendell R. 2012. North American freshwater mussels: natural history, ecology and conservation. Cambridge University Press, New York, NY. ISBN 978-0-521-19938-4

Table 11 Mussel species observed in Wixom Lake and Sanford Lake surveys 2018-2020 and age at maturity information

Common name	*Scientific name*	age at maturity**
Creek heelsplitter (SC)	*Lasmigona compressa*	0-2
Creeper	*Strophitus undulatus*	3 (genus)
Elktoe (SC)	*Alasmidonta marginata*	2[A]
Ellipse (SC)	*Venustaconcha ellipsiformis*	3[A]
Fatmucket	*Lampsilis siliquoidea*	1-3 (genus)
Fluted-shell (SC)	*Lasmigona costata*	0-2
Giant Floater	*Pyganodon grandis*	1
Kidneyshell (SC)	*Ptychobranchus fasciolaris*	7
Mucket	*Actinonaias ligamentina*	5[A]
Paper Pondshell (SC)	*Utterbackia imbecillis*	1
Plain Pocketbook	*Lampsilis cardium*	1-3 (genus)
Rainbow (SC)	*Villosa iris*	1-2 (genus)
Round Pigtoe (SC)	*Pleurobema sintoxia*	4-7
Snuffbox (E)	*Epioblasma triquetra*	3 (genus)
Spike	*Eurynia dilatata*	-
Wabash Pigtoe	*Fusconaia flava*	4-7
White Heelsplitter	*Lasmigona complanata*	0-2

(SC) denotes species of Special Concern in Michigan, (E) Federally endangered.
***Values reported represent age at maturity from Haag 2012. Values for life history traits of representative North American mussel species (p.423-425). (genus) indicates maturity taken from species of the same genus, where available ages depicted as early maturing (0-2), later maturing (4-7). Unknown age at maturity denoted with "-". Where the age at maturity is listed as a prediction based on growth rates the superscript "[A]"* follows the year. *These predictions are best estimates for Michigan's unionid community. For Giant Floater and Paper Pondshell (1*), at least one hatchery study found maturity as early as <1 year.*

A mortality/survival factor is applied by taking the total estimated population of mature mussels killed and dividing it by 0.15 to represent how many more "taggable-sized[9]" mussels would need to be stocked to result in the likely recruitment of a mature adult. Estimated cost to propagate the injured mussels is then tallied to develop the replacement value. To give an example from fisheries, many more walleye fingerlings (juvenile fish) are stocked than are expected to survive to maturity or legal size for recreational harvest; so, within the bounds of what can be supported by the system being stocked, managers stock higher numbers of juvenile fish than desired adult fish, knowing many juveniles will not survive. This additional multiplier resulting from estimates of a mortality factor is not reflected in our estimate of replacement value.

[9] Taggable size generally refers to a mussel, typically greater than 15mm, capable of supporting an external physical tag. (AFS Guidelines)

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY, AND THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES,

Plaintiffs,

v

LEE MUELLER; BOYCE MICHIGAN, LLC; EDENVILLE HYDRO PROPERTY, LLC; BOYCE HYDRO POWER LLC; BOYCE HYDRO, LLC; WD BOYCE TRUST 2350; WD BOYCE TRUST 3649; AND WD BOYCE TRUST 3650,

Defendants.

No. 1:20-cv-528

HON. PAUL L. MALONEY

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DECLARATION OF LUCAS TRUMBLE UNDER 18 U.S.C. § 1746

1. My name is Lucas Trumble. I am a professional engineer who supervises the Dam Safety Unit within the Water Resources Division of the Michigan Department of Environment, Great Lakes, and Energy.

2. I prepared a report in this case that summarizes my expert opinions related to aspects of the May 19, 2020 failures of the Edenville and Sanford dams. The report is attached to this declaration. It explains my opinions and the information I reviewed to reach them. I could testify about the contents of the report if needed.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: May 9, 2023

Lucas Trumble

LF: Dam-Mueller, Boyce Hydro (EGLE & DNR v)/AG# 2020-0291918-C-L/Declaration of Luke Trumble 2023-05-03

STATE OF MICHIGAN
DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY
LANSING

GRETCHEN WHITMER
GOVERNOR

LIESL EICHLER CLARK
DIRECTOR

TO: Nathan Gambill, Assistant Attorney General
Michigan Department of Attorney General

FROM: Lucas Trumble, P.E., Supervisor, Dam Safety Unit
Water Resources Division

DATE: December 7, 2022

SUBJECT: Expert Report in Response to Failure of the Edenville Dam

This report contains the opinions of Lucas A. Trumble, P.E., an expert in dam safety engineering with the Michigan Department of Environment, Great Lakes, and Energy (EGLE). I hold a Bachelor of Science degree in Civil and Environmental Engineering from Michigan State University and have over 15 years of professional engineering experience, including over 12 years of dam safety engineering experience. I currently serve as the Supervisor of EGLE, Water Resources Division's (WRD's) Dam Safety Unit. I also serve as a state representative on the Federal Emergency Management Agency's (FEMA's) National Dam Safety Review Board, as a chair of the Association of State Dam Safety Officials (ASDSO) Tailings Dam Regulatory Committee, and as a member of the ASDSO Dam Failure's and Incidents Committee. In this capacity, I have performed several dam failure investigations and assisted with development of dam failure investigation guidelines for ASDSO.

I am providing this report and serving as an expert witness of the State as part of my regular job duties as Supervisor of the EGLE-WRD Dam Safety Unit. I have not provided expert testimony in any other lawsuits within the last four years.

In forming these opinions, I have evaluated or relied on the findings of the following documents:

1. Technical Memorandum – Wixom Lake Storage Volume Estimates, March 8, 2021
   Prepared by: Jun Wang, P.E. and Sepideh Sarachi, P.E., TRC Companies

2. Final Report – Investigation of Failures of Edenville and Sanford Dams, May 4, 2022
   Prepared by: John W. France, P.E., D.GE, D.WRE; Irfan A. Alvi, P.E.; Arthur C. Miller, PhD, PH, D.WRE; Jennifer L. Williams, P.E.; and Steve Higinbotham, P.E., Independent Forensic Team

Analysis and Expert Opinions related to the TRC Technical Memorandum

On March 8, 2021, TRC Companies (TRC) provided estimates of storage volumes for the Wixom Lake impoundment created by the Edenville Dam to Mr. Lee Mueller, W.D. Boyce Trusts. Contained in this Technical Memorandum are storage curves (stage versus storage volume) for Wixom Lake base on Laser Imaging, Detection, and Ranging (LiDAR) provided by EGLE following the May 19, 2020, failure of the Edenville Dam. From this data, TRC computed the surface area, in acres, of the impoundment at 1-foot increments starting at elevation 668.8 feet and ending at elevation 683.1 feet NGVD29 (assumed—not specified in the report). The surface areas for each 1-foot contour created were then used to calculate storage volume, in acre-feet, and develop the aforementioned stage (elevation) versus storage curve for the impoundment.

The emphasis on elevation 668.8 feet is that it's 7 feet below the normal summer operating level of Wixom Lake, 675.25 feet. This is presumably in effort to demonstrate the storage volume that would be available if Wixom Lake is lowered by 7 feet as would be the case if the 8-foot high tainter gates were fully opened and the lake level were allowed to recede and be controlled by the concrete spillway crests below the gate openings.

Though it is unclear what the significance or conclusions of the TRC technical memorandum are, the graph on page two of the memo appears to indicate that there would be approximately 5,000 acre-feet of available storage between elevations 668.8 feet and 675.25 feet (storage volume available by lowering the lake approximately 7 feet below its normal operating level in summer). It should be noted that 5,000 acre-feet is a small fraction of the total runoff volume for a large flood event at the Edenville Dam and that, even with pre-lowering of the lake by 7 feet, the maximum pool elevation in the lake would not be expected to remain 7 feet below the maximum pool elevation for the same flood event if the lake started at normal operating level.

Therefore, it is my expert opinion that the TRC technical memorandum confirms only one thing; that there is a difference in available storage volume resulting from lowering of Wixom Lake by approximately 7 feet, when compared to normal operating level for summer (Wixom Lake was at summer level during the May 2020 flood). The memo does not expand on the significance of this difference in storage volume and provides no analysis or conclusions as to whether lowering of Wixom Lake would have had any significant impact on the likelihood of dam failure during the May 2020 flood event.

Analysis and Expert Opinions related to the Independent Forensic Team Report

On May 4, 2022, the independent forensic team (IFT) appointed to investigate the causes and contributing factors to the failures of the Edenville and Sanford Dams released their final report. The report investigated both the physical causes and human factors that led to the failure of the Edenville Dam. The report determined that the physical cause of the failure was static liquefaction (flow) instability failure of the easternmost earthen embankment of the dam. There were several contributing factors that provided the necessary conditions for this failure mechanism, including but not limited to, narrow and steep construction of the embankment, loose sandy soils present

in the embankment fill, historically high reservoir elevations on May 19, 2020, and inadequate seepage cutoff and drains at the failure location.

In addition to this major finding, Section 5.2.5 on page 65 of the IFT report utilizes hydrologic and hydraulic models to evaluate several alternatives scenarios during the May 2020 flood to evaluate impacts on likelihood of dam failure under those various scenarios. Specifically, the IFT report evaluates the following scenarios:

1. The 2020 flood if embankment failure had not occurred.

2. The 2020 flood if flow had been passed through the dam's powerhouse when the lake level rose 3 feet above normal (partial duration).

3. The 2020 flood if flow had been passed through the dam's powerhouse for the full duration of the flood.

4. The 2020 flood if the dam's six radial gates had been fully opened to 10 feet, rather than the approximate 7 feet openings during the flood.

5. The 2020 flood with gates fully opened and partial duration powerhouse operation.

6. The 2020 flood with gates fully opened and full duration powerhouse operation.

7. Pre-lowering of Wixom Lake by opening the radial gates by varying degrees ahead of the 2020 flood.

    a. Pre-lowering Wixom Lake only to normal winter level with May 2020 gate operations.

    b. Pre-lowering all four lakes to normal winter level with May 2020 gate operations.

    c. Pre-lowering Wixom Lake by opening the gates to 7 feet.

8. Pre-lowering Wixom Lake by opening the gates to 10 feet.

9. The 2020 flood if full Probable Maximum Flood (PMF) spillway capacity had been installed per the 2012 design.

At the beginning of the May 2020 flood, the reservoir level was at/near the normal summer level of 675.8 feet, and the dam's six radial gates were opened to a maximum of approximately 7 feet. This resulted in a maximum pool elevation at the time of failure of approximately 681.3 feet. The IFT report includes two hypothetical scenarios that explore the viability of pre-lowering of Wixom Lake by opening the gates ahead of time and maintaining Wixom Lake at "run of river," basically relying on the concrete portions of the dam below the gate openings to control the reservoir lever. This has been referred to nominally as a 7-foot drawdown from normal summer level, though actual

lake levels under this scenario would vary with flows into the reservoir. Scenario 7(c) explores pre-lowering of Wixom Lake by approximately 7 feet by opening all gates by 7 feet, which was the maximum the gates could safely be opened at the time of failure.

The IFT report concludes that pre-lowering of Wixom Lake by opening all gates to 7 feet in advance of the May 2020 flood would have resulted in a peak lake level during the flood of 681.1 feet, only 0.2 feet lower than the actual peak at the time of failure. The IFT then concludes on Page 67 of the report that "The pre-lowering alternatives with the gate openings limited to 7 feet would have resulted in less than 0.2 feet difference in peak lake level, which the IFT believes is unlikely to have prevented the failures."

Additionally, in Section 7.2.2.5 on Page 130 of their report, the IFT concludes that, "During the winters of 2018-2019 and 2019-2020, Wixom Lake had been lowered about 6 feet below the normal lake level by keeping the spillway gates open, and there were disputes about the rationale and impacts of doing this among Boyce Hydro, FLTF, and EGLE. As discussed in Section 5 and Appendix F1, the IFT found that, if the lake had been kept lower by this amount until the May 2020 flood occurred, the effect on the lake level on May 19, by itself, would very likely have been too small to prevent the dam failure."

In Appendix F1 on Page F-2 of their report, the IFT also states that, "These conclusions were confirmed by the IFT's hydrologic and hydraulic analyses, discussed later in this appendix, which showed that pre-lowering of Wixom Lake before the May 17 through 19, 2020, event would have had very little effect on the ultimate lake level during the storm."

I have reviewed the IFT report in its entirety and have also received and reviewed the hydrologic and hydraulic data used to develop the models referenced in the report. It is my expert opinion that the above conclusions of the IFT report are based on the best available information and use sound engineering practices to correctly evaluate the potential impacts of pre-lowering Wixom Lake ahead of the May 2020 flood event.

Summary and Conclusions

In summary, after reviewing the documents listed above, I offer the following opinions and conclusions:

1. The TRC analysis of storage volume uses modern topographic information and sound engineering methods to estimate available storage volume in part of the Wixom Lake reservoir. The TRC report provides no analysis of the significance of that storage volume or how it relates to the May 2020 flood and failure of the Edenville Dam. The analysis makes no determinations on how much pre-lowering of Wixom Lake ahead of the May 2020 flood event would have lowered the reservoir level during the flood or if this would have prevented failure of the dam.

2. The IFT's final report, includes both the requisite data and analyses to conclude the causes of the failure of the Edenville Dam and explore hypothetical scenarios

for the May 2020 flood related to additional spillway capacity, different operations of the dam, and pre-lowering of Wixom Lake ahead of the flood. The IFT report confirms that pre-lowering of Wixom Lake would have had such an insignificant impact on peak reservoir elevation and duration that it likely would not have prevented failure. I concur with these findings of the IFT report.

EXHIBIT L - BRIEF IN SUPPORT OF MOTION FOR SUMMARY JUDGMENT

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY, AND THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES,

Plaintiffs,

v

LEE MUELLER; BOYCE MICHIGAN, LLC; EDENVILLE HYDRO PROPERTY, LLC; BOYCE HYDRO POWER LLC; BOYCE HYDRO, LLC; WD BOYCE TRUST 2350; WD BOYCE TRUST 3649; AND WD BOYCE TRUST 3650,

Defendants.

No. 1:20-cv-528

HON. PAUL L. MALONEY

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DECLARATION OF BETHANY MATOUSEK UNDER 18 U.S.C. § 1746

1. My name is Bethany Matousek. I am the Inland Lakes and Streams Program Coordinator within the Wetlands, Lakes, and Streams Unit of the Michigan Department of Environment, Great Lakes, and Energy.

2. I am based out of the Department's Lansing location.

3. I have a Bachelor of Science in Natural Resources Wildlife Management from The Ohio State University and have completed coursework towards a Master of Science in Fisheries Biology at Humboldt State University. My work has focused on stream resources for the last 27 years. I have been in my current position for 12 years. Prior to this position I worked for 5 years in the Michigan Department of Transportation Environmental Section reviewing proposed road projects for compliance with the National Environmental Policy Act.

4. My job duties include development and implementation of the statewide stream mitigation program; providing statewide policy and guidance for the streams program; and development of water resources program training and educational materials for staff, the regulated community, and the public.

5. On May 19, 2020, the Edenville and Sanford dams, which were part of a four-dam system near Midland, Michigan, failed.

6. I went to the site of the Edenville and Sanford dam failures on approximately the following dates in 2020 to assess the upstream and downstream impacts of the failures: May 21, June 4, 8, 10, 15, 16, 17, 23, 24, 25, 26, 29, and 30.

7. Some of the natural resource impacts of the dam failures included:

   a. the diminishment of the public's ability to navigate and fish on Wixom and Sanford Lakes;

   b. the diminishment of Wixom and Sanford Lakes;

c. changing the ecosystems from lake systems into riverine systems affecting every aspect of those systems;

d. soil erosion of exposed channel banks and sediment entering water courses within and downstream of the failed impoundments all the way to Saginaw Bay;

e. tributary streams that became disconnected from their downstream waters and from the larger river channels and former lakes;

f. death of fish, mussels, turtles, macroinvertebrates, and other important organisms within the former lake impoundments;

g. tributary streams dewatered and cutting new paths through unconsolidated lake bed sediments creating erosion and contributing sediment downstream to the river channels;

h. the Tobacco River channel downstream of Edenville Dam was dewatered for an extended time period;

i. a portion of the Tittabawassee River downstream of Edenville Dam was dewatered for an extended time period;

j. forested riparian floodplain, including wetland areas, downstream of the Edenville Dam breach were stripped of vegetation, including large trees, and upper soil layers by the flood waters, which also deposited sand in some remaining wetland areas;

k. the Tobacco and Tittabawassee Rivers upstream of Edenville Dam were disconnected from their downstream waters in terms of fish

movement due to the dewatering of the channels and the development of a head cut/waterfall downstream of the breach at Edenville Dam;

l. the lowering of groundwater elevations in the areas surrounding the lakes;

m. reduction or elimination of certain recreational opportunities;

n. trash and other debris were deposited on lake and stream bottomland;

o. the riparian rights of property owners such as access to navigable water and dockage to boatable water;

p. the aesthetics of the lakes were drastically changed inconsistent with prior condition;

q. recreational park land downstream of Sanford Dam within the floodplain was inundated with floodwaters and sediment deposition occurred across the site.

8. The Edenville Dam failure, and resulting failure of Sanford Dam, released a tremendous volume of water held within the impoundment in a rapid and uncontrolled manner. Some impacts are a result of the dewatering itself and others resulted from the rapid and uncontrolled manner in which the water was released and the location of the release. Sediment that was contained behind the dam was carried downstream within the flowing water.

9. The impacts outlined above cause harm to the water resources that are held in trust for the public by the State of Michigan, including inland lakes,

streams, and wetlands, and the uses of these waters including uses for recreation, fish and wildlife, aesthetics, local government, and commerce.

10. The release of such a large quantity of sediment laden water scoured the bed and banks of the lakes, rivers, and stream channels located within and just downstream of the impoundments. High, steep banks of loose, unconsolidated lakebed sediments consisting of fine sands, silts, and organics were exposed to be eroded by wind, rain, groundwater, and stream flow. This eroded material entered surface waters. The sediment and debris carried by the floodwaters was deposited in stream channels, floodplains, and wetlands.

11. Harms from this sediment, deposited within the channels, include degrading in-stream habitat for fish and macroinvertebrates by filling pools and covering riffles.

12. Dewatering resulted in death of fish and other aquatic organisms. Areas that were dewatered were no longer able to be utilized by aquatic life.

13. Dewatering and lowering water surface elevations also disconnected upstream and downstream habitats by creating barriers to fish passage.

14. The public was harmed by the impacts to recreational uses such as boating and fishing and by the drastically altered aesthetics of the water resources. Riparian property owners were harmed by the impacts to their ability to access, navigate and dock on the diminished lakes. Local government was harmed by the impacts to public recreational lands, and local commerce on and around the lakes was affected.

15. Some of the impacts of the failure of the dams are documented by the following photos included at the end of this document, which I took.

16. I could testify about the contents of this declaration if needed.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: May 23, 2023

Bethany Matousek

Bethany Matousek

Photo from June 4, 2020 at Black Creek and NW River Road showing lowered water levels in Sanford Lake; 1) tall banks of fine grained (sand and silt/organics), unconsolidated material are actively eroding into the stream channel; 2) shallow water cascading down rip rap below bridge – fish cannot swim from below the bridge to the stream channel above the bridge due to the difference in water levels.

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Photo from 6/10/20 culvert under E Lakeshore Dr. on Wixom Lake showing lowered water levels in Wixom Lake; 1) tall unvegetated banks of fine grained (sand and silt/organics), unconsolidated material actively eroding into the stream channel; 2) culvert shown perched above dry lake bottom – fish cannot swim from below the culvert to the stream channel above the culvert due to the difference in water levels.

Photos from 6/16/20 and 6/24/20 on Wixom Lake show dead fish and dead turtles on the dry lake bottom.

Photos from 6/24/20 on Wixom Lake shows tall, unvegetated banks composed of fine grained (sand and silt/organics), unconsolidated materials. Banks are actively eroding into the Tittabawassee River. In the top photo ground water is seeping out of channel slope saturating the soil. River flow is eroding the toe of the slopes, and banks are slumping/sloughing into the channel and sediment is entering the river at both locations. This is representative of the condition of many of the river and stream banks within the former impoundments post-dam failure.

Photo taken 6/30/20 just downstream of Edenville Dam at the head cut that formed where the flow from the dam breach reentered the main channel. The photo shows fish in a pool below the head cut. Fish are unable to move any further upstream due to the height of the head cut.

Photo taken 6/30/20 of head cut area from previous photo description.

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF MICHIGAN
SOUTHERN DIVISION

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY, AND THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES,

Plaintiffs,

v

LEE MUELLER; BOYCE MICHIGAN, LLC; EDENVILLE HYDRO PROPERTY, LLC; BOYCE HYDRO POWER LLC; BOYCE HYDRO, LLC; WD BOYCE TRUST 2350; WD BOYCE TRUST 3649; AND WD BOYCE TRUST 3650,

Defendants.

No. 1:20-cv-528

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DECLARATION OF MS. JOY BROOKS UNDER 18 U.S.C. § 1746

1. My name is Joy Brooks. I am a Floodplain Engineer within the Hydrologic Studies and Floodplain Management Unit of the Water Resources Division within the Michigan Department of Environment, Great Lakes, and Energy.

2. I am based out of the Department's Bay City location.

3. I graduated from Michigan State University in 1996 with a Bachelor of Science in Civil Engineering. I have been an environmental engineer working in floodplain management with the State of Michigan since January of 1998.

4. My current job duties include assisting local communities, engineering professionals and the public with compliance with the National Flood Insurance Program including providing site specific 100-year flood elevation. My job duties in 2020 included issuing state floodplain permits and performing compliance reviews under the State's Floodplain Regulatory Authority found in Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act.

5. On May 19, 2020, the Edenville and Sanford dams, which were part of a four-dam system near Midland, Michigan, failed. The failures caused severe flooding in the surrounding community.

6. I went to the site of the Edenville and Sanford dam failures on approximately the following dates to assess the upstream and downstream impacts of the failures: May 20, 2020, and June 9, 2020.

7. While there I observed a lot of debris being transported and deposited along the flood route downstream of the dams; the debris included trees, playground equipment, home furniture, propane tanks, and other miscellaneous objects. The debris was located within the bottomlands of Sanford Lake, in the bottomlands and 100-year floodplain of the Tittabawassee River downstream of the Sanford Dam, and in upland areas outside the 100-year floodplain of the Tittabawassee River downstream of the Sanford dam.

8. I observed stream bed alterations, including sediment deposits, debris, and severe bank erosion within the 100-year floodplain, stream beds, and channel of the Tittabawassee River downstream of the Sanford dam.

9. I observed damage to both public and private property including damage to residential and non-residential structures; damage to infrastructure, such as roads, bridges, and utilities; and damage to farm fields.

10. In addition to the debris, I observed other injurious substances being deposited into the water because of flooding. For example, stores and shops which contained injurious substances were flooded, and the substances were discharged into the water.

11. I observed lower water levels upstream of the Edenville Dam on June 9, 2020. The water level was significantly lower than previous observations at 4 sites. I received several telephone calls from Robert North, the Gladwin County Emergency Manager, asking for assistance with residential water wells upstream of the Edenville Dam that were going dry after the dam break.

12. In addition, I observed sediment being transported downstream of the dams. Sediment can accumulate and result in a blockage of natural flow within a river and floodplain causing a harmful interference. It can also negatively impact the habitat of both aquatic plants and animals. It can clog water intakes for irrigation or other uses which can damage equipment and infrastructure.

13. I also observed dead fish. The dead fish were in the street in the Village of Sanford, not in a waterbody.

14. I could testify about the contents of this declaration if needed.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: May 24, 2023

Joy Brooks

Joy Brooks