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VIA ELECTRONIC FILING

Project No. 2628-066
R.L. Harris Hydroelectric Project
Response to Recommendations and Comments on Notice of Ready for Environmental Analysis

Ms. Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street N.
Washington, DC 20426

Dear Secretary Bose,

Alabama Power Company (Alabama Power) is the Federal Energy Regulatory Commission (FERC or Commission) licensee for the R.L. Harris Hydroelectric Project (Harris Project) (FERC No. 2628-066). Alabama Power filed the Final License Application (FLA) for the Harris Project on November 23, 2021.[1]

On January 17, 2023, FERC issued its "Notice of Ready for Environmental Analysis, and Soliciting Comments, Recommendations, Preliminary Terms and Conditions, and Preliminary Fish Passage Prescriptions (NREA)", with comments due on or before March 20, 2023.[2] FERC received 20 comment letters.

Attached is Alabama Power's response to some of the comments submitted by the commenting stakeholders. Specifically, Alabama Power is responding to Alabama Department of Conservation and Natural Resources (ADCNR) Section 10(j) and 10(a) recommendations, as well as Environmental Protection Agency (EPA) and Alabama Rivers Alliance (ARA) comments related to fish passage, greenhouse gas emissions, and adaptive management. A response is not being provided for every stakeholder comment; however, this does not mean that Alabama Power agrees with those comments, as Alabama Power has previously provided substantial information regarding many of the same comments throughout the relicensing process.

Alabama Power has extensively addressed issues related to flow, temperature, and the operational constraints of the Harris Project on the record throughout the relicensing process. Alabama Power's relicensing proposal and the record in this proceeding provide ample information for FERC to make a determination that the project as proposed would be best adapted to a comprehensive plan for improving or

[1] Accession Nos. 20211123-5074, -5075, -5076, -5077, -5078, -5079

[2] Accession No. 20230117-3053

developing the waterway under Section 10(a) of the Federal Power Act (FPA) and to give equal consideration to power and non-power benefits of the project under Section 4(e) of the FPA.

If there are any questions concerning this filing, please contact me at arsegars@southernco.com or 205-257-2251.

Sincerely,

Angela Anderegg

Angie Anderegg
Harris Relicensing Project Manager

cc: Harris Action Team Stakeholder List

Attachment

ATTACHMENT

ALABAMA POWER'S RESPONSE TO RECOMMENDATION AND COMMENTS ON FERC'S NOTICE OF READY FOR ENVIRONMENTAL ANALYSIS, AND SOLICITING COMMENTS, RECOMMENDATIONS, PRELIMINARY TERMS AND CONDITIONS, AND PRELIMINARY FISH PASSAGE PRESCRIPTIONS

Alabama Department of Conservation and Natural Resources

Primary Concerns

The Alabama Department of Conservation and Natural Resources (ADCNR) comment letter, filed March 17, 2023[1], included a section entitled "Primary Concerns" that discusses four general issues ADCNR has with the Harris Final License Application (FLA): altered flow regime, sags in dissolved oxygen (DO), altered temperature regime, and on-going effects of project operation on aquatic fauna. Alabama Power's substantive response to ADCNR's 10(j) recommendations associated with these four issues is included below. However, Alabama Power notes that it appears ADCNR's concerns are based on flawed assumptions and incorrect information. For example, it appears that several of ADCNR's "primary concerns" and 10(j) recommendations are based on the assumption that changes to the existing units and how they are operated are being considered. However, Alabama Power has previously explained on the record during the Harris relicensing process that there are limitations to how the existing units can be operated, that the existing units are not being redesigned, and peaking operations are not being eliminated. Similarly, ADCNR seeks to compare existing flows to "pre-regulation periods." The National Environmental Policy Act (NEPA) requires that FERC consider the effects of the proposed action as compared to baseline, which is current operating conditions, not conditions prior to project construction. For its concern about "sags in DO," ADCNR states that "abrupt and extended periods of low DO, particularly during summer months, can cause periodic fish kills." There is no evidence of periodic fish kills below Harris Dam caused by low DO.

For its concern about "ongoing effects," ADCNR states that "the Harris Project will continue to burden the State of Alabama as ADCNR-WFF attempts to provide artificial propagation of numerous aquatic species that have declined significantly." Alabama Power is familiar with the State's fish stocking program but is unaware of any state propagation efforts that are being done to offset downstream effects from the Harris Project. Stocking efforts that Alabama Power is familiar with are related to maintaining the sport fishery within Harris Reservoir. ADCNR also states, in reference to the Final Aquatic Resources Study Report[2], that "a healthy natural unregulated river of that size, with deep-water survey efforts deployed, should not have resulted in difficulties obtaining sufficient sample sizes and length distributions of target species." As stated in Devries, Stell, Hershey, and Wright's response (Appendix A) to Alabama Rivers Alliance (ARA) comments, which included similar comments concerning sample size in the Final Aquatic Resources Study Report, the sample sizes obtained are within ranges to be expected when compared with similar published metabolic rate research. Furthermore, factors such as collection method, timing and habitat can contribute to likelihood of collecting certain fish species and lengths. Standard push-barge electrofishing was deployed in the tailrace while standardized boat electrofishing methods were used at other sites. Habitat availability or occurrence at a particular site can affect the likelihood of collecting certain species among all sites. For example, Tallapoosa Bass were also infrequently encountered at the upstream control site, with habitat homogeneity at this site potentially contributing.

Section 10(j) Recommendations

1. Harris Project, Tallapoosa River Flow Regime and Minimum Flow Determinations

Condition: The Licensee shall implement the operational flow regime as outlined by ADCNR-WFF within 5 years of license issuance. Details of Proposed Alternative – Instream Flow Schedule is described in Attachment A of this document and includes a seasonal minimum flow schedule, ramping factors and downstream spawning stabilization periods. From July 1 through November 30 of each year, the CMF will be 390 cfs, as measured at the USGS stream gage statistics from Wadley, to enhance spawning and shallow water habitat in the Tallapoosa River downstream of the Harris Project. From May 1 through June 30 and December 1 through December 30 of each year, a CMF will be 510 cfs. January 1 through April 30, the CMF will be 760 cfs, all subject to allowable variances described in Attachment A.

[1] Accession No. 20230320-5040

[2] Accession No. 20210412-5745

Alabama Power Response:

FERC's Integrated Licensing Process (ILP) is designed not only to front-load the requirements and reviews that are essential to the National Environmental Policy Act (NEPA) process but also to address information needs and gaps early in the process in consultation with stakeholders. As part of this ILP process, Alabama Power consulted with numerous stakeholders since 2018, including ADCNR to discuss issues, study methods and plans, study results, and protection, mitigation, and enhancement (PME) measures. During this extensive public participation and consultation process, Alabama Power asked on multiple occasions for stakeholders to identify any specific flow alternative for Harris Dam to be evaluated prior to finalizing the FLA. Unfortunately, ADCNR did not submit a proposed flow alternative until after Alabama Power filed its FLA and after FERC issued the Notice of Ready for Environmental Analysis (NREA). Nevertheless, Alabama Power is providing a high-level evaluation of ADNCR's recommended flow.

In preparing this response, Alabama Power evaluated flows at the Wadley gage from calendar years 2006-2022 under Green Plan (baseline) conditions[3], as well as Alabama Power's proposal to provide a continuous minimum flow of approximately 300 cfs (300 CMF) in the Tallapoosa River below Harris Dam. The percent of time that ADCNR's flow recommendation was equaled or exceeded was calculated for baseline conditions and for the proposed 300 CMF. For 300 CMF, any discharge value at Wadley that was less than 300 cfs was increased by 300 cfs. The results are provided in the table below.

As shown, under baseline conditions, ADCNR's recommended flow alternative is already being met at Wadley an overall average of 60 percent of the time. Alabama Power's proposal increases the overall average time that the ADCNR's recommended flow alternative is met to 79 percent of the time, with the highest percent increase during the months of May through November.

Period	Flow (cfs)	% time equaled or exceeded under baseline operations	% time equaled or exceeded under proposed 300 CMF operations
1/1 - 4/30	760	70	70
5/1 - 6/30	510	62	72
7/1 - 11/30	390	52	90
12/1 - 12/31	510	74	74
Overall Average		60	79

ADCNR's recommended flow alternative states that a higher priority should be placed on the maintenance of minimum flows rather than the maintenance of reservoir water levels. Based on modeling conducted during the relicensing process and presented in the Final Downstream Release Alternatives Phase 2 Study Report[4], in order to operate in accordance with ADCNR's recommended alternative, there would be adverse impacts to the ability to fill the reservoir and to the ability to maintain reservoir levels.

Alabama Power's proposal to provide a continuous minimum flow of approximately 300 cfs would enhance the seasonal flows downstream, increase the amount and stability of wetted habitat, decrease temperature fluctuations, and avoid adverse effects to reservoir levels under normal operating conditions. Accordingly, ADCNR's recommended flow alternative is unnecessary and should not be included as a condition in the new license.

[3] Green Plan operations began partway through calendar year 2005.

[4] Accession No. 20211119-5041

a. Minimum Flow Turbine Unit Selections

Condition: A continuous flow would be beneficial and likely dampen the effects of peaking operations, increase shallow water habitat availability and improve downstream water quality. ADCNR-WFF supports the Licensee's proposal to design, install, operate, and maintain a minimum flow unit to provide a CMF at the Harris Project, but continues to request a CMF with seasonal minimum flows. The Harris Project should be designed for adjustable flows based on an adaptive flow management plan within the proposed Project Operations and Flow Monitoring (POFM) Plan and provide tailrace temperatures that mimic the natural water temperature regime of the system. The CMF unit and power generation units should also meet state water quality standards at all times, including temperature seasonal maximum and minimum limits (in addition to hourly and daily temperature change limits). If APC continues to operate under daily peak-load operations, unit ramping for both one unit and two units during peak load generation should have restricted start times and stop times to minimize drastic flow, DO and temperature changes.

Alabama Power Response:

As stated in Exhibit E of the FLA, there are two factors affecting the location and physical size of the minimum flow unit. First, the only suitable location that would accommodate an additional unit is on the outside of Unit 1 (east side) of the powerhouse where the proposed minimum flow unit would be housed in a new reinforced concrete addition. The new steel-lined penstock would penetrate the existing Unit 1 penstock for source water and discharge below the tailrace water surface. Second, the preliminary minimum flow unit design indicates that the physical size of the unit is limited by the space available in the powerhouse addition; therefore, the amount of flow through the unit (hydraulic capacity) would also be limited.

On March 1, 2023, ADCNR was provided a site tour of the Harris powerhouse to see first-hand the layout of the existing powerhouse and location of the proposed minimum flow unit. As stated in Exhibit E of the FLA and explained to ADCNR at the site visit, Alabama Power's proposed 300 cfs minimum flow unit is the largest unit that can practicably be installed in the physical space available. Also, as stated numerous times on the record, the existing units are not capable of operating at levels less than best gate (approximately 6,500 cfs). As Alabama Power demonstrated above, seasonality in releases from the Harris Dam is already inherent due to the nature of existing climate and hydrology, with higher flow periods typically occurring in late winter and early spring, and lower flow periods typically occurring in summer and early fall. Furthermore, Alabama Power's proposal will provide an enhancement to seasonal flows.

Accordingly, the recommendation that the Harris Project be designed for adjustable flows based on an adaptive flow management plan is impractical and unnecessary and should not be included as a condition in the new license.

b. Turbine Unit Ramping Factors

Condition: The upramp time of each turbine at Harris Dam will be no less than 30 minutes from off-line to full gate. For down ramp time, after the first operating unit is taken off-line, the second operating unit shall not be taken off-line for at least two hours after the first operating unit was taken off-line.

Alabama Power Response:

As stated in Alabama Power's July 10, 2020 response to the Initial Study Report comments and additional study requests[5] and as reiterated in the Final Battery Energy Storage System Report[6], the Harris Project units are not capable of ramping. Both units were designed as peaking units to quickly react to electrical grid needs. As such, the turbines were not designed to operate over a wide operating range – or restricted ramping rate – over an extended period. In fact, restricted ramping is avoided to prevent damage to the hydro turbine and generator equipment. When transitioning from spinning mode[7] to generating mode, the wicket gates are opened over a period of approximately 45 seconds. One reason for this method of operating is so the turbine spends a minimal amount of time in the rough zone. The rough zone is an area in the turbine operating range where flows that are less than efficient gate cause increased vibrations in the turbine as well as cavitation along the low-pressure surfaces of the turbine runner. Ramping of the units can cause severe damage to the hydro turbine and generator equipment machinery by exposing it to excessive vibrations from vortex cores, pressure oscillations, and cavitation.

Additionally, as stated in Exhibit E of the FLA, ramping would involve incrementally increasing the flow through the turbines up to best/full gate. Ramping would not change the overall magnitude of water surface fluctuations experienced downstream, resulting in a negligible effect on resources downstream of Harris Dam. Because the turbines at Harris Dam were not designed to run at flows less than best/full gate, they would be subject to mechanical damage and therefore, Alabama Power would not operate the units in this manner.

Regarding ADCNR's recommendation for a down ramp time, Alabama Power notes that the Harris project is critical to system reliability when it is called upon to replace a sudden loss of generation sources. During those times, units can both load and unload within the hour. By placing a requirement to wait two hours to unload a second unit, the project's ability to quickly adapt and respond to system needs is severely restricted, unnecessarily putting at risk the reliability of the bulk power grid. This artificial requirement to wait two hours to unload a second unit would also have negative impacts to the lake level from generating two additional hours, by sending some 400,000,000 additional gallons of water downstream, for each occurrence, and that could occur more than one time per day. That additional volume would then be unavailable during subsequent periods, which would restrict the ability of the project to meet the daily peak energy demand going forward. Because of hydropower's unique position to support the intermittent nature of renewables, as more solar energy is added to the generating pool, this issue would become even more pronounced and detrimental to the bulk power system reliability.

Accordingly, this recommendation is infeasible and creates unnecessary risk to the existing units and system reliability; therefore, it should not be included as a condition in the new license.

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[5] Accession No: 20200710-5122

[6] Accession No. 20211119-5039

[7] Spinning mode is also known as motoring or synchronous condensing mode, where, upon shutdown from a generating condition, the unit essentially becomes a motor with an exciter system that then allows the generating unit to receive or supply reactive power as necessary to maintain transmission system voltage.

c. Spawning Stabilization

Condition: ADCNR-WFF supports holding Harris Reservoir water levels constant or slightly increasing for a 14-day period to provide improved conditions for fish spawning and hatching success, after consultation on timing with our agency. In addition, ADCNR-WFF recommends a similar spawning stabilization period be implemented in the tailrace for a 14- day period every year, after consultation on timing with resource agencies and FERC approval. These spawning stabilizations should be a FERC license condition requirement.

Alabama Power Response:

Alabama Power did not propose a downstream spawning flow in the FLA. The original interest in downstream spring flow stabilization was based on the theory that peaking generation resulted in a water temperature regime that was deleterious to spawning. Based on the results of the Final Aquatic Resources Study Report, water temperatures in the Tallapoosa River downstream of Harris Dam were within acceptable ranges for spawning for the target species[8] that were analyzed.

Additionally, as described in Exhibit E, Section 9.4.7, stabilization of downstream releases during early spring is difficult to accomplish due to high reservoir inflows typically experienced during the spring. Because Alabama Power's proposal will provide downstream water temperatures that support fish spawning, and due to the inherent difficulties associated with stabilizing downstream flows during the spring, this recommendation should be considered infeasible and not included as a license condition.

d. Drought

Condition: ADCNR-WFF supports the Licensee position to continue operating in accordance with ADROP to address drought management and to develop flow operations during drought and unit outages in their POFM Plan, with resource agencies consultation and FERC approval.

Alabama Power Response:

In the FLA, Alabama Power proposed to continue operating in accordance with the Alabama-ACT Drought Response Operations Plan (ADROP) and to develop drought operations procedures for the minimum flow as part of the new Harris license. Therefore, there is no need for it to be evaluated as a 10(j) recommendation.

2. Water Quality

Condition: ADCNR-WFF is in support of the Licensee to develop and implement a Water Quality Monitoring Plan (WQMP), but requests this plan be developed prior to license issuance in consultation with resource agencies and FERC approval. ADCNR-WFF recommends real time access to discharge, temperature and DO data, year-round, in the forebay and tailrace.

Alabama Power Response:

As FERC is aware, the requirement to develop a WQMP will be part of the license in order to ensure Alabama Power meets the conditions of Alabama Department of Environmental Management (ADEM)'s Water Quality Certification (WQC) and should therefore be developed following license issuance.

[8] The target species were selected in consultation with ADCNR.

Additionally, any monitoring should be defined by the conditions of the WQC and consistent with Alabama Power's third-party accredited monitoring program (For example, under Alabama Power's program, data must be subject to a QA/QC review and therefore cannot be provided in real time).

a. Dissolved Oxygen

Condition: The Licensee shall meet 401 water quality certification standards required by Alabama Department of Environmental Management (ADEM) of 5 mg/l DO for waters designated for "Fish and Wildlife" at all times during generation and non-generation. A Dissolved Oxygen Improvement Plan within the WQMP should be developed with well-defined endpoints, measurable response objectives, and a rigid timeline for any needed upgrade completions, prior to license issuance in consultation with resource agencies and FERC approval. All strategies to increase DO to meet the State standard should be considered and evaluated in the plan. Until these upgrades are completed, the Licensee should develop and implement flows that will provide adequately oxygenated water to the tailrace.

Alabama Power Response:

Alabama Power notes that ADEM is the state agency delegated with Clean Water Act authority in the state of Alabama. Thus, ADEM has responsibility for setting the state water quality standards, interpreting and determining compliance with those standards, and certifying that there is reasonable assurance that the discharge resulting from the Project will not violate applicable water quality standards. The state dissolved oxygen standard applicable to the Harris Project is 5.0 mg/L during generation for waters classified as Fish & Wildlife:

> For a diversified warm water biota, including game fish, daily dissolved oxygen concentrations shall not be less than 5 mg/l at all times; except under extreme conditions due to natural causes, it may range between 5 mg/l and 4 mg/l, provided that the water quality is favorable in all other parameters. The normal seasonal and daily fluctuations shall be maintained above these levels. In no event shall the dissolved oxygen level be less than 4 mg/l due to discharges from existing hydroelectric generation impoundments. All new hydroelectric generation impoundments, including addition of new hydroelectric generation units to existing impoundments, shall be designed **so that the discharge will contain at least 5 mg/l dissolved oxygen where practicable and technologically possible.**

Ala. Admin Code R. 335-6-10-.09(5)(e)4(i) (2011 Supp.) (emphasis added).

Alabama Power submitted its WQC application to ADEM on March 3, 2023. In issuing the WQC, ADEM will provide any necessary conditions to ensure the discharge resulting from the Harris Project will not violate state water quality standards.

Alabama Rivers Alliance (ARA) also recommends a condition in the new license requiring Alabama Power to retrofit, upgrade or replace the current aeration system to achieve at least 2.0 mg/L increase in DO. Additionally, ARA recommends that FERC "consider incorporating a PME measure into the new license that requires immediate improvement of the existing aeration system." Alternatively, ARA suggests that Alabama Power "could instead increase its ability to selectively draw from additional levels of the reservoir, or destratify portions of the reservoir so that water with higher levels of DO is being passed through the turbines."

The basis for both ADCNR's 10(j) recommendation and ARA's recommendation is their mischaracterization of the information provided in Alabama Power's WQC application. Both ADCNR and ARA misstate the state standard and then conclude Alabama Power is not meeting it. As stated above, ADEM is the state agency charged with issuing the WQC and determining compliance with state water quality standards. Alabama Power expects its proposed PME measures will provide reasonable assurance that the Harris Project will comply with the state water quality standards. Such compliance will be determined by ADEM. Therefore, there is no justification for this 10(j) recommendation and it should not be included as a requirement in the new license.

b. Temperature

Condition: ADCNR requests that the FERC require the Licensee to follow a 90°F (32.2°C) maximum and a ± 5° F (2.7° C) change from ambient water temperature limit, and a 1.8° F (1° C) rate of change per hour requirement. A Temperature Regulation Plan should be developed within the WQMP, with well-defined endpoints, measurable response objectives, and a rigid timeline for any needed upgrade completions required to maintain these limits, prior to license issuance in consultation with resource agencies and FERC approval. All strategies to provide temperatures that mimic an unregulated thermal regime should be considered and evaluated in the plan.

<u>Alabama Power Response:</u>

The rationale provided by ADCNR to support their recommendation mischaracterizes ADEM's regulations related to temperature requirements. ADCNR cites only the following regulations as support:

> (i) The **maximum temperature** in streams, lakes, and reservoirs, other than those in river basins listed in subparagraph (ii) hereof, **shall not exceed 90° F**.
>
> (iii) The **maximum in-stream temperature rise** above ambient water temperature **due to the addition of artificial heat by a discharger** shall not exceed 5° F in streams, lakes, and reservoirs in non-coastal and non-estuarine areas.
>
> (vi) In all waters the normal daily and seasonal temperature variations that were present before the **addition of artificial heat** shall be maintained, and there shall be no thermal block to the migration of aquatic organisms.

ADEM Admin. Code r. 335-6-10-.09(5)(e)(3)(i), (iii) and (vi) (emphasis added).[9]

None of these provide support for ADCNR's recommendation. Alabama Power addresses each, below.

Subpart (i) arguably at least applies to the Harris Project. However, as reported in the application for a WQC, since 2017, the water passing through the hydroelectric dam does not approach 90°F, let alone exceeded that value. Nonetheless, ADEM has additional flexibility in its regulations for water to exceed this threshold if the waterbody can reasonably accept it.[10] Accordingly, there is no need for a 90°F maximum temperature limit.

Subparts (iii) and (vi) simply do not apply to the Harris Project. The application of both subparts is limited to "the addition of artificial heat." It is well settled that hydroelectric facilities do not "add" anything to water that is passing through a turbine. Furthermore, even if subpart (iii) did somehow apply to the Harris Project, it addresses only a "maximum in-stream temperature rise" and does not regulate temperature decreases. Thus, to the extent ADCNR is relying on this subpart to support its request for a "-5°F change from ambient" recommendation, that reliance is unfounded and baseless.

ADEM is the state agency responsible for regulating water quality within the state of Alabama, including temperature. ADCNR's interpretations of ADEM's regulations are flawed and cannot reasonably be relied upon to establish ADCNR's temperature recommendations. If ADEM determines some form of

[9] It appears ADCNR mistakenly cited to ADEM Admin. Code r. "335-6-10.05" when it meant to cite to ADEM Admin. Code r. 335-6-10-.09(5)(e)(3)(i), (iii) and (vi), which are the temperature criteria applicable to the relevant segments of the Tallapoosa River.

[10] In fact, several waterbodies in the State of Alabama naturally exceed 90°F during certain annual periods.

temperature regulation is necessary, such regulation would be included in the WQC issued by ADEM. FERC should not usurp or pre-judge that WQC process by inserting temperature conditions that may be inconsistent with ADEM's water quality regulations.

Accordingly, the basis for ADCNR's recommendation to require a temperature limit and develop and implement a Temperature Regulation Plan is unfounded and this recommendation should not be included as a requirement in the new license.

3. Aquatic Resources

a. Fish Entrainment

Condition: As indicated in section 8.1.2.2 of the FLA and according to the study results (Appendix F), APC recognizes that fish entrainment and turbine mortality occur at the Harris Project which results in a loss of public trust resources. ADCNR-WFF is concerned with this issue and recommends Licensee pursue and provide methods to eliminate, minimize or mitigate for these losses.

Alabama Power Response:

There are many methods to protect the reservoir fishery, including Alabama Power's proposal to provide reservoir stabilization and a fish habitat enhancement program. While fish stocking is a common enhancement measure, this measure was not discussed with Alabama Power prior to FERC's issuance of the NREA. Regardless, Alabama Power's proposal fully addresses ADCNR's concern.

Accordingly, this recommendation is not necessary and should not be included as a condition in the new license.

b. Fish, Mollusk and Crayfish Propagation

Condition: If ADCNR-WFF fishway prescriptions are addressed to improve aquatic habitats upstream and downstream of Harris Dam, the Licensee shall establish a Memorandum of Agreement with an approved and licensed hatchery/facility to develop and implement a freshwater fish, mollusk and crayfish propagation program for the Tallapoosa River in consultation with resource agencies and FERC approval. The goals of this program will be to: 1) stabilize existing populations of select rare, state listed, species of greatest conservation need and federally listed species; 2) reintroduce extirpated species; and 3) reestablish select faunal representative species into restored habitats. Initial propagation work will focus on the monitoring of select species in existing habitats to prevent their extirpation. Reintroductions and reestablishment of species into restored habitat will rely on population and habitat assessments to determine when and where conditions are favorable for the release of juveniles. Activities of this program include but are not limited to: 1) collection and maintenance of brood stock and fish hosts; 2) developing propagation and rearing techniques 3) artificial culture and rearing of fish, mollusks or crayfish; 4) testing of proposed release sites to determine habitat suitability; and 5) monitoring of release sites to determine success of releases and population status of target species. This propagation program would be carried out until monitoring data indicate that self-sustaining populations are established. The most cost-effective way to implement such a propagation program is to use nearby state or federal facilities although nongovernmental organizations (NGO) or private alternatives should be explored. Upon agreement, the Licensee will reimburse selected propagation program for capital improvements and operational costs at facility, not to exceed replacement costs outlined in the American Fisheries Society, Investigation and Monetary Values of Fish and Freshwater Mussel Kills (Bowen and O'Hearn 2017).

Alabama Power Response:

FERC does not incorporate off-licensing funding agreements into the licenses it issues. Accordingly, ADCNR's suggestion is not an appropriate subject for a 10(j) recommendation.

Moreover, ADCNR has not previously raised this suggestion in any prior discussions or communications with Alabama Power. This proposed artificial propagation program may best be undertaken by the state or a non-profit organization with the expertise to manage the propagation of these species and not as a part of the Harris relicensing proceeding.

c. Aquatic Resources Monitoring Plan

Condition: ADCNR-WFF is in support of the Licensee with resource agencies input and FERC approval to develop and implement an Aquatic Resources Monitoring (ARM) Plan within 9 months of license issuance. ADCNR-WFF recommends this plan be implemented at determined intervals through the Harris Project FERC license period with standardized sampling protocols for all aquatic species (macroinvertebrates, mollusks, crayfish, fish). The monitoring plan should include requirements for both pre and post aquatic resource monitoring implementation of any project operational changes. ADCNRWFF requests consultation with APC to ensure methodologies are scientifically supported, comparable and repeatable. Special attention and focus should be given in the plan to sportfish, state and federally protected species and SGCN. Research, survey and monitoring needs provided in AL-Wildlife Action Plan 2015-2025 (ADCNR-WFF 2015) should be considered and prioritized.

Alabama Power Response:

Alabama Power proposed a robust Aquatic Resources Monitoring (ARM) Plan modeled after previously approved study plans, detailed in the FLA. FERC has the authority and responsibility to determine, in its discretion, what plans to require of a licensee and which agencies and other stakeholders it should consult with in developing those plans.

d. Aquatic Habitat Restoration Program

Condition: ADCNR-WFF supports fish habitat improvements by adding habitat enhancements. ADCNR-WFF recommends developing a plan, schedule, and monitoring program within 9 months of license issuance. Identifying and establishing candidate areas with native aquatic plants is highly recommended. Continuing to selectively cut and monitor felled trees for shoreline cover is recommended, as well as the addition of fish attraction devices such as brush piles and other woody debris (recycled Christmas trees, felled trees) and synthetic materials (spider blocks, concrete, and PVC structures) in Harris Reservoir to provide cover for fish and to enhance angling opportunities in Harris Project waters. In addition to reservoir improvements, tailrace fish habitat improvements and enhancement options should also be evaluated.

Alabama Power Response:

FERC has the authority and responsibility to determine, in its discretion, what plans to require of a licensee and which agencies and other stakeholders it should consult with in developing those plans. Also, as described in Exhibit E, Section 9.4.8, Alabama Power is not aware of any tailrace habitat deficiencies, and none have been identified by stakeholders to date. Furthermore, Alabama Power's proposed minimum flow would have a net benefit to downstream habitat, including an increase in wetted perimeter and habitat stability. There was some discussion relative to the Auburn University bioenergetics study noting that water velocities in the immediate tailrace area exceeded the swimming capabilities of target fish species. However, fish were captured in the tailrace as part of that study, indicating they are not permanently displaced by tailrace flows. Additionally, Channel Catfish and Redbreast Sunfish captured in the tailrace exhibited significantly better condition (e.g., body weight relative to total length) than those captured further downstream. Therefore, tailrace fish habitat improvements and enhancement options are unnecessary and should not be included as a license condition.

Section 10(a) Recommendations

Sedimentation and Erosion: Alabama Power disagrees with ADCNR's recommendation for Alabama Power to perform lake-wide surveys annually to identify areas of erosion in the Lake Harris Project boundary and include a management response. As stated in the April 2021 Erosion and Sedimentation Study Report, of the twenty-two erosion sites identified on Lake Harris, eight sites were found to have no significant signs of active erosion. The remaining fourteen sites did show signs of active erosion; however, the erosion at these sites is occurring at or above normal reservoir elevation and were likely the result of anthropogenic and/or natural processes independent of existing project operations. Examples of anthropogenic effects include wave action due to boating activity, land clearing and landscaping, and other construction activities affecting runoff towards the reservoir. Natural erosion processes observed included wind and boat generated wave action and bank scour due to channelized flows at the toe of banks. These processes would occur independently of any project operations. None of the erosion sites surveyed were likely the result of fluctuations due to project operations. Therefore, conducting annual surveys would be onerous and without merit.

Invasive species: ADCNR is the agency charged with evaluating the resource impacts of and developing response criteria for invasive fish, mollusks, plants, and crayfish. Alabama Power does not plan to actively survey for invasive fish, mollusks, and crayfish species but will notify ADCNR should invasive species be discovered, and it will work with ADCNR to implement recommended management actions. However, as described in the FLA, Alabama Power proposes to continue implementing its Nuisance Aquatic Vegetation and Vector Control Management Program on Lake Harris.

Preliminary Fishway Prescription

ADCNR recommends that "FERC reserve its authority to require such fishways as may be prescribed by Department of Commerce or Interior for the project under Section 18 of Federal Power Act."

<u>Alabama Power Response:</u>

Fishways and fish passage in the FERC licensing process are the responsibility of the Secretaries of Commerce and the Interior. If either Secretary submits to FERC a Section 18 fishway prescription, FERC must include that prescription in its license order for the project. As ADCNR's comment acknowledges, such prescriptions can include a request that FERC reserve the ability to reopen a license in order to require a licensee to comply with a fish passage prescription that a Secretary may issue at some point during the term of a license. Though license articles reserving fish passage prescription authority are common, it is up to the relevant federal agency Secretary to request that FERC reserve such authority in the new Harris license.

Environmental Protection Agency (EPA)

Fish Resources

Comment: The estimations regarding fish entrainment and mortality included in the Desktop Entrainment, the Study Report, and the Pre-Application Document concluded that approximately 294,427 fish are lost annually due to the existing turbines, and an estimation of additional 12,691 fish could be lost due to the proposed new Francis-type turbine. Section 4.4 Turbine Characteristics and Fish Mortality only mention Francis and Kaplan turbine types. Fish friendly turbine types are not included or considered in the information.

Alabama Power Response:

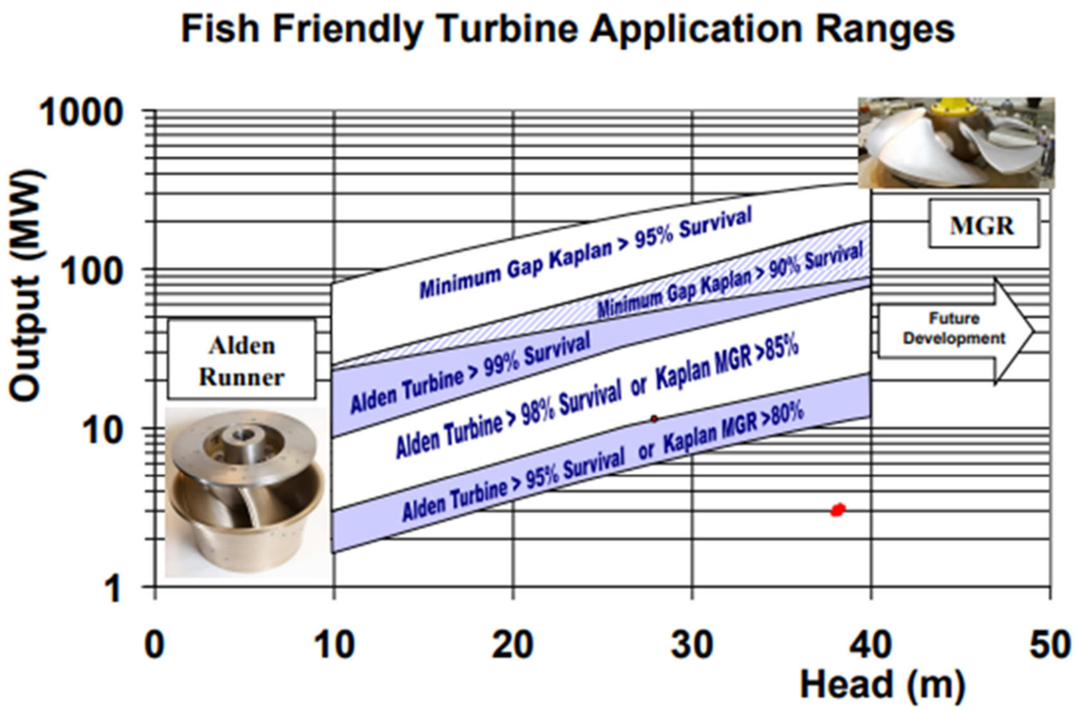
It appears EPA misunderstands the findings of the Desktop Fish Entrainment & Turbine Mortality Assessment for Proposed Minimum Flow Unit Report. For example, the 294,427-quantity referenced in the Report represents entrainment, not mortality, for the existing units and the proposed continuous minimum flow unit, combined.

Alabama Power agrees that fish friendly turbines do exist in the industry; however, the application for fish friendly turbines is limited. To address the question regarding the consideration of a fish-friendly turbine design for the Harris Dam CMF, two companies with fish-friendly offerings were selected for an overview of their designs.

Natel Energy's Restoration Hydro Turbine (RHT) is a compact hydroelectric turbine that meets the flow requirement need but falls short for a high-head application such as Harris Dam. The operating envelope for this turbine[11] shows that it will support discharges up to approximately 1090 CFS, however, the maximum net head is 66 feet, which falls very short of the approximately 120 feet of head at Harris Dam.

Voith Hydro offers the Alden turbine as a fish-friendly turbine option. The Alden turbine has a somewhat similar design to a Francis turbine with a lower shroud connecting the runner blades at the outer diameter, but the Alden turbine has fewer blades and rotates more slowly than a Kaplan. The figure below shows the turbine application range for the Alden turbine and another fish-friendly design from Voith known as a Minimum Gap Runner (MGR).

[11] https://www.natelenergy.com/turbines



Source: Coulson, S., et al, “Alden Fish Friendly Turbine: Final Development for Commercial Application,” Proceedings of HydroVision 2011, PennWell Corporation, Tulsa, OK, 2011.

The red dot on the figure represents the operating point of the proposed 300 cfs CMF at Harris Dam. For both of Voith’s fish-friendly turbine types, the minimum flow unit falls well outside the application envelope. Additionally, there are limiting characteristics around the use of these designs, other than being outside the application range, that indicate why they are not a suitable choice for Harris. The proposed CMF design uses a compact package unit design with a horizontal orientation while the Voith designs are based on a vertical orientation. The current design was chosen to fit within the limited space of the area between the existing powerhouse and the spillway. The Voith Alden turbine diameter is typically about 50 to 55 percent larger than a Francis turbine for a similar application. This means not only would the unit need to rotate 90-degrees to a vertical orientation but also increase in diameter, which would require more space than is available.

Adaptive Management Approach

Comment: The EPA encourages the use of adaptive management approaches for the Tallapoosa River below the R. L. Harris Dam due to the adverse impacts caused by low flows and sometimes dangerous high flow regimes of this project that continue to impact aquatic health and public usage of the Tallapoosa River. The EPA maintains that additional progress is attainable through a continuation of this adaptive management approach and building upon what has been learned through the Green Plan. As additional information about riverine health becomes available and scientific advances in generation technology emerge, we encourage AP to continue efforts to improve the chemical, physical and biological conditions of the Tallapoosa River by keeping open channels of communication with the community and agencies involved.

Alabama Power Response:

In light of the significant, if not exhaustive, amount of study already conducted to evaluate impacts of Harris Project operations on downstream resources that has resulted in a relicensing proposal that fully and adequately addresses this issue, there is no compelling reason to leave this issue inconclusively resolved during the new license term by making it the subject of adaptive management. For that reason, EPA's recommendation is unnecessary. Moreover, considering the capital, operation, and maintenance costs associated with the new minimum flow unit proposed by Alabama Power, it is neither cost effective nor practical to require additional review and consideration of operations through adaptive management during the new license term.

Alabama Rivers Alliance (ARA)

I. Requirements for Environmental Analysis under NEPA

A. ARA Recommends an Environmental Impact Statement Be Prepared

Alabama Power Response:

Alabama Power agrees that FERC should prepare an Environmental Impact Statement for the Harris relicensing and notes that on April 6, 2023, FERC's notice of its intention to prepare an environmental impact statement in this licensing proceeding was published in the Federal Register.

II. Water Quality

A. Dissolved Oxygen Levels

Alabama Power Response:

See response above to similar comments from ADCNR.

B. Water Temperature

b. New Analysis of Water Temperature and Degree Days

ii. Water Temperature is as Crucial a Variable as Flow for Aquatic Resources

Alabama Power Response:

ARA provided comments on the analysis contained in the Final Aquatic Resources Study Report (FARSR), attaching a critique and concluding that the FARSR fails to properly assess the effects of the altered temperature regime on aquatic resources. In Appendix A, Alabama Power is providing Dennis R. DeVries, Ehlana Stell, Henry Hershey, and Russell A. Wright's response to Dr. Bickley's analysis of the Auburn University's Bioenergetics report (Appendix D of the Final Aquatic Resources Study Report).

III. Downstream Releases, Releases, Proposed Continuous Minimum Flow Turbine, and the Need for Adaptive Management of Flows and Water Temperature

A. Static vs. Adaptable Flow Regime

B. Evaluating Minimum Flows of Over 300 cfs

D. Adaptive Management of Flows

Alabama Power Response:

The feasibility of providing an additional 100-150 cfs and impacts to temperature downstream from passing all or part of the continuous minimum flow from the epilimnion was evaluated in Alabama Power's AIR Response #3, dated December 27, 2022.[12] Passing all or part of the continuous minimum flow from the epilimnion would increase, not reduce, average and maximum daily and hourly water temperature fluctuations. With regard to the need to adaptively manage flows during the term of the new license, see response to EPA's similar comment above.

VI. Consideration of Harris Project Greenhouse Gas Emissions During Environmental Analysis

Alabama Power Response:

ARA's comment letter claims that the Harris Project is a source of past, present, and future greenhouse gas emissions (GHG), and it includes a recommendation that FERC "should consider and include in its NEPA document the greenhouse gas emissions created by the reservoir and project operations, as recommended by the Council on Environmental Quality's (CEQ) recently updated *National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change*." ARA includes in its comment letter a report purporting to validate the results of a G-Res model used by the Virginia Scientist Community Interface to analyze the net GHG footprint of the Harris Project for ARA. Also included is another report from the Virginia Scientist Community Interface discussing its interpretation of the modeling it conducted for ARA on Harris GHG emissions.

As FERC knows, the NEPA requires federal agencies to consider the potential effects on the quality of the human environment of a proposed Federal agency action and to consider reasonable alternatives to that action. The issuance of a hydropower license by FERC is such a federal agency action that triggers NEPA analysis, and FERC has already published notice in the Federal Register of its intent to prepare an environmental impact statement for the relicensing of the Harris project. For purposes of evaluating potential effects of the proposed action as required by NEPA, FERC defines and uses the baseline (i.e., current) conditions at the Harris Project. FERC then considers the effects of the proposed action as compared to that baseline to determine whether and to what extent the proposed action will affect the environment, whether there are reasonable alternatives that may have less of an effect, and whether there are appropriate measures that could mitigate those effects.

As CEQ's recent guidance cited by ARA makes clear, in the context of GHG emissions an agency should consider "the potential effects of a proposed action on climate change, including assessing both GHG emissions and reductions <u>from the proposed action</u>." The CEQ guidance repeats this standard multiple times making extremely clear that an agency, like FERC, should consider the foreseeable GHG emissions "of a proposed action" as compared to baseline conditions, which is consistent with NEPA requirements. The CEQ guidance also acknowledges that "some proposed actions may involve net GHG emissions reductions or no net GHG increase, such as certain infrastructure or renewable energy projects." So, as both NEPA and the CEQ guidance make abundantly clear, FERC need only consider

[12] Accession No. 20221227-5102

changes to GHG emissions caused by the proposed action, and it need not consider GHG emissions that are unchanged or are reduced by the proposed action as compared to baseline conditions.

Nothing in either the G-Res modeling validation report for the Harris Project or the VSCI report demonstrates or even suggests that relicensing the Harris Project will result in an increase in GHG emissions. And for good reason. Any potential change in GHG emissions that may result from Alabama Power's licensing proposal would be de minimis, temporary or both. Accordingly, during FERC's NEPA process for the Harris relicensing, there is no need to model, consider or mitigate for GHG emissions, and nothing in CEQ's recent guidance would suggest otherwise.

APPENDIX A

RESPONSE TO ALABAMA RIVERS ALLIANCE COMMENTS ON THE FINAL LICENSE APPLICATION FOR THE R.L HARRIS HYDROELECTRIC PROJECT (FERC DOCKET NO. P-2628-066) . . . .

DENNIS R. DEVRIES, EHLANA STELL, HENRY HERSHEY, RUSSELL A. WRIGHT

Response to Alabama Rivers Alliance Comments on the Final License Application for the R.L Harris Hydroelectric Project (FERC Docket No. P-2628-066) . . . .

Dennis R. DeVries, Ehlana Stell, Henry Hershey, Russell A. Wright
School of Fisheries, Aquaculture & Aquatic Sciences
Auburn University, AL

<u>STATEMENT OF CONFLICT OF INTEREST</u>. As a preface to our responses to the information provided in Dr. Sam Bickley's report, we need to identify and declare conflicts of interest that exist among Dr. Bickley, Dr. DeVries, and Dr. Wright. We assume that these COIs were declared by Dr. Bickley to the Alabama Rivers Alliance before he agreed to serve as an scientific expert to review our report, and are frankly shocked that these COIs were not declared at the start of Dr. Bickley's report.

- Dr. DeVries appears as a co-author on two of Dr. Bickley's presentations (these are both included in Dr. Bickley's CV).
- Drs. DeVries and Bickley are working as co-authors on one publication being developed from one of Dr. Bickley's dissertation chapters.
- Dr. DeVries was a Principal Investigator on the Sea Grant proposal that funded much of Dr. Bickley's graduate research.
- Dr. Bickley worked in Dr. Wright's lab where he used Dr. Wright's bomb calorimetry equipment to quantify energy density of fishes from his minnow trap collections in coastal seagrass beds as a part of his dissertation research.
- Dr. DeVries served as a member of Dr. Bickley's PhD graduate advisory committee until DeVries had to remove himself from the committee on 7 July 2022 for ethical reasons stemming from Dr. Bickley's activities.

<u>COMMENTS/RESPONSES RELATIVE TO EXHIBIT 1 (DR. SAM BICKLEY'S REPORT)</u>.
As scientists, we welcome comment and critique on our research; in fact, that is part of the scientific process that helps to advance science and can lead to an improved understanding of the diverse ecological systems on which we depend. However, the comments, critiques, and alternative approach to analysis of the data presented by Dr. Bickley fall far short of improving the science. A focal point of his report is the application of a degree-day approach to analyze the compiled temperature data. Unfortunately, Dr. Bickley did not acknowledge or deal with the inherent assumptions involved with his analysis. In addition, without the inclusion of any sort of sensitivity analysis of his work to variation in some of those assumptions, it is not possible to address the issues or judge the confidence one might have in the conclusions that Dr. Bickley suggests. Drawing conclusions without explicitly addressing assumptions or potential effects of variation in those assumptions is scientifically reckless given that the conclusions may not be scientifically supportable, at least based on the analysis that Dr. Bickley conducted. Below we address Dr. Bickley's concerns, including an assessment of his degree-day approach.

Section 2. FARSR Temperature Analysis. The bulk of Section 2 of Dr. Bickley's report addresses the Kleinschmidt report so we have not addressed those comments that relate to their report; if we are incorrect in this assumption, and any of Dr. Bickley's comments in this section do indeed relate to the Auburn University report, we would be more than happy to respond to them. At the end of Section 2.3 of the report, there are references to the degree day approach that was mentioned in the Auburn University report and is what Dr. Bickley uses in his re-analysis of the temperature data. We will address concerns with the approach, the application of this approach, and interpretations from the re-analysis under Section 4 below where Dr. Bickley presents his findings from this approach.

Section 3. DeVries et al. Downstream Population Study.
Section 3.1. Literature review. The explicit objective for this portion of the Auburn University study from the original proposal for this research (as discussed and agreed upon by administrators from ADCNR and Alabama Power prior to any work being conducted) was to "Summarize the data that are available in the literature concerning temperature requirements for target species including spawning and hatching temperatures, lethal limits, and thermal optima." Outputs from this work were Tables 1.1, 1.2, 1.3, and 1.4 in the Auburn report presenting those temperature data for the four target species that were identified in the published literature. The available literature derived from widely varied systems such as reservoirs, ponds, and aquaculture facilities (in the laboratory and in culture ponds). The thermal tolerances of species are influenced by multiple variables, including study-specific methods used to determine thresholds, genetic makeup, phenotypic plasticity and acclimatization, acclimation, etc., and while some general trends may remain, using thermal tolerance data from non-riverine populations to apply to a riverine population, or using data from populations acclimated to one latitude and applying it to populations at another latitude (e.g., Largemouth Bass living in the Midwest vs. Florida) would be scientifically irresponsible and the results likely misleading.

It is important to note for Channel Catfish, the published optimal thermal range is 24-30°C with preferred temperatures from 18-31°C and spawning occurred from 20-30°C. These temperatures correspond with temperatures in the Harris tailrace and downstream to Horseshoe Bend from approximately mid-May to mid-September in nearly all years. The optimal range for most centrarchids (Redbreast Sunfish, Alabama Bass, and Tallapoosa Bass are all centrarchids) typically ranges from 24-32°C which again are temperatures found for several months from mid to late spring through fall. Again, these published temperature ranges are from diverse systems with populations not found in lotic environments, making any conclusions tenuous at best, and again, potentially misleading.

Dr. Bickley notes that "These limited data should have been incorporated into the analysis of temperature data discussed below.". Clearly Dr. Bickley is not aware of the objectives of the funded work, which was specifically to "summarize the data . . . ", and this is exactly what was done. These results were presented at several public meetings and in the interim report, and no concerns with the approach were raised at any time. We address specific problems associated with Dr. Bickley's concerns in Section 3.2.2.

Section 3.2.1 DeVries et al. fails to adequately describe their statistical methods when analyzing temperature. Dr. Bickley notes that "winter temperature values are missing from this dataset so winter temperatures were not analyzed" which is absolutely correct (although Dr. Bickley states that the data were from 2001-2018, when they were actually from 2000-2018). The temperature data were not collected as a part of the Auburn University study, but rather were collated from a variety of studies by Alabama Power and other stakeholders, organized through Kleinschmidt and Associates, and provided to Auburn University as described in the proposal for this research. Missing data is a common situation in almost all long-term scientific datasets, the missing data were indicated in the report, and in this case were not particularly noteworthy given that winter temperatures were both less affected by water releases during generation and have less impact on growth of fishes in this system. Dr. Bickley describes general temperature patterns which are as presented in the Auburn University report. However, Dr. Bickley claims that "the analysis of water temperature in DeVries et al. is limited in its application to the question of how temperature varies in response to hydropower generation because the authors do not present the results of any rigorous statistical analysis", saying also that "the authors fail to provide the basic statistical approach for their analysis of temperature and therefore these data should not be used to infer that there is no effect of hydropower generation on downstream temperature regimes." There are a number of problems with these statements. To start with, nowhere in the Auburn University report is there a statement, inference, or logical argument presented to state that there is no effect of hydropower generation on downstream temperature regimes. If Dr. Bickley drew that conclusion on his own from the report, he was ill informed and misguided. Again, Auburn University was charged with the objective to "Summarize the data that are available in reports and from relevant agencies for water temperatures across a gradient downstream from the Harris Dam tailrace and compare those data with similar data from reference sites upstream of Harris Reservoir." And again, the data were provided to Auburn University and with only 3 years of data from Heflin combined with the numerous physical habitat differences between the Tallapoosa upstream of Harris Reservoir and the downstream sites (which may or may not be driven in part by the presence of Harris Dam), no meaningful comparisons with the upstream site could be made. As for the analysis, the data were analyzed and presented in Figures 2.1 through 2.11, using the program R to conduct those analyses. Contrary to Dr. Bickley's thinking, R is indeed a program used to analyze data (among other things) and saying what program was used is a standard part of reporting any scientific work (just like reporting that SAS or SPSS had been used in the past). It is unclear why Dr. Bickley is concerned with the description of the program R, but it was presented in the report as it is presented in the peer-reviewed literature and as is standard practice in normal scientific publication.

Section 3.2.2 DeVries et al. fails to analyze temperature in respect to various temperature thresholds identified in the literature review. As stated above, the objectives for both the review of target species' temperatures thresholds and the analysis of the temperature data were "to summarize", and that is what was done. An analysis integrating those aspects was beyond the scope of the project that was funded under the agreed-upon proposal. Objectives were presented explicitly in public meetings at which Auburn University presented their research findings, and if any stakeholder was concerned about the scope of the research, they should have expressed it to Alabama Power or FERC at those times. But beyond this procedural issue, it would have been reckless, scientifically irresponsible, and likely misleading for Auburn University to have made the sort of connections suggested by Dr. Bickley between the thermal information from the literature and the field temperature patterns given the variation in temperature tolerance data that were obtained, study-specific differences in methods used to determine thresholds, the published impacts of acclimation, and evolutionary differences in where studied populations were located, combined with a lack of data for some species as noted by both Auburn University and Dr. Bickley. The majority of literature available derives from extremely varied systems such as reservoirs, small impoundments, and aquaculture ponds. The thermal tolerance of species is influenced by multiple variables including genetic and phenotypic plasticity and acclimatization, and while some general trends remain, using specific thermal tolerance data from non-riverine populations or populations acclimatized to different atmospheric conditions (e.g., Largemouth Bass living in the Midwest vs. Florida) would be irresponsible.

If we do apply the optimum ranges reported in the literature then the optimal thermal range for Channel Catfish is 24-30°C with preferred temperatures from 18-31C and spawning occurs from 20-30°C (21-30°C in Pawiroredjo et al. [2008]). These temperatures correspond with temperatures experienced in the Harris tailrace and downstream in the Tallapoosa River to Horseshoe Bend during approximately mid-May to mid-September in nearly all years. As we stated previously, the optimal range for most centrarchids (Redbreast Sunfish, Alabama Bass, and Tallapoosa Bass are all centrarchids) typically ranges from 24-32°C which again are temperatures found for several months from mid to late spring through fall.

Section 3.2.3 DeVries et al. analyzes temperature pre-and post-Green Plan implementation by using an ANOVA of averaged monthly temperatures which reduces ecologically-relevant variation. While only summary statistics were provided on daily and hourly time scales, the information was provided such that information in the Auburn University report was *not* restricted to "averaged monthly temperatures". Dr. Bickley presents a partial quote of the Auburn University report by saying it "eliminated some variation", but fails to include the entire quote, that "hourly data points were used to generate hourly and daily averages, minimum, and maximum temperatures through the year. This eliminated some variation but allowed for a consistent comparison of temperatures across years." In fact, Table 2.1 is based entirely on hourly data points, considered at varying temperature fluctuations so that readers can explore implications of varied definitions of temperature fluctuations. And the Auburn University report does indeed note that "a degree-day approach might be worth examining"; however, knowing that pursuing such an approach would be complex, would require making a large number of likely inappropriate assumptions, and was unfortunately beyond the scope of the objectives for this project as defined in the proposal, that approach was not pursued at the time of the report. Issues concerning application of the approached that Dr. Bickley used based on Pawiroredjo et al. (2008) will be discussed further in section 4.

Section 3.3 Fish Diet, Fish condition, and Fish Community. The deadline for the Auburn University report was in early 2021, which was subsequently followed by the defense of and submission of Lamb (2021), and eventual preparation of a manuscript submitted for publication (now Lamb et al. in press). As such, the thesis and eventual submitted manuscript came after the presentation of the report, and as had been presented to both Alabama Power and the stakeholders, the graduate student's thesis work continued until preparation and defense of the thesis. All of those outputs clearly demonstrated that the fish community in the tailrace differed from the other sites, even to the point of a gradient identified in Lamb (2021) and Lamb et al. (in press; figure 3 in this paper which presents the graphical results from the multidimensional scaling analysis of the fish community data). It seems that Dr. Bickley's concern here is not with the analyses, results, conclusions, or interpretations (he actually seems to merely summarize work that has already previously been summarized), but rather once again that these differences were not somehow integrated with the temperature threshold and historical river temperature data. Once again, that was not part of the objectives of this work, and such an integration would have been scientifically inappropriate and reckless, given the issues associated with the summarized temperature threshold data described earlier. Relative to differences in fish condition factors, the Auburn University report clearly states that "While there are many factors that could contribute to this effect, cooler water temperatures in this area could certainly impact growth and potentially body condition", which Dr. Bickley does not mention or seem to consider in his report. In addition, the Auburn University report goes on to state that "Higher Channel Catfish and Alabama Bass body condition in the tailrace could also be influenced by differences in diet at this site", and "While not statistically significant, Redbreast Sunfish body condition was similarly higher on average in the tailrace versus the downstream sites", and "it appears that abundance and diet variation could be, in part, affecting the observed patterns of body condition in the tailrace". All of these points are relevant to Dr. Bickley's concerns, yet are overlooked or ignored in Dr. Bickley's report.

Section 3.4 Metabolic Rate and Bioenergetics Model. Throughout his critique of this portion of the Auburn University report, Dr. Bickley provides a summary of what had already been presented in the Auburn University report. The problem with Dr. Bickley's narrative lies in his final sentence: "I concur with the author's conclusion and suggest that these results should not be used to assert that there is no effect of variable temperature downstream of Harris Dam on aquatic resources." The problem is that nowhere in the report does it state, imply, or suggest that the energetics data and results be used to assert that there is no effect of variable temperature downstream of Harris Dam on aquatic resources. Throughout the life of this project, and during every presentation to stakeholders, caveats relative to the development, application, and interpretation of bioenergetics models were explicitly stated, as they are also stated in the Auburn University report. Throughout the life of the project, it was clear that a bioenergetics approach was attempted as a potential tool to test the interactive complexities of flow, temperature, and fish energetics. Interestingly, we could not model fish in the tailrace because the flows were simply too great, leading to issues with the activity parameter in the model, a result that is clearly stated in the Auburn University report. To fully parameterize the activity parameter under those conditions, would have required fine scale estimates of the behavior that were beyond the scope of the research program. The problem with Dr. Bickley's conclusion is that it intertwines the objective science presented in the Auburn University report with suggestions of advocacy, which is a dangerous proposition in that objectivity is difficult to maintain once a stated outcome is advocated. The assertion that Dr. Bickley suggests not be made was never made. As such, to state that it is not valid is redundant and not a criticism of the presented work.

In addition, relative to the specific comments that Dr. Bickley made in his summary, differences in relative swimming speed were due to smaller fish overall being collected from Horseshoe Bend at the time of report publication, which was clearly stated. It is well established in the scientific community that standard/resting metabolic rate increases with temperature until a critical thermal threshold is reached. The small sample size derived from multiple issues, the least of which was the size limitation imposed by the testing apparatus. However, in the experiment mentioned in paragraph 2 of this section, Dr. Bickley ignores the final statistical analysis performed for this part of the project where all species were combined via an ANCOVA that accounted for individual (and therefore species) variation in the "pre-condition". Via this analysis (Fig. 4.14 in the Auburn University report), we show how decreased water temperature was more important than increased water velocity in determining respiration rate as the rate increased significantly only when water temperature was maintained. This could have direct impacts on the fish exposed to the highest velocity and larger temperature declines (2-4°C) in the system during hydropower generation but the actual effect would warrant further investigation also including the behavior of the fish such as refuge seeking, etc. as well. Finally, one reason for the Channel Catfish models failing to produce valid results may be due to the models being constructed using pond derived data and not data from riverine systems; as noted repeatedly, acclimation conditions, latitudinal variation, local adaptation of source population differences, etc. are all important. Swimming performance and metabolic rate all can differ depending on the environment in which a fish is raised (Beechum et al. 2007, 2009).

Section 3.5 Summary.

In his summary section for this part of Dr. Bickley's report, he lists 5 reasons for why the Auburn University report is of "limited use when assessing the effects of cold water releases from Harris Dam on aquatic resources". Although all of these have been addressed above, we address them explicitly here for the sake of summarizing this section.

--It fails to incorporate biologically-important metrics such as degree days when analyzing temperature.
There are a large number of issues with the way that Dr. Bickley applied a degree day approach for analyzing the temperature data, many of which have been addressed above. However, we fully consider this approach and the problems associated with it in the next section (Section 4).

--It fails to compare temperature in regulated, downstream reaches to temperatures in unregulated, upstream reaches.
The Auburn University team made clear to all stakeholders that a comparison between the upstream Heflin site and sites downstream of Harris Dam was not valid given the dramatic differences between sites that were not due to being upstream or downstream. The sites are physically different in turbidity, depth, width, and vegetative coverage. Downstream of the dam, turbidity tends to be low (with the exception of rainfall runoff events), the river is more exposed to solar radiation, and agricultural use changes. That said, we do show the temperature patterns for Heflin over 3 years and while temperature does reach higher maximum temperatures (never above 30°C) than the tailrace or Malone, it is similar to Wadley. The difference in Heflin daily average and the tailrace or Malone is approximately 3-5°C during the peak of summer. It is noteworthy that Heflin experienced near freezing temperatures in winter 2018 which were not detected downstream of Harris Dam. While much focus is placed on upper thermal limits, prolonged cold stress can also be detrimental to many fish species (Donaldson et al. 2008).

--Temperature analysis relies on mean monthly averages of temperature which eliminates important daily variation in temperature.
As stated above, the data in Table 2.1 of the Auburn University report is based entirely on hourly data points, considered at varying temperature fluctuations so that readers can explore implications of varied definitions of temperature fluctuations.

--Bioenergetics models were only successfully completed for Redbreast Sunfish, and overall sample size for measurement of metabolic rates was low.
Bioenergetics models are complex and difficult, requiring vast amounts of data and mathematical skills beyond the simple programming that can be used to initially use basic models. Re-configuring a model that works on annual time scales for shorter time scales to get at hourly temperature variation was difficult, and this work successfully resulted in a functioning model for one of the target species that provided excellent insight into how complex interactions among temperature, flow, activity, diet, metabolic functioning, etc. might ultimately affect fish in this complex system. And that is exactly what the goal of this aspect of the research was. Sample sizes presented in the Auburn University report were reasonable, and within the bounds of what would be expected for this type of research, given the wide range of sample sizes that are regularly published in the peer reviewed literature for studies of metabolic rates in organisms.

--However, the report does provide limited evidence for downstream alterations to fish communities, fish diet, and fish condition, and supports previous studies showing similar alterations to fish communities (Freeman et al. 2005)
Findings relative to fish community data clearly showed differences among sites (and even a gradient among sites), which we argue is far more than "limited evidence".

Section 4. Analysis of degree-days and temperature at Tailrace, Malone, and Wadley. As stated in the Auburn University report, an approach using degree days "might be worth examining", but given that it constituted a completely different analysis that required a wide array of assumptions and was beyond the scope of the original proposal, we made the suggestion but did not pursue these additional analyses. Unfortunately, the degree day approach used by Dr. Bickley is narrow and misleading, suffering from the problems with assumptions that we have noted. For example, the range of temperatures across which Channel Catfish were found to spawn was very large, ranging from 20-30C across studies, and the methods for determining these temperatures, as well as all aspects of the studied populations and systems in which they were studied, vary across the papers that generated that seemingly simple 20-30C range. For example, acclimation was found to be an important factor affecting estimated thermal minima, thermal maxima, and preferred temperatures in laboratory studies. As such, taking data from shallow lentic systems in a single aquaculture study in southern Louisiana (Pawiroredjo et al. 2008) to generate predictions for what would be required for fish in a lotic system in Alabama where temperatures are systemically much lower is at best misleading, and at worst scientifically reckless. In addition, not taking into account system differences, moving versus static water, acclimation, and the range of reported spawning temperatures for the species is scientifically irresponsible.

Despite these overarching problems, we independently replicated Dr. Bickley's analysis. We were able to successfully replicate the results given in Dr. Bickley's Table 1, and here we provide a brief sensitivity analysis to show the importance of choosing justifiable reference points (spawning temperature and period window width). We include the code we used to reproduce Bickley's results, and the results of our sensitivity analysis for full transparency. To calculate degree days for each day of each year, we subtracted Dr. Bickley's selected threshold temperature (21C) from the average daily temperature for each day in the time series. Then we used a rolling function to sum the degree days over a rolling 10-day window for each year. The number of windows varied between years because the time-series were different lengths, and started on different calendar days. Then, we tallied the number of windows for which the sum of degree days was greater than 57. We repeated this analysis for each year and each dataset (tailrace, Malone, and Wadley). We were able to reproduce the exact numbers found in Bickley Table 1, and present them in our Table 1.

However, there are several critical flaws with Dr. Bickley's analysis:
(1) The choice of 21C as the threshold temperature for the onset of spawning in Channel Catfish may not be accurate for wild fish in the Tallapoosa River. Bickley selected this temperature from Pawiroredjo et al. (2008) presumably because it was "recommended for use when applying degree-days to Channel Catfish spawning for predictive and comparative functions." These temperatures are likely only applicable to pond-raised fish, and the authors themselves clearly warn that "This work was performed in southern Louisiana, and catfish in other regions may respond differently", stating also that "the exact lower temperature limit for Channel Catfish spawning has not been determined". Therefore, a range of threshold temperatures must be considered when evaluating spawning potential in the Tallapoosa River.
(2) The choice of a 10-day rolling window is arbitrary and not justified. Bickley cites Irwin et al. (2019) to support this choice of a 10-day spawning window, and a review of Irwin et al. (2019) shows they used a 10-day window or a 10-day period repeatedly, including for days with no peaks in flow > 7,000 cfs, for days where lake levels fall below the rule curve, and for summed degree days exceeding 63 at a 17.2°C threshold. Irwin et al. (2019) does not provide a citation for this 10-day window across any of these metrics, but does cite Andress (2002) for its use relative to reproduction, relating to "successful hatching of a common centrarchid (*Lepomis auritus* [redbreast sunfish]; Andress, 2002)". Dr. Bickley's "borrowing" of this window from a centrarchid to support the time needed for reproduction, hatching, etc. in an ictalurid is simply unjustifiable, scientifically inappropriate, and potentially quite misleading. Redbreast Sunfish egg development times have nothing to do with catfish spawning readiness.

Given this, we tested the sensitivity of the results to the threshold temperature, and the spawning window width. We found that using a slightly different threshold temperature of 18C and increasing the spawning window width to 15 days changed the results and conclusions dramatically (Table 2). Hundreds of potential spawning windows were tallied for each site, and the only year that had none was Malone in 2011, which had large data gaps.

We question whether the rolling window approach is appropriate for assessing catfish spawning potential at all, given that degree days do not accumulate over 10 or 15-day windows. They accumulate and apparently reset annually. In Pawiroredjo et al. (2008), 57 degree days accumulated over an entire season (from January or February until after spawning). In the compiled temperature dataset, this 57 degree day threshold was reached at all sites in almost all years, suggesting that enough thermal energy does accumulate at each site to trigger the onset of catfish spawning. There are certainly many other factors at play besides temperature that may control spawning success, including flow, habitat availability, photoperiod, etc., some of which were included in the laboratory studies and bioenergetics modeling efforts. To claim that catfish cannot spawn in the tailrace because of thermal conditions is simply not justified based on the degree-day approach to analysis of the data. The fact that catfish are rarely collected in the tailrace is worth noting, but we have not yet identified a defensible explanation based solely on thermal data.

In addition, collections reported in the Auburn University report include Channel Catfish at the tailrace site in all seasons (Tables 3.4, 3.6), indicating that they are at least present at this site (although we certainly acknowledge that they could be moving in and out of the area, into tributaries and back into the main channel, etc.). While not included in the report (because questions of spawning in the tailrace were not part of the study), we did collect numbers of juvenile Channel Catfish in the tailrace during our collections. These include the following:

-10 Channel Catfish in May 2019 (4 with measurable gonadal weights, 6 immature gonads, size ranged from 7.41-70.86g)
-7 Channel Catfish in July 2019 (5 with measurable gonads, size ranged from 20.99-57.46g)
-4 Channel Catfish in September 2019 (3 with measurable gonads, size ranged from 61.5-93.82g)
-2 Channel Catfish in November 2019 (all immature, size ranged from 2.26-3.88g)
-2 Channel Catfish in January 2020 (size ranged from 5.2-8.35)
-4 Channel Catfish in March 2020 (2 with measurable gonads, size ranged from 6.86-67.10g)
-3 Channel Catfish in May 2020 (all immature, size ranged from 30.47-43.80g)
-3 Channel Catfish in July 2020 (all immature, size ranged from 14.29-79.66g)
-5 Channel Catfish in September 2020 (3 spent females, size ranged from 6.95-76.59g)
-13 Channel Catfish in November 2020 (2 with measurable gonads, size ranged from 2.74-50.45g)
-6 Channel Catfish in January 2021 (1 with measurable gonads, size ranged from 2.39-48.49g)

These collections, including the presence of measurable (developing) gonads and post-spawning (spent) gonads along with young-of-year size fish directly brings into question that a degree-day analysis results in zero spawning windows in the Harris Dam tailrace and further calls into question the validity of Dr. Bickley's application of a degree-day analysis. While temperatures were lower in the tailrace than Wadley, the mid spring-mid fall temperatures appear to remain well within the spawning and optima temperatures needed for the 4 target species of our study. And perhaps most importantly, it is important to remember that temperature is not the only driver of spawning and nest selection.

SUMMARY. There is no question that there are a number of documented negative impacts of hydroelectric dams on aquatic communities (and a few limited positive impacts). However, as scientists we are required to remain objective, use the data to test what can be tested, and acknowledge limitations in the data or analyses, assumptions that are required, etc. as we conduct our research. Such objectivity is fundamental to science. Unfortunately, the degree-day analysis that Dr. Bickley used to question much of the findings of the Auburn University report does not use this approach, and is flawed due to the unstated assumptions that he had to make, the borrowing of critical data from unrelated species, use of data from shallow earthen aquaculture ponds when modeling a riverine population from a different latitude, an overall lack of consideration of the sensitivity of his model to variations in the assumptions, and broad and general implications for his results caused by the accumulation of all of these factors. In addition, Dr. Bickley continually ignores the fact that the Auburn University analysis of the temperature data did include hourly measures, and was not restricted to "mean measures of temperature, such as the mean monthly values assessed in DeVries et al". Such omissions are critical when trying to provide a critique of a research project. In the end, this system is an incredible biological resource, and one that is highly complex in the interrelated ecological factors that are involved. Integrating temperature patterns and complex organismal ecological interactions is difficult, and we hope that additional research and management of this system continue to unravel these complexities toward the long-term sustainability of the system.

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Table 1. Number of 10-day (spawning) windows for Channel Catfish during 2000-2018 at three different sites (tailrace, Malone, Wadley) using a 21C threshold temperature for degree-day calculations. These are the results that we have replicated from Dr. Bickley's analysis and report (his Table 1).

Year	tailrace	Malone	Wadley
2000	0	0	0
2001	0	0	0
2002	0	0	0
2003	0	0	0
2004	0	0	0
2005	0	0	0
2006	0	0	18
2007	0	1	39
2008	0	10	29
2009	0	5	21
2010	0	32	67
2011	0	0	68
2012	0	12	25
2013	0	0	0
2014	0	0	22
2015	0	0	50
2016	0	32	92
2017	0	0	0
2018	0	0	0

Table 2. Number of 15-day (spawning) windows for Channel Catfish during 2000-2018 at three different sites (tailrace, Malone, Wadley) using an 18C threshold temperature for degree day calculations.

Year	tailrace	Malone	Wadley
2000	66	72	29
2001	71	83	87
2002	80	23	82
2003	114	102	102
2004	92	80	120
2005	113	120	122
2006	98	121	118
2007	33	130	154
2008	75	118	126
2009	99	107	117
2010	120	120	123
2011	66	0	132
2012	84	115	115
2013	113	118	129
2014	106	114	99
2015	105	118	127
2016	109	127	138
2017	115	107	129
2018	124	132	111

Supplemental Material: R code used for degree day reanalysis.

```
--------------------------
#tempanalysis
library(lubridate)
library(zoo)

#load tailrace data
tr <- read.csv("tailracetemp.csv")
colnames(tr) = c("Date","temp")
tr$day = ymd_hm(tr$Date)
tr$year = format(as.Date(tr$Date),"%Y")
# plot(tr$temp~tr$day)
tr$day = as.character(as.Date(tr$day))

#load malone data
ml <- read.csv("malonetemp.csv")
colnames(ml) = c("Date","temp")
ml$day = ymd_hm(ml$Date)
ml$year = format(as.Date(ml$Date),"%Y")
# plot(ml$temp~ml$day)
ml$day = as.character(as.Date(ml$day))

#load wadley data
wad <- read.csv("wadleytemp.csv")
colnames(wad) = c("Date","temp")
wad$day = ymd_hm(wad$Date)
wad$year = format(as.Date(wad$Date),"%Y")
# plot(wad$temp~wad$day)
wad$day = as.character(as.Date(wad$day))

#calculate daily average temperatures for tailrace
dailyave <- tapply(tr$temp,as.factor(tr$day),mean,na.rm=T)
# plot(dailyave ~ unique(tr$day))
dailyave = data.frame(mean = unname(dailyave),day = names(dailyave))
dailyave$dd = dailyave$mean - 21
dailyave$Date = as.Date(dailyave$day)
dailyave$year = as.character(format(dailyave$Date,"%Y"))
# plot(dailyave$dd ~ dailyave$Date)

#calculate number of spawning windows in each year with rolling function (rollapply from package:zoo)
years=unique(dailyave$year)
windows <- list(NA)
for(i in 1:length(years)){
  windows[[i]] <- rollapply(dailyave$dd[dailyave$year==years[i]],width=10,sum,na.rm=T,align="left")
  }
trwindows <- lapply(windows,function(x)sum(x>57))
```

```
#calculate daily average temperatures for malone
dailyave <- tapply(ml$temp,as.factor(ml$day),mean,na.rm=T)
# plot(dailyave ~ unique(ml$day))
dailyave = data.frame(mean = unname(dailyave),day = names(dailyave))
dailyave$dd = dailyave$mean - 21
dailyave$Date = as.Date(dailyave$day)
dailyave$year = as.character(format(dailyave$Date,"%Y"))
# plot(dailyave$dd ~ dailyave$Date)

#calculate number of spawning windows in each year with rolling function (rollapply from package:zoo)
years=unique(dailyave$year)
windows <- list(NA)
for(i in 1:length(years)){
  windows[[i]] <- rollapply(dailyave$dd[dailyave$year==years[i]],width=10,sum,na.rm=T,align="left")
}
mlwindows <- lapply(windows,function(x)sum(x>57))


#calculate daily average temperatures for wadley
dailyave <- tapply(wad$temp,as.factor(wad$day),mean,na.rm=T)
# plot(dailyave ~ unique(wad$day))
dailyave = data.frame(mean = unname(dailyave),day = names(dailyave))
dailyave$dd = dailyave$mean - 21
dailyave$Date = as.Date(dailyave$day)
dailyave$year = as.character(format(dailyave$Date,"%Y"))
# plot(dailyave$dd ~ dailyave$Date)

#calculate number of spawning windows in each year with rolling function (rollapply from package:zoo)
years=unique(dailyave$year)
windows <- list(NA)
for(i in 1:length(years)){
  windows[[i]] <- rollapply(dailyave$dd[dailyave$year==years[i]],width=10,sum,na.rm=T,align="left")
}
wadwindows <- lapply(windows,function(x)sum(x>57))

table1 = cbind(trwindows,mlwindows,wadwindows)


################################
################################
####REPEAT ANALYSIS WITH WIDER WINDOW AND LOWER THRESHOLD TEMPERATURE####
################################
################################

#calculate daily average temperatures
dailyave <- tapply(tr$temp,as.factor(tr$day),mean,na.rm=T)
# plot(dailyave ~ unique(tr$day))
dailyave = data.frame(mean = unname(dailyave),day = names(dailyave))
```

```
dailyave$dd = dailyave$mean - 18
dailyave$Date = as.Date(dailyave$day)
dailyave$year = as.character(format(dailyave$Date,"%Y"))
# plot(dailyave$dd ~ dailyave$Date)

years=unique(dailyave$year)
windows <- list(NA)
for(i in 1:length(years)){
  windows[[i]] <- rollapply(dailyave$dd[dailyave$year==years[i]],width=15,sum,na.rm=T,align="left")
}
trwindows <- lapply(windows,function(x)sum(x>57))


#calculate daily average temperatures for malone
dailyave <- tapply(ml$temp,as.factor(ml$day),mean,na.rm=T)
# plot(dailyave ~ unique(ml$day))
dailyave = data.frame(mean = unname(dailyave),day = names(dailyave))
dailyave$dd = dailyave$mean - 18
dailyave$Date = as.Date(dailyave$day)
dailyave$year = as.character(format(dailyave$Date,"%Y"))
# plot(dailyave$dd ~ dailyave$Date)

years=unique(dailyave$year)
windows <- list(NA)
for(i in 1:length(years)){
  windows[[i]] <- rollapply(dailyave$dd[dailyave$year==years[i]],width=15,sum,na.rm=T,align="left")
}
mlwindows <- lapply(windows,function(x)sum(x>57))


#calculate daily average temperatures for wadley
dailyave <- tapply(wad$temp,as.factor(wad$day),mean,na.rm=T)
# plot(dailyave ~ unique(wad$day))
dailyave = data.frame(mean = unname(dailyave),day = names(dailyave))
dailyave$dd = dailyave$mean - 18
dailyave$Date = as.Date(dailyave$day)
dailyave$year = as.character(format(dailyave$Date,"%Y"))
# plot(dailyave$dd ~ dailyave$Date)

years=unique(dailyave$year)
windows <- list(NA)
for(i in 1:length(years)){
  windows[[i]] <- rollapply(dailyave$dd[dailyave$year==years[i]],width=15,sum,na.rm=T,align="left")
}
wadwindows <- lapply(windows,function(x)sum(x>57))

table2 = cbind(trwindows,mlwindows,wadwindows)
write.csv(table1,"bickleyresponsetable1.csv")
```

```
write.csv(table2,"bickleyresponsetable2.csv")

#if thermal energy (degree days) accumulates from the start of the timeseries
#until the end of the timeseries, does it ever get to 57 accumulated degree days?
#the results of this line tell whether it does for each year
lapply(years,function(x) any(cumsum(dailyave$dd[dailyave$year==x])>57))

# plot the cumulative sum for each year with the 57dd reference line.
#x axis is julian date. the timeseries crosses 57 almost every year between day 180-220 which
#is between June and August

dailyave$day = as.POSIXlt(dailyave$day)$yday
plot(NULL,xlim=c(0,365),ylim=c(-100,100))
for(i in 1:length(years)){
  lines(cumsum(dd)~day,data=dailyave[dailyave$year==years[i],])
  abline(h=57)}
```