Comments on
Housatonic River
Corrective Measures Study Report
Prepared by
Environmental Stewardship Concepts
On Behalf of
The Housatonic River Initiative
May 19, 2008

Issues/Recommendations

- **Contrary to GE's claims, PCBs in and around the Housatonic River present a major threat to humans and wildlife**
- **Monitored natural recovery (MNR) is not an effective approach to dealing with persistent pollutants like PCBs in or out of the river**
- **Technologies such as phytoremediation and sediment washing are viable alternatives to placing contamination in landfills and can reduce PCB concentrations to safe levels**
- **Under the approach selected by GE, the Housatonic River would remain a catch and release fishery indefinitely**
- **EPA should force GE to take a more aggressive approach that uses new technologies and will reduce PCB contamination in the environment and wildlife to safe levels**

General Comments

The Corrective Measures Study, or CMS, presents a series of options for how GE might cleanup the PCB contamination from the Housatonic River. EPA has published a summary of the CMS and explains each method. The remedies selected by GE are not effective and they fail to properly evaluate other alternatives.

This document should be viewed with extreme skepticism. Based on GE's previous actions and their own statements, they obviously have no intention of implementing an effective cleanup. The CMS makes a point to note GE's disagreements with both the EPA and the scientific community regarding the risks from PCBs. GE argues that PCBs pose no human health or ecological risks, even though there is overwhelming evidence to the contrary (ATSDR, Rice et al. 2003). Reviewers should not forget that this is the second attempt GE has made to create an acceptable CMS- the first was judged so unsuitable by EPA that they demanded it be significantly revised.

There are several reasons to believe that little has changed with this new draft. An excellent example is GE's gross misrepresentation of the Biogenesis sediment washing technology (TD 4). GE's evaluation of the process both overestimated costs and underestimated effectiveness. GE also assigned risks like spills during transport to this remediatial option that were not considered for other alternatives like upland disposal in a landfill that would have an equal or greater chance of these accidents happening. GE was clearly biased against the use of this technology, even though it demonstrated tremendous potential for the cleanup of the Housatonic River.

The CMS is generally deficient in not considering any new methods or approaches. There is no in-depth consideration of in place treatment of PCBs using bacteria, plants, or animal extracts. Nor is there any money set aside to develop new treatments. If GE and EPA had devoted more money in the year 2000, then the past 8 years may have yielded some innovative methods. Potentially effective alternative technologies were never investigated. Phytoremediation has shown some promise for removing PCBs from contaminated soils at other sites. One study performed by Kelly Hurt at a Mississippi scrap yard took PCB concentrations down from the hundreds of parts per million down to approximately 1 ppm (Hurt 2008). An evaluation of this approach should be included in the CMS.

The cleanup remedies selected by GE (SED 3, FP 3, and TD 3) do not significantly reduce risk, and what reductions that do occur will not be realized for several decades. GE estimates the PCB levels in fish under various cleanup options, described as options Sed 1-8 for the river, as FP 1-5 for the floodplain and T 1-3 for the treatments. The fish tissue levels under sediment treatment options are presented in a number of figures, using the EPA model for the river. Note that under SED 3, the option desired by GE, tissue levels do not decline for many decades.

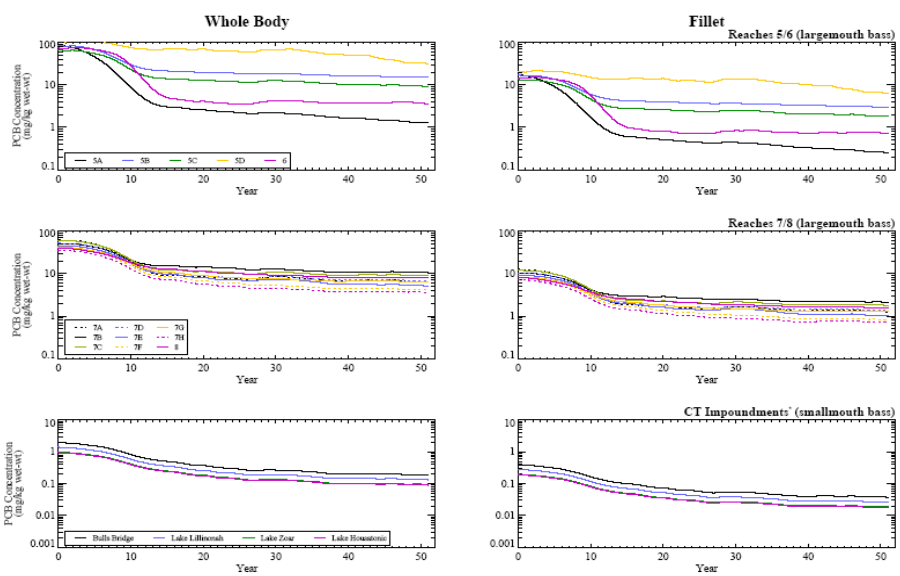

Figure 4-3c. Average PCB concentration in gamefish by subreach under SED 3.

Notes: Average calculated for fish ages 5 to 9 from days between Aug. 28th through Oct. 26th of each year
Fillet based concentrations were calculated as whole body concentrations divided by 5.0
** Results shown for CT impoundments are concentrations estimated by the CT 1-D Analysis.*

The figures above below are taken from the CMS. These figures show the rate at which PCBs decline in fish in the Housatonic over the course of the 60 years after the cleanup. The figure below indicates that the two unrealistic options will do little or nothing for cleanup. The option GE selected, SED 3, will result in fish tissue PCBs at levels above the health consumption advisory- in other words, GE has admitted that the Housatonic will forever be a catch and release fishery.

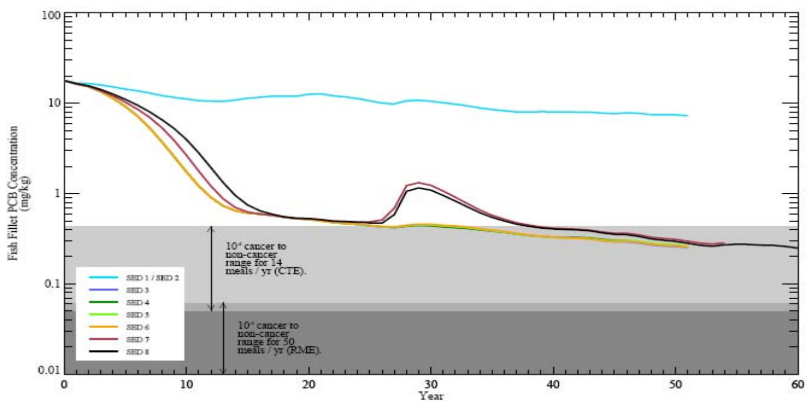

Figure 4-16a. Average fillet PCB concentrations in largemouth bass from Reach 5A

Notes: Average calculated for days from Aug. 28th through Oct. 26th of each year
Average calculated for fish ages 3 to 9.
Fillet based concentrations were calculated as whole body concentrations divided by 5.0.

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The cleanup will take a long time under any scenario, whether there is dredging, capping, or no action taken. Of course, if nothing is done (options 1 and 2) then PCBs will forever remain at concentrations unacceptably high for humans and wildlife.

The spatial analysis of contamination levels in and around the Housatonic River does not have enough resolution to result in an effective cleanup. Some of the spatial bins used in the evaluations were over a half mile in length. To achieve the proper level of resolution, GE needs to be able to estimate sediment and soil concentrations in 50m intervals. Doing so would actually save GE money by preventing the unnecessary dredging or capping of areas with little to no contamination while simultaneously ensuring that “hotspots” of high levels of PCBs are adequately addressed. GE has the means to effectively model contamination at this resolution and future versions of the CMS should include this level of modeling.

The alternatives selected by GE are unlikely to result in an effective cleanup. They will leave dangerous concentrations of PCBs both within the Housatonic River as well as in the floodplain that will continue to exert their toxic effects on wildlife and eventually humans. Monitored natural recovery is essentially the same as “no action,” and capping only isolates the contamination (which will not degrade significantly) until the cap’s eventual failure. Neither of these approaches have been documented to be effective over the long term (20+

years), and in the case of monitored natural recovery the evidence indicates that it is in fact not effective (see below).

The options selected by GE are not the only ones that EPA can and will consider. EPA can take different combinations of methods that GE did not put together in any of their options. Under such a case, EPA would have to tell GE to modify the CMS and do something that they have already chosen to not do or to reject. EPA said at the public meetings that there are 3 options: accept the CMS as is (and accept GE's selected options); make modifications to the CMS and send to GE; or take over the CMS from GE and then invoice them and let the lawyers and courts determine the costs and responsibility.

The first option is completely unacceptable because the CMS does not adequately address contamination and what little is done will take much longer to achieve than other alternatives. If the third option is selected, the cleanup could be delayed and hampered indefinitely as the legal battles play out slowly in court, and as a result we would prefer this option remain one of last resort. However, given GE's poor response to EPA's previous call for revisions, EPA should be prepared to move quickly to take over the cleanup if GE is unwilling to take responsibility and clean the river up to appropriate standards.

Review of Remedial Alternatives

Below is a summary of the various remedial options evaluated in the CMS either individually or in combination with one another throughout the river.

<u>Riverbed Remediation:</u>

<u>No Action (SED 1)</u>: This option would leave existing contaminated sediments in place with no monitoring or follow up actions. Contrary to GE's claims, this option presents tremendous risks to both human health and wildlife. Contamination will remain in place forever and continue to impact human and ecological health.

<u>Monitored Natural Recovery (MNR) (SED 2-8)</u>: This option is essentially the same as "No Action," except that GE and regulatory agencies would measure PCBs that will continue to impact human health and the environment. There is no evidence that PCBs break down or can be isolated from the environment using MNR (more detail below).

<u>Thin Layer Capping (SED 3-7)</u>: A thin layer of sediment to be placed over PCBs in the riverbed would not provide the protection needed to isolate PCBs in the long-term. Erosion and scour from significant rain events would quickly remove this thin layer and allow for the continuing PCB exposures. We are opposed to any remedy that utilizes this approach.

Capping (SED 4-7): Simply covering up the PCB problem in the Housatonic River is not acceptable. There is no evidence that this approach can work in the long-term. Even "armored" caps can fail under the stresses caused by major storms like noreasters and hurricanes. Under caps, PCBs will not degrade to any significant degree- ever. Therefore, any cap would have to maintain its integrity forever. There is no evidence that any cap design can achieve this. For a comparable cost, PCBs can be removed and treated to eliminate these risks permanently, and much better alternatives are available.

Dredging/Sediment Removal (SED 3-8): Physically removing contaminated sediments is a known method to reduce PCBs in fish and lower exposures. PCBs do not break down in any appreciable way naturally. Great care must be taken when dredging to make sure that contaminated sediments are not released into the water column and spread to other parts of the river. Once sediments have been removed, they are still contaminated and treating them is the best alternative for their disposal.

Rechannelization (limited unspecified areas): Altering the course of the river is not practical and is really just a more extreme version of capping. The PCBs that remain in the original riverbed can still be transported during major flood events, and will continue to contaminate the river. This approach could have a number of unintended consequences since it would affect the normal path of water drainage in the area. Altering the path of the Housatonic River is inadvisable at a time when the Army Corps of Engineers is actively working to undo channel alterations all over the United States because of these risks.

Floodplain Remedial Options

The following approaches are proposed either individually or in combination with each other at various points along the river.

Armor/Stone: Armoring the riverbanks changes the natural flow patterns of the river and would actually increase scouring on the river bottom. Natural runoff would also carry PCBs from the floodplain into the river, simply going around the armor in many places. The creation of these structures would not only be unsightly but also disrupt the natural flow of the river.

Access Restrictions: Restrictions only keep some residents, not all, out of contaminated areas. Wildlife will still be exposed and PCBs will remain in the soil where they will be transported into the river. It is the same as "No Action."

Activity and Use Restrictions: This option presents the same problems as "Access Restrictions," and again does not address the real problem that PCBs remain in the floodplain and continue to be transported into the river.

Conditional Solutions: This approach assumes that the properties will continue to be used in the same fashion in the future, placing a burden on communities in how they plan and develop their own land. These controls restrict how they will develop based on GE's desire to save money and not clean areas to standards, punishing communities for GE's actions.

Consumption Advisories: Advisories are another form of use restriction, and cannot be adequately enforced. Subsistence fishing is common in many areas, and advisories do not help the most vulnerable to the effects of PCBs. Since actual contamination is not addressed, advisories will remain indefinitely (see figures above).

Mechanical Extraction and Replacement: Removing contaminated soils is the next best option to treating them in place. Contrary to GE's claims, if done at a reasonable pace and combined with vegetation restoration there is no reason why this approach would not work. If undertaken, these efforts should be performed prior to any in-stream sediment removal to ensure that any contaminated runoff is captured and removed.

Covers: Plain soil covers will not contribute to the break down of PCBs, and will eventually wash away. Once this happens, the situation will be the same as if no action were ever taken since PCBs will not degrade under the cover.

Engineered Barriers: This solution has the same problem as regular covers, but could be potentially even worse. Erosion around the cover would eventually compromise it. Paved covers destroy valuable habitat and may still suffer the same fate as other forms of engineered covers.

Soil and Sediment Treatment Technologies:

Off-Site Disposal (TD 1): Landfills are not the best option for the disposal of PCB contaminated sediments, since the PCBs will remain active and toxic indefinitely. Considering the very limited landfill space available and public opposition to any new landfills, treatment is a far more preferable option.

Disposal in a Confined Disposal Facility (TD 2): Confined disposal facilities (CDFs) have a notoriously bad track record for containing contaminated materials, and still leave PCBs close to the water. This option contains many of the flaws of landfilling while adding even more risk by surrounding them by water and increasing the chances for leakage in comparison to landills.

Upland Disposal (TD 3): While preferable to disposal in a CDF, landfills do not eliminate harmful PCBs and risk spreading them during transport. Creating a landfill on-site to dispose of these soils and sediments has been soundly rejected by communities, environmental groups, and local officials. Even if this were a more preferable option to treatment (which it is not), it is completely infeasible due to its strong public opposition.

Chemical Extraction (TD 4): This method is by far the best option for treating dredged contaminated soils and sediments. It is the only option that actually destroys PCBs permanently and prevents the possibility of future exposures. Please refer to the General Comments section above for more information.

Thermal Desorption (TD 5): One of the main problems with this treatment is that the high temperatures required for the process create even more toxic dioxins out of the PCBs it is intended to treat. Dioxins are then released in the emissions of the facility and spread even more dangerous pollutants over a much broader area. If this approach can be implemented in a way that eliminates dioxin production, then it could be viable.

The Toxicity of Polychlorinated Biphenyls

The extreme toxicity and the effects of PCBs have been well documented by both the scientific community and regulatory agencies. However, GE continues to insist that these compounds have little to no toxicity. To quote:

> "GE believes, based on the weight of scientific evidence from human studies, that PCBs have not been shown to cause cancer in humans or adverse non-cancer effects in humans at environmental levels. Further, GE does not believe that the evidence reveals significant adverse effects of PCBs on the Rest of River ecosystem; indeed, field surveys by both EPA and GE contractors have demonstrated abundant, diverse, and thriving fish and wildlife populations and communities in the Rest of River area despite decades of exposure to PCBs."

GE's statements simply do not match with reality. GE has been incredibly reluctant to acknowledge these realities and is one reason why they were required to revise the original CMS. However, GE has not changed its position, and therefore a review of the toxicology of PCBs in both humans and wildlife is required.

PCB toxicity has been documented in a number of different wildlife species, and many of the species in the Housatonic watershed are particularly sensitive. The long term effects of PCBs on wildlife do not manifest themselves as steep population declines in most instances, so population levels measures such as abundance or diversity are not appropriate endpoints to measure or consider. The cumulative effects of stress have lead to sudden and sharp declines in animal populations after a certain threshold is crossed (deFur et al. 2007, supplemental material).

A reproducing population is not healthy if the individual members of the population are unhealthy, despite their reproductive capability. According to the Guidelines for Ecological Risk Assessment, EPA protects at the level of the population (EPA, 1998), not at the level of the individual. Carried to the extreme, this position will allow a population of animals to suffer any range of ill effects so long as enough animals reproduce and the next generations continue as before, regardless of the health of the individuals or the population age structure.

This problem of protecting the population and allowing the individuals within the population to remain or become unhealthy, poorly functioning, etc., is unacceptable. This issue is not new and is described in some detail by Van Veld and Nacci (2003) for several sites. One of the most well known sites that has this same problem is the Elizabeth River in Virginia that is contaminated with PAH's. Mummichog populations in the Elizabeth River are severely affected by the PAH contamination – all the fish in the population develop liver cancer and die, but not before reproducing. The result is a sustaining population of sick, cancerous fish. This outcome is **not** the sign of a healthy population or healthy ecosystem.

Nor is the Elizabeth River in Virginia the only case of such responses of individuals to persistent contamination by highly toxic contaminants, PCB's especially. The literature contains documentation of the responses of other species to chronic PCB exposure, with metabolic effects on liver function especially.

Chronic exposure to PCBs has been documented to adversely affect fish, particularly cold water species such as trout that can be found in the Housatonic River (Rice et al. 2003). Trout with PCB body burdens of as little as 0.33 mg/kg produce eggs with significantly higher rates of fry mortality and deformations (Eisler 1986). Adverse effects on the reproductive success of individuals such as these are of particular concern when evaluating population level risks and vulnerabilities (Newman 2008).

Reproductive and developmental problems in response to PCBs are well documented in a wide variety of species, including humans. Laboratory experiments birds have demonstrated reductions in hatching rates and decreases in survival rates of hatchlings after females were exposed to as little as 10 µg/kg in their food prior to egg laying (Britton and Huston 1973,). Low levels of PCBs in eggs (23 ng/g fresh weight) were found to cause beak deformations in the American Kestrel, considered a substitute for evaluating the bald eagle (Hoffman et al. 1996). Young mink fed 24 ng/g of PCBs in their diet developed jaw deformities within 31 to 69 days (Render et al. 2000). Mink reared from females exposed to 0.5 µg/g had higher rates of mortality and lower body weights than control animals (Restum et al. 1998).

Similar trends have been identified in humans their laboratory animal surrogates. EPA considers PCBs to be "probable human carcinogens" based on occupational studies and a wealth of data from laboratory experiments (EPA 1997). Children are particularly sensitive, and alterations in reproductive organs can be expected as a result of PCB exposure to this age group (ATSDR 2000). PCBs have also been linked to neurological problems (Schantz et al. 2003), reduced immune function (Selgrade 2007), and increases in cancer later in life (Martinez et al. 2005).

Contrary to GE's assertions, the weight of evidence in the scientific literature clearly points to significant PCB toxicity in both humans and wildlife. EPA has performed admirably in resisting GE's continuous claims of reduced toxicity, and should continue to do so in the future. GE clearly isn't interested in an objective examination of these topics. EPA has a responsibility to push back strongly against such assertions, if only to prevent wilder and more ridiculous claims from being raised by other potentially responsible parties across the nation.

Monitored Natural Recovery

GE has proposed the use of MNR over large stretches of contamination as a method for reducing risks to humans and wildlife from PCBs. MNR does essentially nothing to address these risks, and takes decades to achieve it. Despite GE's heavy reliance on this option in its final remedy, the CMS lacks any data that demonstrate its effectiveness over time.

MNR is based on the depositional nature of larger waterways. Over time, sediments from upstream are deposited in contaminated locations, theoretically isolating the pollutants on the stream or river bottom from the water column and wildlife over time (EPA 2005). Once isolated, the pollutants can then begin to degrade. Regulatory officials evaluate on a site specific basis the amount of time that it takes for the pollutants to break down depends on a number of variables such as sediment chemistry (% organic carbon, etc.), the constituents and concentrations of the chemical mixture in question, and temperature. Often, the timeframe selected is greater than 20 years. Currently, there are no sites where MNR is in use that have implemented the remedy for the requisite amount of time.

Mechanisms of the Breakdown of POPs

The breakdown of toxic compounds is generally defined as any transformation that reduces the toxicity of the pollutant. For most POPs (or persistent organic pollutants) such as PCBs and dioxins, this is accomplished through the removal of the chlorine atoms bound to the molecule that give them their toxicity. Unfortunately, this is much easier said than done and a whole industry has been created trying to create new and innovative ways to accomplish this reaction. To date, these efforts have been met with limited success.

POPs, as their name implies, are incredibly long-lived in the environment. They resist biological breakdown by bacteria and other microbes, and were often created and used because of their stability and lack of reactivity with other compounds. Many are also quite resistant to thermal breakdown, with some congeners of dioxins requiring temperatures in excess of 700°C (1,292°F) for decomposition (Rice et al 2003). When POPs enter aquatic systems such as streams and rivers, they become even more stable and difficult to break down.

The two most effective processes for the natural degradation of POPs like dioxins and PCBs are exposure to sunlight and decomposition by some anaerobic bacteria. Anaerobic (no oxygen) metabolism by microbes has been shown to have a limited ability to dechlorinate toxic POPs (Adriaens et al 1995, Ballerstedt et al 1997, Barkovskii and Adriaens 1996, Bedard et al 2007). Unfortunately, when the compounds are bound to sediments this ability is greatly reduced (Albrecht et al 1999).

Light does not have the opportunity to act on PCBs during MNR since the principle behind the approach requires that contaminated sediments be buried and isolated from the environment over time. However, when the sediments are isolated in this fashion it prevents sunlight from reaching and breaking down contaminants. Therefore, once POPs are bound to sediment and subsequently buried, they are effectively isolated from any natural processes that work to break them down.

The Interplay of Water and Sediments in Aquatic Systems

Even though POPs bind tightly with sediments and are not soluble in water, they are not completely immobile in aquatic systems even once they are buried beneath layers of sediment. Many aquatic environments, particularly streams and rivers, are quite dynamic. Conditions vary significantly over both temporal and spatial scales, and can have significant effects on sediments within the water body. These changes are critical in understanding the spatial distribution and concentrations of POPs within these systems.

Conditions change substantially the further one goes upstream in a river system. Large rivers are mostly depositional, murky with sediments that have runoff from its watershed. This turbidity acts to substantially limit the penetration of light into the river, and prevents submerged plant communities from becoming established. As one goes upstream, erosion becomes more significant than deposition (Paul and Meyer 2001). Flash flooding becomes more common because streambeds are smaller and have a reduced capacity to accept runoff. There are significant and regular interactions between the floodplain and the stream in these smaller systems. Scouring of the streambed is common in these streams, particularly in highly developed areas accepting large amounts of sediments. These low order streams are much more dynamic than large rivers, and conditions change constantly.

This is not to say that large rivers are static. Large flooding events can move significant amounts of sediment downstream and bring large debris into the river that can cause significant scouring of the riverbed. One flood in the Colorado River increased the stream bed by nearly five feet (Leopold 1962). In colder climates, ice can also disturb the bottom of even large rivers. In the lower Fox River in WI, ice scours as much as four feet deep have been recorded (WDNR 2006). The creation of frazil ice, or ice crystals that are formed within the water column in turbulent waters at very cold temperatures can also cause significant scouring of sediments.

Rivers and watersheds are the primary pathways of sediment transport in most areas. Events both large and small have the potential to disturb streambed sediments. Most of these events happen with enough frequency that it is not so much a matter of if but when they will occur.

Long-Term Effectiveness

There is little information on the long-term effectiveness of MNR. Preliminary data indicate that these techniques may not be as effective as predicted. One example is the James River in Richmond, VA. Illegal dumping of the pesticide Kepone contaminated the river and resulted in a ban on fishing in 1975. The pesticide is incredibly toxic and also stable in the environment in ways similar to PCBs and dioxins. The ban was replaced in 1988 with a fish consumption advisory which remains in place to this day. While the average concentration of Kepone in James River fish have declined to below FDA action levels, the pesticide is still regularly detected in fish tissue at levels high enough to warrant continuing the advisory. Tissue concentrations have remained approximately constant since the fishing ban was lifted in 1988 (VA DEQ Fish Data, 1988-2004). It can reasonably be concluded that over 30 years after the initial contamination, natural depositional processes have not isolated Kepone enough to prevent fish in the James River from being exposed to significant concentrations.

This should not be surprising given the extreme persistence in the environment of many of these compounds. The same processes that isolate contaminated sediments from aquatic organisms also serve to prevent or inhibit natural recovery mechanisms. Considering that many POPs have the potential to remain in sediment for over 100 years, it is almost a statistical certainty that a significant scouring event (such as a 100 year flood event) will occur during the timeframe required for MNR to run its course. These events redistribute the essentially undegraded POPs and make them readily accessible to aquatic organisms such as fish where they can enter and accumulate in the food chain. The long-term effectiveness of MNR is countered by many of the same natural processes that it wishes to exploit. In most cases MNR is not a desirable remedial option, particularly if the objective is to reduce fish tissue concentrations below levels that require consumption advisories.

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