UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II

DATE: March 25, 2005

SUBJECT: National Remedy Review Board Recommendations for the Lake Bottom Sub-Site of the Onondaga Lake Superfund Site

FROM: William J. McCabe, Acting Director
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EPA - Region 2

TO: JoAnn Griffith, Chair
National Remedy Review Board

I am writing in response to your memorandum, dated February 18, 2005, providing the advisory recommendations of the National Remedy Review Board (NRRB) in connection with its review of the proposed remedial action for the Lake Bottom sub-site of the Onondaga Lake Superfund site. Please note that the New York State Department of Environmental Conservation (NYSDEC) was consulted in the preparation of this response.

Let me first express both the Region's and the State's appreciation to the Board for its expedited review of the proposed remedy for the Lake Bottom site. Our specific responses to the Board's advisory recommendations are provided below. For convenience purposes, each recommendation is presented in the order identified in your memorandum followed by our response.

Recommendation # 1: The Board recognizes that the State and Honeywell are operating pursuant to a consent decree based on state law. The Board believes, however, that it would be helpful for the State's decision document to refer to specific provisions of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), as well as relevant EPA guidance, to more clearly demonstrate how the Proposed Plan was prepared consistent with the same. The Board also recognizes that Honeywell's comments suggest that while it prefers its own remedy, it does not appear to substantively object to the State's preferred remedy described in the Proposed Plan.

Response # 1: The State and Honeywell's predecessor, Allied-Signal, Inc., entered into an interim Consent Decree (Index No. 89-CV-815) whereby Honeywell, in part, agreed to perform a remedial investigation and feasibility study (RI/FS) for the Lake Bottom sub-site (this Consent Decree was entered by the U.S. District Court for the Northern District of New York on March 16, 1992). Among the goals of the RI/FS were the investigation of the nature, extent and effect of the contaminants in the lake, and the evaluation of remedial alternatives. The contaminants that were investigated included hazardous substances, such as mercury, chlorinated benzenes, and PCBs. The RI/FS also investigated less hazardous stressors, such as calcium and chloride. The preferred remedy described in NYSDEC's Proposed Plan (as well as the other action alternatives) included habitat enhancement, an improvement of habitat conditions in areas where hazardous substances do not occur at levels that warrant remediation, but where habitat impairment due to stressors has been

identified as a concern. The Record of Decision (ROD) will distinguish between "habitat re-establishment" (see Response #10, below), which is consistent with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 requirements, from "habitat enhancement," which is not. Any "habitat enhancement" actions performed at the site would be done so in conformance with the requirements of state law and not pursuant to the requirements of CERCLA.

The decision document will state that in selecting a remedy, NYSDEC considered the factors set out in CERCLA Section 121, 42 U.S.C. §9621, by conducting a detailed analysis of the viable remedial alternatives pursuant to the NCP, 40 CFR §300.430(e)(9), OSWER Directive 9355.3-01 (Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA: Interim Final, October 1988), and OSWER Directive 9200.1-23.P (A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents, July 1999). In addition, the decision document will state that community/public participation activities were conducted in accordance with CERCLA §117 and the NCP 40 CFR §300.430(f)(3).

Recommendation # 2: The Board notes that the package presented to the Board did not quantify the human health and ecological risk reduction likely to be achieved for the various remedial alternatives. While remedy costs for various alternatives were presented, the benefits obtained by the different alternatives were not clearly described in the package presented to the Board. For example, it is unclear what additional benefits are afforded by dredging increasing volumes of sediment in Alternatives 2 through 5. The Board recommends that the decision document clarify how the preferred alternative best meets the remedial action objectives for the site.

Response # 2: While the components of Alternatives 2 through 5 are identical in sediment management units (SMUs) 3, 4, 5, 6 and 8, they differ with respect to both the remediation of the In-Lake Waste Deposit (ILWD) in SMUs 1, 2 and 7, and the chlorobenzene non-aqueous phase liquids (NAPLs) present in SMU 2. The removal of portions of the ILWD prior to isolation capping has the potential to greatly reduce the mass of chemical parameters of interest (CPOIs) in SMU 1, and portions of SMUs 2 and 7, leaving behind significantly lower volumes and masses of wastes (and residual NAPLs) and significantly lower concentrations of many of the CPOIs beneath the cap. This will improve the effectiveness of the cap in isolating contaminants beneath the cap. The occurrence of "slumps" or slope failures within the ILWD, as was noted during side-scan sonar imaging of the lake bottom, as well as the generally soft nature of the wastes/sediments (resulting in very low shear strengths in certain areas) represent a significant engineering concern associated with capping in this area. Thus, dredging to improve slope stability of the ILWD and to improve overall geotechnical conditions for cap placement are also important considerations for SMU 1 and portions of SMUs 2 and 7.

In SMU 2, NAPLs have been observed in the sediments (up to a depth of 13 ft [4 m]) although the full extent is unknown. Based on the vertical extent of NAPLs in the NAPL recovery Interim Remedial Measure (IRM) area (which is immediately adjacent to Onondaga Lake), the possibility exists that the NAPLs in SMU 2 are as deep as 30 ft (9 m) below the top of the sediments. With regard to NAPLs in SMU 2, Alternatives 2 and 3 include partial NAPL removal (to a depth of 4

m), while Alternatives 4 and 5 include full NAPL removal (to a depth of 9 m) in SMU 2.

The State and the Region believe that the additional dredging afforded by Alternative 4 relative to Alternatives 2 and 3 is warranted because Alternative 4 involves more removal of contaminated sediments and NAPL, which corresponds to a greater degree of cap effectiveness, and long-term reliability and permanence of the overall remedy for the lake and a reduced possibility of remedy failure. CERCLA Section 121 paragraph (b)(1) states "the President shall, at a minimum, take into account:(F) the potential for future remedial action costs if the alternative remedial action in question were to fail." All of the alternatives which employ capping in a given area would be protective to the extent that the cap functions properly. If the cap fails via contaminant breakthrough and/or a catastrophic event (e.g., slope failure), it would need to be repaired and sediments contaminated by the release would need to be remediated (e.g., removed, capped in place). In the event of a failure, the impacts would be expected to be greatest under those alternatives that involve capping of the greatest mass/highest concentrations of contaminants. Accordingly, Alternative 4 provides more protection than Alternatives 2 and 3. It should also be noted that the ILWD is in an area of the lake that is likely to be subjected to high erosive forces from wave action, ice scour, anchor drag, etc., and much of the additional dredging would be in areas near creek mouths and along an exposed shoreline where flow from the creeks can be extreme in flood conditions, or where wave action can build up along this portion of the lake. In addition, some of the additional waste materials which would be removed from the lake under Alternative 4, but would remain under an isolation cap under Alternatives 2 and 3, have been characterized as principal threat wastes including large quantities of highly-contaminated waste material and NAPLs. The implementation of any of these alternatives would include the off-site treatment of all NAPLs that were segregated during the dredging/handling process. The treatment of NAPLs at an off-site facility is a critical component of the alternatives that meets EPA's treatment preference. The larger the volume of NAPLs that are removed from the lake and sent for off-site treatment, the more an alternative satisfies this preference for treatment. Thus, Alternative 4 would satisfy the NCP's preference for treatment of principal threat waste to a greater degree than would Alternatives 2 and 3. While Alternative 5 would remove more contaminated materials from the ILWD than Alternative 4, cap reliability would not increase commensurate with the increased $86 million in estimated present-worth cost over Alternative 4 since Alternative 5 would involve the capping of sediments with contaminant concentrations similar to those for Alternative 4. This will be discussed further in the Record of Decision.

The human health and ecological risk reductions associated with various remedial alternatives were presented in the FS report. Table I.26 (attached) shows the estimated residual surface-weighted average concentrations (SWACs) for mercury and polychlorinated biphenyls (PCBs) in sediment for the various remedial alternatives evaluated in the FS. Table I.28 (attached) shows the estimated percent reductions and the estimated residual tissue concentrations for prey fish and sport fish prior to and following remediation. Table I.28 shows that under the no-action alternative on both a littoral and lake-wide basis, the estimated concentrations of mercury and PCBs would exceed the upper end of the target tissue concentration range for sport fish, and that

the estimated concentrations of mercury would exceed the upper end of the target concentration range for prey fish greater than 18 cm in length. Following implementation of Alternative 4 (see values under column F1 - H), the estimated concentrations of mercury and PCBs in fish would be at or below the upper end of the target tissue concentration range for all fish on both a littoral and lake-wide basis. While the residual risks for Alternatives 2 through 5 (which are equivalent to the residual risks presented in the tables for FS Alternatives F1 through H) are shown to be equal, it should be understood that Honeywell's analysis assumed that these alternatives would be equally successful in achieving RAO 2 (to eliminate or reduce releases of contaminants from the ILWD and other littoral areas around the lake). However, as is discussed above, the preferred alternative (Alternative 4) would employ more reliable capping in the ILWD and more removal of NAPL in SMU 2 and thus would be better able to meet the RAOs for the site than would Alternatives 2 and 3, and would be more cost-effective than Alternative 5.

Recommendation # 3: The package presented to the Board and the Proposed Plan had limited discussion on the current and future uses of the lake. Further, the Onondaga Nation indicated during its presentation that people traditionally relied upon fish as an integral part of their diet and anecdotal information indicates that people may continue to consume fish from the lake in spite of the current fish consumption advisory. (The advisory recommends that no more than one meal per month be eaten and that walleye not be eaten at all. The advisory also recommends that infants, children under the age of 15 years, and women of childbearing age eat no fish from the lake.) The Board suggests that the decision document provide additional information regarding the current uses of the lake, to include any site-specific information related to fish consumption to better explain the importance of taking an action. In addition, this information could be used to improve, if necessary, the effectiveness of fish consumption advisories and other institutional controls.

Response # 3: The discussion of current uses of the lake is limited due to the fact that the current usage pattern is constrained both by the advisories and the pollution of the lake. Therefore, the current usage does not reflect potential future uses of the lake in the absence of such constraints. Historically (up to the early 1900s), Onondaga Lake was a tourist destination and a prime fishing location. With the county park surrounding much of the northern part of the lake, there is a strong potential for increased future recreational uses once the pollution-related constraints are removed. Also, various community groups have indicated support for increased recreational use of Onondaga Lake. Currently, there is a canoe launch on lower Ninemile Creek near the lake and a marina and yacht club on the northern shore of the lake in Liverpool. Direct and indirect contact recreation is likely to increase substantially after the cleanup of the lake is completed.

While there is no site-specific information on fish consumption rates in Onondaga Lake or on the degree to which the fish consumption advisory is effective, the literature (Connelly et al., 1992 and New York State Department of Health [NYSDOH], 1999; as cited in *Human Health Risk Assessment [HHRA] for the Hudson River PCBs Site*, TAMS and Gradient, 2000) indicates that advisories are less than 100 percent effective, with a relatively wide range of data on awareness of the advisories (about 67 to 95 percent). In all surveys, a large percentage of individuals (32 to

nearly 50 percent, based on Connelly et al., 1996 and Connelly et al., 1992, respectively; as cited in TAMS and Gradient, 2000) indicated that they would consume the fish they caught in the absence of advisories. The Onondaga Lake HHRA used EPA default values for fish consumption (25 grams per day for the reasonable maximum exposure [RME] scenario). In addition, the HHRA also qualitatively evaluated subsistence level fish consumption using an ingestion rate of 170 grams per day. Both ingestion rates assume that the NYSDOH fish consumption advisory is not in place or is not adhered to (see Section 4.3.1 of the Onondaga Lake HHRA).

Thus, based on the literature, which indicates that advisories are not completely effective, and anecdotal observations of people taking large numbers of fish home with them, it is likely that there are people who are consuming fish from Onondaga Lake in excess of NYSDOH's recommended amounts. Based on historical accounts and the potential for increased use, it is anticipated that consumption of fish will increase greatly if the contamination in the lake and fish is significantly reduced. Because of these considerations, one of the preliminary remediation goals (PRGs) contained in the FS and the Proposed Plan is to achieve concentrations of bioaccumulative contaminants in fish that are protective for the general population. As noted in the Proposed Plan, the human health methylmercury target PRG fish tissue concentrations (based on the Onondaga Lake HHRA) are 0.2 milligrams per kilogram (mg/kg) wet weight for the reasonable maximum exposure scenario and 0.6 mg/kg wet weight for the central tendency scenario. The 0.2 mg/kg wet weight target is roughly equal to the mean fish tissue background concentration of mercury in US lakes. The EPA methylmercury National Recommended Water Quality criterion for the protection of human health of 0.3 mg/kg in fish tissue, which falls between the two site-specific values (0.2 and 0.6 mg/kg), is also considered to be a human health fish tissue PRG.

It should be noted that the differences between the three fish tissue values referenced above are due to differences in the assumed fish consumption rates. The RME fish consumption rate of 25 grams per day used in the Onondaga Lake Bottom HHRA is higher than the consumption rate used in the Federal Ambient Water Quality criterion (17.5 grams per day), while the CT fish consumption rate of 8 grams per day used in the Onondaga Lake Bottom HHRA is lower than this value. The RME and CT fish consumption rates used in the Onondaga Lake HHRA were derived by EPA from the fish consumption rates identified in surveys of anglers from bodies of water similar to Onondaga Lake and are EPA's recommended default values for recreational freshwater anglers.

References for the Response to Recommendation #3:

TAMS Consultants, Inc. (TAMS)/EPA, 2000. Human Health Risk Assessment for the Hudson River PCBs Site. Prepared by TAMS and Gradient for EPA and US Army Corps of Engineers. TAMS Consultants, Inc., Bloomfield, New Jersey.

TAMS, 2002. Onondaga Lake Human Health Risk Assessment Report. Original document

prepared by Exponent, Bellevue, Washington, for Honeywell, East Syracuse, New York. Revision prepared by TAMS, New York, New York and YEC, Valley Cottage, New York, for New York State Department of Environmental Conservation, Albany, New York.

Recommendation # 4*:* EPA has established a set of sediment management principles regarding the cleanup of contaminated sediment sites (OSWER Directive 9285.6-08:*Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites,* February 12, 2002). One of these principles discusses the need to coordinate with state and local governments and Tribes. At the meeting, the Onondaga Nation expressed concern related to the lack of coordination with it regarding the proposed remedy and the timing of the public comment period. The Board encourages an open dialogue among all parties. In addition, the Board recommends that, if requested, the State consider extending the public comment period to allow time for additional dialogue with the Nation and other parties, including time for consideration of the Board's comments and the State's response to these comments.

Response # 4*:* The State has reviewed the Onondaga Nation's written comments which were submitted to the NRRB. They will be incorporated into the Administrative Record for the site and will be addressed in the Responsiveness Summary. Furthermore, with the belief that an open dialogue will best serve all interested parties, the State has worked diligently to consider the wide variety of comments received and has performed an extensive outreach program relative to the Proposed Plan. In this regard, the State initially provided for a three-month public comment period, which is three times that typically provided under either the State or federal Superfund program. Additionally, the State conducted three public availability sessions and two public meetings. The State also met with local stakeholders to discuss the Proposed Plan, including the Onondaga Nation (five meetings), Onondaga County Legislature's Environmental Committee, Onondaga County's Department of the Environment, Onondaga Lake Partnership (which consists of federal, state, local, public, and private interests that are involved in managing the environmental issues of Onondaga Lake and the Onondaga Lake watershed), Atlantic State's Legal Foundation (Technical Assistance Grant recipient), various local scientists associated with Upstate Freshwater Institute, professors from the State University of New York Syracuse College of Environmental Science and Forestry, and officials and residents of the Town of Camillus (the town in which a sediment consolidation area may be constructed). The State also met with environmental organizations, including the Sierra Club, Citizens Campaign for the Environment, and the Central New York Air and Waste Management Association.

The Onondaga Nation has requested an extension of time to submit comments on the proposed plan and to consult with EPA and the State concerning the proposed remedy. The request from the Nation was the only request that was received for an extension of time for submission of comments. The State has indicated that it will petition the Court for an extension of the Court-ordered schedule for a final decision on remedy selection. If approved by the Court, a new comment period will be opened for a period of 30 days from the date of publication of a newspaper notification that the Board's comments and these responses to the Board's comments

by EPA Region 2 and the State are available in the administrative record repositories for review by the public. In addition, EPA Region 2 and the State have had four meetings with the Onondaga Nation since the Board meeting concerning the proposed plan and intend to continue discussions with the Nation throughout the remedy selection and implementation phases of the project.

Recommendation # 5*:* The Board commends the State for utilizing a variety of measures of ecological risk (*e.g.*, effects range - low (ER-L), effects range - median (ER-M), etc.). However, the Board notes that EPA ecological risk assessment guidance (OSWER Directive 9285.7-25: *Process for Designing and Conducting Ecological Risk Assessments,* June1997) and EPA's draft sediment guidance (OSWER Directive 9355.0-85: *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, January 2005) recommend that a range of numerical remediation goals be developed and refined using the NCP remedy selection criteria to provide the basis for selecting final sediment cleanup levels. The Board encourages the State to explain further how the remediation goals developed for the site, either as currently expressed in the Proposed Plan or as they may be modified for the ROD, are appropriate and consistent with the NCP and EPA guidance.

Response # 5*:* As discussed in the Proposed Plan, NYSDEC developed five site-specific sediment effects concentrations (SECs) (the ER-L, threshold effect level [TEL], ER-M, probable effect level [PEL], and apparent effect threshold [AET]) and a consensus-based probable effect concentration (PEC) to assist in evaluating sediment quality in Onondaga Lake. From a narrative standpoint, the various SECs present three different thresholds for predicting the presence of toxic effects. The ER-L and TEL represent concentrations below which toxic effects are predicted to rarely occur. The ER-M and PEL represent concentrations above which toxic effects are predicted to frequently (but not always) occur. The AET represents a threshold above which toxic effects are predicted to always occur. For mercury, the following SEC values were calculated: 0.51 mg/kg for the ER-L; 0.99 mg/kg for the TEL; 2.8 mg/kg for the ER-M; 2.84 mg/kg for the PEL; and 13 mg/kg for the AET. The PEC, which was determined by calculating the geometric mean of the five SECs, is a single value for each CPOI which represents a midrange of risk. For mercury, the PEC was calculated at 2.2 mg/kg. Three of the SECs were determined to be representative of the entire range of SECs to be used to evaluate areas and volumes of impacted sediment to be considered for remediation: the ER-L, PEC, and AET. These criteria, along with criteria based on the mean PEC quotient (PECQ) approach, were used in developing SMU-specific remedial alternatives. For many SMUs, the amount of remediation (e.g., area of capping) was the same since the entire area exceeded all of the SECs.

Five of the six action alternatives in the Proposed Plan (Alternatives 2 through 6) were developed based on exceedances of the mean PECQ of 1 or exceedances of the mercury PEC in order to ensure that potential risks posed to benthic invertebrates presented by mercury were also addressed. One alternative (Alternative 7) was based on exceedances of the individual ER-L values for the 23 CPOIs. While, as the Board recommended, additional remedial alternatives based on the mean PECQ of 1 and the mercury SECs could be included in the ROD, the State

and the Region believe that these alternatives would either be similar to alternatives already included in the Proposed Plan or would not meet the threshold criterion of overall protectiveness of human health and the environment. Specifically, alternatives based on the mean PECQ of 1 and the mercury ER-L or mercury TEL would be similar to Alternative 7 in the Proposed Plan, since most of the lake exceeds these criteria for mercury. Alternatives based on the mean PECQ of 1 and the mercury ER-M or mercury PEL would be similar to Alternatives 2 through 6, which are based on exceedances of the mean PECQ of 1 and the mercury PEC, since the ER-M, PEL and PEC for mercury are within a very narrow range (2.2 to 2.84 mg/kg).

Alternatives based on the mean PECQ of 1 and the mercury AET, which is 13 mg/kg, or use of the individual AETs for the 23 CPOIs instead of the mean PECQ approach, were not included in the FS report or the Proposed Plan because remediation based on the AET was not considered to be protective of benthic macroinvertebrates (i.e., this represents a concentration at which adverse effects are always expected to occur), or wildlife and humans which consume fish from the lake (e.g., the AET for mercury is approximately 16 times greater than the bioaccumulation-based sediment quality value [BSQV] of 0.8 mg/kg). Since the mean PECQ integrates the toxic effects of multiple contaminants, this methodology provides a better representation of the risks posed by contamination in the lake than using multiple individual SECs.

Consequently, the State and the Region believe that the range of sediment cleanup levels and alternatives provided in the Proposed Plan is appropriate and consistent with the NCP and EPA's ecological risk assessment guidance (OSWER Directive 9285.7-25: *Process for Designing and Conducting Ecological Risk Assessments,* June 1997) and EPA's draft sediment guidance (OSWER Directive 9355.0-85: *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, January 2005).

Recommendation # 6*:* The list of alternatives for consideration in the Proposed Plan includes limited variations of capping, dredging, and monitored natural recovery. It was not clear what basis was used to screen out alternatives that could isolate waste in place, such as the relocation of a barrier wall outside the boundary of the ILWD. The Board recommends that the State explain in the Administrative Record why this alternative was screened out. In addition, only alternatives based on ER-Ls, or the mercury PEC and a mean PECQ of "1" were considered in the Proposed Plan. From the package presented to the Board, it was unclear why the State considered alternatives based on the mercury PEC and a mean PECQ of "2" to be unprotective. The Board recommends that the State either explain its decision more fully in the Administrative Record or expand the range of remediation goals which are evaluated for the site.

Response # 6*: Concerns Associated with the Construction of a Barrier Wall Around the ILWD*

The construction of a barrier wall around the ILWD followed by capping was not carried forward in the development of alternatives for the site because of regulatory issues regarding filling in a portion of Onondaga Lake and construction issues.

Regulatory Concerns Associated with the Construction of a Barrier Wall Around the ILWD

Any remedy incorporating dredging or placement of fill in protected streams or navigable waters in New York State must meet the substantive technical requirements of Environmental Conservation Law Article 15 Water Resources Title 5 Protection of Water. The applicable standards are found at 6 NYCRR Part 608.8 and require that the proposal: a) is reasonable and necessary; b) will not endanger the health, safety or welfare of the people of the State; and c) will not cause unreasonable, uncontrolled or unnecessary damage to the natural resources of the State. This applicable, or relevant and appropriate requirement (ARAR) protects the waters of the State from unreasonable or unnecessary impact from dredge and fill activities. A barrier wall would result in the loss of at least 84 acres of littoral habitat, impact navigational uses, and decrease the natural resource value of the lake. This damage would not be warranted as there are other options available (as were evaluated in the FS and the Proposed Plan) for remediating the ILWD portion of Onondaga Lake that would meet the requirements of 6 NYCRR Part 608 and not result in unreasonable and unnecessary damage.

Construction Concerns Associated with the Construction of a Barrier Wall Around the ILWD

The ILWD covers about 84 acres of the lake bottom with water depths ranging from under 1 foot to over 30 feet. The quantity of materials needed to fill this area to above flood level would likely be in excess of two million cubic yards. The in-lake barrier wall would be greater than several thousand feet in length and would need to be constructed in a manner where it would be strong enough that it could support the ILWD and the fill materials, and be able to withstand wind, wave and ice erosive forces. Accordingly, a cofferdam-type barrier wall might be required, which would involve the placement of a large quantity of additional materials. Therefore, it is likely that the construction of a barrier wall around the ILWD and the subsequent filling of this area would require the placement of a larger quantity of materials than the total quantity of capping materials that would be required by Alternative 4 for all of the SMUs combined.

Justification for Use of a Mean PEC Quotient of 1 in NYSDEC's Proposed Plan

One of the RAOs identified in the Onondaga Lake RI report is to eliminate or reduce existing and potential future adverse effects on fish and wildlife resources. To address this RAO, areas of sediment were selected for inclusion in the remedial alternatives based on various site-specific criteria as part of the Onondaga Lake FS.

The mean PECQ approach was proposed by Honeywell as one of the criteria to use for determining remedial areas. The mean PECQ is a single unitless index that has the potential to account for both the presence and concentrations of multiple contaminants in sediment samples. NYSDEC evaluated the mean PECQ approach to determine whether it could be applied to Onondaga Lake.

The relationship between the mean PECQ values and the toxicity data from 1992 was not

particularly strong (see Slides 1 and 2, attached). This is due in part to the high degree of variability in the occurrence of toxicity in Onondaga Lake sediments, which may be related to the wide range of concentrations of the CPOIs in any given sediment sample. Such problems are inherent in any large scale sediment study, and are exacerbated in Onondaga Lake because of the extensive perturbation of the lake ecosystem that occurred over an extended period of time.

There were three main reasons for selecting the mean PECQ of 1 as the basis for remediating Onondaga Lake sediments:

- First, a mean PECQ value of 1 can be considered an "average" hazard quotient. The concept of the hazard quotient is based on the inference that if the concentration of a CPOI is less than or equal to its corresponding toxicity threshold (e.g., the PEC for that CPOI), then toxicity would not be anticipated to occur. The mean PECQ is the "average" hazard quotient for the number of CPOIs detected in the sediments. Discounting additive toxicity, a mean PECQ of 1 signifies that on average, none of the CPOIs are present in concentrations that exceed their corresponding PEC, and that acute toxicity is not likely to occur.

- Second, the mean PECQs were derived using only acute toxicity data for a single species[1] which is a relatively insensitive species. They do not take into account the potential for chronic toxicity impacts, or variations in sensitivity by other benthic species. Given the lack of chronic toxicity data, the selection of a remediation value higher than a mean PECQ of 1 cannot be justified.

- Third, a review of all of the sediment toxicity data collected in 1992 (see Slides 1 and 2) and 2000 (see Slides 3, 4 and 5, attached) shows that the areas of the lake that exceed the mean PECQ of 1 and a mercury PEC of 2.2 mg/kg generally coincide well with the areas of the lake where acute toxicity to the benthic macroinvertebrates was shown to occur.

For these reasons, the mean PECQ of 1 was used along with exceedances of the mercury PEC of 2.2 mg/kg in five of the seven alternatives in the Proposed Plan, including NYSDEC's preferred alternative.

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[1] Two species were used for toxicity testing done in 1992, *Chironomus tentans* and *Hyalella azteca*, using both mortality and growth as test effects. Since *C. tentans* mortality was the most sensitive effect, only those test results were used to derive mean PECQs. Forty-two day toxicity tests were conducted in 2000, also using *Chironomus tentans* and *Hyalella azteca*, but including the more sensitive endpoint of chironomid emergence. Too few studies, however, were conducted in 2000 to be integrated into (or otherwise used in) the derivation of mean PECQs. Those tests do add qualitative credibility to the usefulness of the mean PECQ of 1.

There was no apparent statistical basis for the use of a mean PECQ of 2 for defining areas for remediation. There was no clear inflection point at a mean PECQ of 2 and the use of the PECQ of 2 was not supported by the toxicity data. Alternatives based on the mean PECQ of 2 were included in Honeywell's FS but were not carried into the Proposed Plan since they were determined by NYSDEC not to be protective.

Relative Costs between Mean PECQ of 1 and 2

To assess the difference in cost that results from the use of a mean PECQ of 1 over the use of a mean PECQ of 2, lake-wide alternative (LWA) D2 (based on a mean PECQ of 2) was added to the FS (see Table 5.1 of the FS for details) at the request of NYSDEC to be identical to LWA F1 (based on a mean PECQ of 1). All components of these two alternatives are identical with the exception of the cleanup criterion. Thus, the difference between the cost for LWA F1 of $312 million and the cost for LWA D2 of $294 million represents an added cost of $18 million for using the more protective criterion.

This cost difference is based on the increase in areas that would be included for capping and removal in SMUs 5, 6 and 8. There would be an additional 24 acres of isolation capping and 16,000 cubic yards (cy) of removal in SMU 5, an additional 29 acres of isolation capping and 11,000 cy of removal in SMU 6, and an additional 134 acres of thin-layer capping in SMU 8 for a total increase of 187 acres of capping and 27,000 cy of removal using a mean PECQ of 1 instead of a mean PECQ of 2 (see Table 5.2 of the FS for details).

If Alternative 4 in NYSDEC's Proposed Plan were modified to be based on a mean PECQ of 2 instead of a mean PECQ of 1, the cost would be approximately $433 million ($451 million – $18 million). The added cost for using the more protective criterion is roughly 4 percent of the total estimated cost for the preferred alternative.

Summary

The mean PECQ of 1 was selected by NYSDEC as a basis for defining areas for remediation in the preferred remedy to account for uncertainties inherent in the toxicity data including statistical uncertainty, use of only acute toxicity data, and the use of a relatively insensitive species in the toxicity testing. The cost of using a mean PECQ of 1 over a mean PECQ of 2 increases the cost of the remedy by approximately $18 million.

Recommendation # 7*:* Under CERCLA 121(d)(2)(A), the Federal Ambient Water Quality Criteria would be a relevant and appropriate requirement. In January 2001, EPA released a methylmercury National Recommended Water Quality criterion for the protection of human health for the consumption of organisms. This criterion is 0.3 mg/kg as measured in fish tissue, based on a fish consumption rate of 0.0175 kg/day. The Board recommends that the State add this EPA value to its decision document as support for its fish tissue preliminary remediation goal (PRG) or describe why it would not be an applicable, or relevant and appropriate

requirement. Similarly, the decision document and Administrative Record should include evaluations of the requirements related to Clean Water Act Section 404(b)(1) and Section 10 of the Rivers and Harbors Appropriation Act of 1899.

Response # 7: As recommended by the Board, EPA's methylmercury National Recommended Water Quality criterion for the protection of human health for the consumption of organisms of 0.3 mg/kg in fish tissue will be added to support a site-specific methylmercury recommended fish tissue number or range in the ROD.

A discussion of the Clean Water Act Section 404(b)(1) and Section 10 of the Rivers and Harbors Appropriation Act of 1899 will be included in the ROD. Since a discussion of the substantive requirements of both the dredge and fill permit program under Section 404 and the Section 10 permit program are included in Appendix C of the FS report, the Region and the State believe that no further documentation need be placed in the Administrative Record.

The requirements of Clean Water Act Section 404(b)(1) are found at 40 CFR 230, Subparts C through H. A complete assessment of the Onondaga Lake Bottom remedial action in relation to the technical requirements of 40 CFR 230 (Subparts C through H) will be prepared during the project's design stage. At that time, detailed information will be available relevant to the type of dredging equipment that will be employed, the characteristics of capping materials, the method for placement of cap material, and other project elements.

The substantive requirements of Section 10 of the Rivers and Harbors Act will be addressed with U.S. Army Corps of Engineers during the project's design phase.

Recommendation # 8: The detailed cost estimates provided to the Board were essentially from Appendix F of the FS reports. The Appendix included several assumptions which were used to base the alternative cost estimates. In these assumptions, it is stated that the Sediment Consolidation Area (SCA) cap would include approximately 4.5 feet of soil material and a geosynthetic liner, etc. for a total thickness of nearly five feet. As this is thicker than is typically used at other sites, the Board recommends that the State consider whether the use of a thinner cap would meet site requirements and reduce costs. Additionally, page F 2-19 of the Appendix states that several oversight and management costs were used that are not consistent with EPA cost guidance. Most of these percentages are lower than EPA's guidance (*A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, OSWER 9355.0-75, July 2000) and, therefore, may underestimate the estimated cost. The Board recommends that the Administrative Record include a more clear justification for these cost estimates.

Response # 8: The SCA cap conceptual design (e.g., 4.5 feet of soil material and a geosynthetic liner) was used to estimate costs of the various alternatives in the FS report. During the remedial design, the State will identify the specifics (e.g., types and thicknesses of cap components) necessary to ensure that the cap meets site requirements and is protective of public health and the environment. Based on cost data from the FS, a thinner cap (e.g., 3-ft thick) would likely reduce

the overall cost by greater than $1 million (for materials), as well as savings in labor costs.

While the EPA cost guidance document was used in developing the majority of the costs for the FS, the percentages for professional/technical services (Project Management, Remedial Design, and Construction Management) were modified from the percentages stated in Exhibit 5-8 of the cost guidance, since it does not provide percentages for projects estimated to cost greater than $100 million. The guidance recognizes that as the total cost of the project increases, the percentage of the total project cost for engineering services decreases. This is why the percentage for professional/ technical services in the guidance decreases from 10 to 20 percent of capital costs for projects less than $100,000 to 5 to 6 percent for projects more than $10 million. The FS report followed this trend and used a lower percentage for professional/technical services for those alternatives estimated to cost more than $100 million. More specifically, a 2 to 4 percent value was employed in the FS report, depending on the total capital costs of the alternative being developed. The intent of employing these values was to avoid the potential overestimation of project costs.

An example of why this approach was used can be seen in reviewing the total costs for the SCA design in the different alternatives. While the basic design of the SCA would remain the same (and, therefore, the level of the engineering effort for the SCA design would not vary much between alternatives), the cost estimate for professional/technical services based on a constant percentage of total capital costs would increase dramatically due to the cost of the additional building materials (but not additional engineering services) needed to construct the larger SCAs.

Recommendation # 9: The Board recommends that the State develop and implement a monitoring program for sediment, water, and biota as soon as practicable after remedial goals are finalized. The monitoring should be designed to serve as the baseline against which remedy performance can be measured. It also should include indicator parameters to provide near-term evidence that the system is responding to remedial activities as expected. For example, advective flux measured before and after installation of shoreline hydraulic controls will verify that the advection estimate used in cap design is correct. Additionally, the Board understands that a quantitative model for mercury cycles in the lake was not developed during the RI/FS process, in part due to uncertainties associated with the predictive precision of such a model. As additional data are acquired through a monitoring program, it may be possible to develop or refine fate and transport models for the site to optimize the remedial design as implementation proceeds.

Response # 9: The development and implementation of a monitoring program for various site media (e.g., sediment, water, and biota) will begin as soon as practicable following the issuance of the ROD. The monitoring will be designed to serve as the baseline against which remedy performance can be measured. The development of the monitoring program will consider the possible inclusion of indicator parameters (e.g., advective flux) which could be employed to provide evidence that the system is responding to remedial activities as expected. As additional data are acquired, the State will consider whether it is appropriate to develop or refine fate and transport models for the site. If such models are developed or refined, they will be used, as

appropriate, to optimize the remedial design as implementation proceeds.

Recommendation # 10: Page 40 of the package presented to the Board defines habitat optimization as having desired characteristics to meet a particular natural resource goal. However, during the presentation, the State clarified the definition and indicated that the habitat components of the remedies presented in Table 5.1, Lake-wide Alternatives, "reestablish" a viable habitat in areas that will be rededicated. The Board recommends that this be clarified in the Administrative Record and that the term "reestablish" be used.
Response # 10: The ROD will utilize the term "re-establish." The terms "habitat re-establishment" and "habitat optimization," which will be clarified in the Administrative Record, are explained below:

Habitat re-establishment is the restoration of habitats in areas where remediation substantially alters existing conditions. Re-establishment can be either restoring the same type of habitat that existed prior to remediation or establishing a different type of habitat that has been deemed appropriate for the ecological conditions of the area.

Habitat optimization is a type of habitat re-establishment, which is defined as re-establishing habitat with desired characteristics to meet a particular natural resource goal for a particular area of the lake in combination with designing the dredging/capping aspect of remediation.

The details of the re-establishment in the various areas of the lake will be developed during remedial design, based upon a comprehensive lake-wide habitat restoration plan.

Recommendation # 11: OSWER Directive 9285.6-08:*Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites,* February 12, 2002, recommends that remedial action objectives (RAOs) and preliminary remediation goals (PRGs) be clearly tied to risk management goals. The Board recommends that the State revise or clarify the RAOs and PRGs in the decision document to more clearly communicate the objectives of the cleanup and how meeting the PRGs will help the cleanup attain the RAOs. In particular, the State should ensure that the goals are risk-based (see Principles 7 and 8) and that the cleanup levels are clearly tied to risk management goals (Principle 7). For example, the RAOs could discuss the level of risk reduction that will be accomplished by the cleanup or what risk will remain at the end of the cleanup (*i.e.*, residual risk). Another example of an RAO could be to what degree the fishing advisory is expected to be relaxed as a result of the cleanup. Once the RAOs are more clearly defined, the State should clearly show how the PRGs will help attain the RAOs. The decision document should also discuss the uncertainties involved in deriving the PRGs and how they may relate to uncertainties in achieving the RAOs. For example, it appears that the bioaccumulation sediment quality value (BSQV) was derived using lake-wide average mercury concentrations in both fish and sediments. The Board is concerned that assuming a linear relationship between mercury in fish and mercury in sediment through a broad range of sediment concentrations may lead to underestimating the fish tissue levels of mercury at low sediment concentrations.

Response # 11: The ROD will provide further clarification as to how the PRGs are tied to risk

management goals, communicate the objectives of the cleanup, and discuss how meeting the PRGs will help the cleanup attain the RAOs.

As part of the RI/FS process, the State and the Region worked with Honeywell to ensure that the cleanup levels were tied to risk management goals by developing risk-based sediment and fish tissue concentration target goals based on site-specific exposure assumptions.

However, the RAOs and PRGs must also consider the goal of remedial programs being implemented in New York State. Specifically, Part 375-1.10(b) states *"The goal of the program for a specific site is to restore that site to pre-disposal conditions, to the extent feasible and authorized by law. At a minimum, the remedy selected shall eliminate or mitigate all significant threats to the public health and to the environment presented by hazardous waste disposed at the site through the proper application of scientific and engineering principles."* While the PRGs for the site are clearly risk based, the development of the RAOs gave consideration to the restoration goal required by Part 375.
To clarify the intent and the connection to risk reduction inherent in the PRGs, a restatement of the objectives and goals is provided below.

The RAOs for Onondaga Lake were based on site-specific information including the nature and extent of the CPOIs, the transport and fate of mercury and other CPOIs, and the baseline human health and ecological risk assessments. The RAOs were developed in the RI as goals for controlling CPOIs within the lake and protecting human health and the environment. RAO 4 has been modified so as to be consistent with Recommendation #11 and will be included in the decision document as provided below.

The RAOs for Onondaga Lake are:

• RAO 1: To eliminate or reduce, to the extent practicable, methylation of mercury in the hypolimnion.

This will eliminate or reduce the largest source of methylmercury to biota (and humans) in the lake system, thereby reducing the risk due to bioaccumulation of methylmercury.

• RAO 2: To eliminate or reduce, to the extent practicable, releases of contaminants from the ILWD and other littoral areas around the lake.

These areas represent one of the largest sources of mercury and other contaminants to the lake system. Elimination of these releases and exposures will significantly reduce direct contact toxicity currently evident in the benthic community. In addition, the risks due to bioaccumulation caused by direct exposure in the water column and the sediments from bioaccumulative contaminants such as PCBs will be reduced as well as risks caused by mercury transported from these littoral areas to the hypolimnion where it is currently methylated.

• RAO 3: To eliminate or reduce, to the extent practicable, releases of mercury from profundal sediments.

These releases are a major source of total mercury into the anoxic hypolimnion where it is methylated and introduced into the food chain. Elimination of these releases will reduce risks due to bioaccumulation caused by methylation of the mercury released from these sediments into the hypolimnion.

• RAO 4: To be protective of fish and wildlife by eliminating or reducing to the extent practicable, existing and potential future adverse ecological effects on fish and wildlife resources and to be protective of human health by eliminating or reducing, to the extent practicable, potential risks to humans (*e.g.,* so that humans may consume fish in accordance with the State's general advisory for other bodies of water in New York State).

Inclusion of this RAO allows for the development and use of benthic toxicity-based cleanup levels and fish tissue-based cleanup levels, thus resulting in the reduction of risks to the ecosystem and to humans. Specifically, the goal of this RAO is to reduce risks so as to be protective of fish and wildlife which inhabit or depend on the lake, and the resources upon which they depend, and to reduce risks to human health (e.g., so that humans may consume fish in accordance with the State's general advisory for other bodies of water in New York State instead of the more restrictive advisory currently in effect for Onondaga Lake).

• RAO 5: To achieve surface water quality standards, to the extent practicable, associated with CPOIs.

These standards are generally based on the protection of (reduction of risks to) human health and the environment. Achievement of these standards will reduce risks to levels considered acceptable as evidenced by the establishment of these standards.

In order to achieve the RAOs, PRGs were established to provide additional information/goals with which remedial alternatives could be developed and provide a basis for selecting an appropriate remedy. Onondaga Lake contains three primary media that have been impacted by CPOIs: sediments; biological tissue; and surface water. The following three PRGs have been developed, each addressing one of the affected media. PRG 2 has been revised from what was presented in the Proposed Plan in accordance with Response # 7.

• PRG 1: Achieve applicable and appropriate site-specific SECs for the CPOIs and the BSQV for mercury, to the extent practicable, by reducing, containing, or controlling CPOIs in profundal and littoral sediments.

As discussed in the NRRB Presentation Package and the Proposed Plan, use of the mean PECQ of 1 plus the mercury PEC will eliminate direct acute toxicity to the most directly exposed community in the lake (the benthos), and by so doing, will greatly reduce the chronic risks to the

benthic community, as well as risks to organisms higher up the food chain. These criteria (the PECs for individual CPOIs which are used to calculate mean PECQ values) are based on the site-specific SECs that were calculated as part of the Onondaga Lake Baseline Ecological Risk Assessment. The use of the mercury BSQV of 0.8 mg/kg on an area-wide basis will further reduce levels of mercury in sediments, which is predicted to reduce the amount of mercury available for methylation and uptake into the food chain, thus reducing body burdens of mercury in fish.

• PRG 2: Achieve CPOI concentrations, to the extent practicable, in fish tissue that are protective of humans and wildlife that consume fish. This will include EPA's methylmercury National Recommended Water Quality criterion for the protection of human health for the consumption of organisms of 0.3 mg/kg in fish tissue.

Since a major source of risk to humans and upper-level predators is consumption of fish contaminated with mercury and other bioaccumulative CPOIs, concentrations of mercury in fish flesh that are protective based on the human health and ecological risk assessment models have been established. PRG 2 will be achieved by the reduction of total mercury in the lake system (thus reducing the availability of mercury for methylation) and by eliminating the conditions conducive for methylation by oxygenating the hypolimnion.

Concentrations of PCBs and polychlorinated dibenzo-*p*-dioxin/ polychlorinated dibenzofurans in fish tissue were also determined to be risk drivers for human health and wildlife. These contaminants are not as widespread in lake sediments as is mercury and are found primarily in a few specific areas of the lake (e.g., SMUs 1, 2, 6, and 7). The NYSDEC sediment screening criteria for protection of wildlife and humans from bioaccumulation were used as the comparison values for these two CPOIs. The areas where these CPOIs are elevated are generally co-located with areas that exceed the cleanup criteria of the mean PECQ of 1 plus the mercury PEC and would be addressed under the remedial alternatives evaluated in the Proposed Plan.

• PRG 3: Achieve surface water quality standards, to the extent practicable, associated with CPOIs.
These standards are generally based on the protection of (reduction of risks to) human health and the environment. Achievement of these standards, which are defined in the NRRB Presentation Package and Proposed Plan, will reduce risk to levels considered acceptable, as evidenced by the establishment of these standards.

The derivation of these goals and objectives and means to achieve them are further discussed below.
The preferred remedy (along with remediation of the upland subsites, including impacted tributaries) will address the RAOs and PRGs both directly and indirectly by reducing the external inputs to the lake, reducing and isolating the contaminant inventories in the lake, and by eliminating or reducing internal processes (e.g., methylation in the anoxic waters, resuspension of contaminated wastes/sediments) in the lake. While a mechanistic model does not exist to predict

the behavior of mercury and other CPOIs in the lake after remediation, the predicted reductions (on the order of 90 percent) in inputs and inventories are expected to reduce the exposures and uptake of contaminants in humans and wildlife. BSQVs have been developed for Onondaga Lake to provide a conservative total mercury concentration in sediments below which bioaccumulation is expected to be low enough to result in mercury concentrations in fish that are protective for human and wildlife consumption. These values are based on the average lakewide and littoral zone mercury sediment concentrations, since fish are mobile and may be exposed to various locations in the lake. A BSQV of 0.8 mg/kg mercury based on the most sensitive receptor, the river otter, was selected for use in the FS Report and Proposed Plan. This goal is considered protective of all human and ecological receptors modeled in the Onondaga Lake risk assessments. Following implementation of the preferred remedy, the average mercury concentration in the littoral zone, the primary foraging area for birds and mammals, is predicted to be 0.48 mg/kg, a reduction of 86 percent from the current average mercury concentration in the littoral zone (3.5 mg/kg).

The BSQV assumed a linear relationship between mercury in fish and total mercury in sediment through a broad range of sediment concentrations and oxygen conditions. This includes the anoxic conditions in the profundal zone which comprises two thirds of the lake sediment surface area. The uptake of mercury from the sediments is highly dependent on the amount of methylmercury in the surface sediment and porewater. While it is known that the proportion of methylmercury to total mercury in sediments is not constant, surface sediment data collected during the RI show that the ratios of methylmercury to total mercury in the littoral zone outside of SMU 1 are generally low (mean of 21 samples = 0.22 percent) and consistent (standard deviation of 0.15 percent, with a range of ratios from 0.04 to 0.6 percent), while ratios in SMU 1 are similar (mean of 22 samples = 0.20 percent) although somewhat more variable (standard deviation of 0.25 percent, with a range from 0.1 to 0.9 percent). The ratios in the profundal zone are higher (mean of 15 samples = 0.70 percent with a standard deviation of 0.3 percent and a range from 0.07 to 1.4 percent). In addition, the ratios of methylmercury to total mercury in the profundal zone are distinctly higher near the sediment-water interface than at depth while the ratios in the littoral zone are consistent vertically in the sediment. The profundal zone also has a higher concentration of methylmercury in the surface sediments than the littoral zone by a factor of 2 to 10, except for SMU 1 which has higher total mercury and methylmercury concentrations than most of the littoral zone.

Under NYSDEC's preferred remedy, all of SMU 1 will be remediated including removal of sediments to depths of 2 to 3 meters followed by placement of several feet of sand cap. Therefore, following remediation, SMU 1 is expected to have a low concentration of total mercury and a low ratio of methylmercury to total mercury, resulting in low concentrations of methylmercury at the surface. The rest of the littoral zone will be remediated to varying degrees, but since the ratio of methylmercury to total mercury is consistently low in these areas, the remediation based on total mercury concentrations is expected to address the methylmercury concentrations to a consistent degree as assumed by the linear relationship in the BSQV approach. The profundal zone will be addressed primarily by monitored natural recovery (MNR)

and oxygenation of the hypolimnion. It is likely that the introduction of oxygen to the water column will directly affect the sediment-water interface, causing those sediments to become oxic, and producing a methylmercury to total mercury ratio similar to the current ratios in the littoral zone outside of SMU 1. Thus, any effect due to variable ratios will be eliminated following remediation, and the inclusion of data under current conditions from the profundal sediments in the development of the BSQVs provides a conservative factor when this is applied to littoral sediments overlain by oxygenated water. It is anticipated that a significant reduction of the current total mercury concentrations in the sediments and oxygenation of the hypolimnion will decrease the proportion of methylmercury to total mercury and the methylmercury concentrations in sediments. Removal and capping of sediments, the reduction of external inputs, and oxygenation will lead to significant reductions in total mercury and methylmercury in surface water. Consequently, the comment that fish tissue levels of mercury may be underestimated at low sediment concentrations because a linear relationship between mercury in fish and total mercury in sediment was used to develop the mercury BSQV is not anticipated to be of concern.

Recommendation # 12: In the package presented to the Board, the total mercury loading from external sources to Onondaga Lake identified approximately one-third as coming from tributaries, the treated wastewater from the Metropolitan Syracuse Wastewater Treatment Facility, and groundwater. While several of these external sources have undergone interim response measures, other noteworthy external mercury sources to the lake are in the investigation phase. The Board is concerned with the timing of the lake-wide cleanup in relation to completion of all external source cleanups. This concern was also provided in written comments to the Board by the Onondaga Nation. Therefore, the Board recommends that the Administrative Record include a matrix showing the expected sequence of remedial actions at all external sources, in relation to the start of design and actual implementation of the lake-wide cleanup that is ultimately selected.

Response # 12: As is indicated in the Proposed Plan, the remediation of the Onondaga Lake sub-site will need to be coordinated with upland remedial activities. The control of contamination migrating to the lake from the various upland sites (e.g., Willis Avenue, Semet Residue Ponds, Wastebed B/Harbor Brook, LCP/Bridge Street, and Geddes Brook/Ninemile Creek) is an integral part of the overall cleanup of Onondaga Lake. To prevent the recontamination of lake sediments, ongoing releases of contamination to a given portion of the lake will need to be eliminated prior to performing cleanup activities in that area of the lake. For example, the hydraulic control systems which will be installed/operated as part of the Wastebed B/Harbor Brook and Willis/Semet Barrier Interim Remedial Measures will address the ongoing releases of contaminants from these upland areas to SMUs 1 and 2, respectively. These systems will need to be constructed and operating prior to cleanup activities commencing in this part of the lake.

Furthermore, the effectiveness of the capping proposed for SMUs 1 and 2 would rely upon the proper functioning of the noted hydraulic control systems. Likewise, the effectiveness of capping in SMU 7 would be a function of the effectiveness of the hydraulic control system, which is proposed to be installed along the lakeshore as part of the remedy for this portion of the lake.

Therefore, the timing of remedial activities in Onondaga Lake will need to be coordinated with the remedial work which will be performed as part of the interim and final remedies at these upland areas. This will be reflected in a matrix showing the expected sequence of remedial actions at all external sources. The matrix will be included in the Administrative Record.

Recommendation # 13: Looking at the data available to the Board regarding contaminant concentrations in the ILWD, it appears that most of the potential hotspot material would be removed as part of the two-meter dredging in Alternative 4. The Board recognizes the importance of additional data collection during remedial design and recommends use of these data in an adaptive management fashion to maximize remedy effectiveness and minimize cost. The Board recommends that the remedy as stated in the decision document include flexibility in dredge depth and cap thickness so that cap effectiveness and cost efficiencies can be attained following additional data collection. For example, additional evaluation of contaminant profiles in sediment and cap model results may elucidate whether flux of chlorobenzenes and other organics through the cap would or would not cause significant risk to benthos.

Response # 13*:* The remedy that will be described in the ROD will include flexibility in dredge depth (with regard to "hot spot" threshold concentrations as they may be modified as a result of the additional cap modeling that will be performed during the remedial design) and cap thickness so that cap effectiveness and cost effectiveness can be attained.

TABLE I.26

PRE-REMEDIATION SWACs, ESTIMATED RESIDUAL SWACs, AND ESTIMATED PERCENT REDUCTION IN MERCURY AND PCB CONCENTRATIONS IN SEDIMENT BASED ON LAKE-WIDE REMEDIATION

	Remedial Alternatives / CPOI Concentration mg/kg Dry Weight)						
	A	B - D	D2	E	F1 - H	I	J
Lake-Wide Basis							
Mercury							
Pre-Remediation SWAC	2.91	2.91	2.91	2.91	2.91	2.91	2.91
Estimated Residual SWAC	2.91	1.00	0.97	0.97	0.96	0.92	0.34
Estimated Percent Reduction	0	65	67	67	67	68	88
Total PCBs							
Pre-Remediation SWAC	0.201	0.201	0.201	0.201	0.201	0.201	0.201
Estimated Residual SWAC	0.201	0.047	0.047	0.052	0.027	0.033	0.025
Estimated Percent Reduction	0	77	77	74	87	84	87
Littoral Basis							
Mercury							
Pre-Remediation SWAC	3.49	3.49	3.49	3.49	3.49	3.49	3.49
Estimated Residual SWAC	3.49	0.63	0.53	0.53	0.48	0.38	0.23
Estimated Percent Reduction	0	82	85	85	86	89	93
Total PCBs							
Pre-Remediation SWAC	0.367	0.367	0.367	0.367	0.367	0.367	0.367
Estimated Residual SWAC	0.367	0.047	0.047	0.052	0.027	0.033	0.025
Estimated Percent Reduction	0	87	87	86	93	91	93

Note:

Concentrations in capped areas following remediation are assumed to be equivalent to concentrations measured in Otisco Lake.

Residual concentrations of mercury in SMU 8 were estimated by the natural recovery model as described in the text. Residual concentrations of PCBs in SMU 8 were assumed to be equivalent to residual concentrations in the littoral zone.

TABLE I.28
CURRENT AND ESTIMATED MERCURY AND PCB CONCENTRATIONS IN FISH TISSUE FOLLOWING SEDIMENT REMEDIATION

		Remedial Alternatives / CPOI Concentration mg/kg Dry Weight)							Target Tissue Concentration Range
		A	B - D	D2	E	F1 - H	I	J	(mg/kg ww)
Lake-Wide Basis									
Mercury									
Estimated Percent Reduction		0	65	67	67	67	68	88	
Estimated Residual Concentration in Prey Fish (mg/kg ww)	<18 cm length	0.22	0.08	0.07	0.07	0.07	0.07	0.03	0.01 - 0.3
	>18 cm length	0.67	0.23	0.22	0.22	0.22	0.21	0.08	0.01 - 0.3
Estimated Residual Concentration in Sport Fish (mg/kg ww)		1.1	0.38	0.37	0.37	0.36	0.35	0.13	0.2 - 0.6
Total PCBs									
Estimated Percent Reduction		0	77	77	74	87	84	87	
Estimated Residual Concentration in Prey Fish (mg/kg ww)	<18 cm length	0.98	0.23	0.23	0.25	0.13	0.16	0.12	0.02 - 9.6
	>18 cm length	1.6	0.36	0.37	0.41	0.21	0.26	0.20	0.02 - 9.6
Estimated Residual Concentration in Sport Fish (mg/kg ww)		0.9	0.21	0.21	0.23	0.12	0.15	0.11	0.003 - 0.2
Littoral Basis									
Mercury									
Estimated Percent Reduction		0	82	85	85	86	89	93	
Estimated Residual Concentration in Prey Fish (mg/kg ww)	<18 cm length	0.22	0.04	0.03	0.03	0.03	0.02	0.01	0.01 - 0.3
	>18 cm length	0.67	0.12	0.10	0.10	0.09	0.07	0.04	0.01 - 0.3
Estimated Residual Concentration in Sport Fish (mg/kg ww)		1.1	0.20	0.17	0.17	0.15	0.12	0.07	0.2 - 0.6
Total PCBs									
Estimated Percent Reduction		0	87	87	86	93	91	93	
Estimated Residual Concentration in Prey Fish (mg/kg ww)	<18 cm length	0.98	0.12	0.13	0.14	0.07	0.09	0.07	0.02 - 9.6
	>18 cm length	1.6	0.20	0.20	0.22	0.12	0.14	0.11	0.02 - 9.6
Estimated Residual Concentration in Sport Fish (mg/kg ww)		0.9	0.11	0.12	0.13	0.07	0.08	0.06	0.003 - 0.2

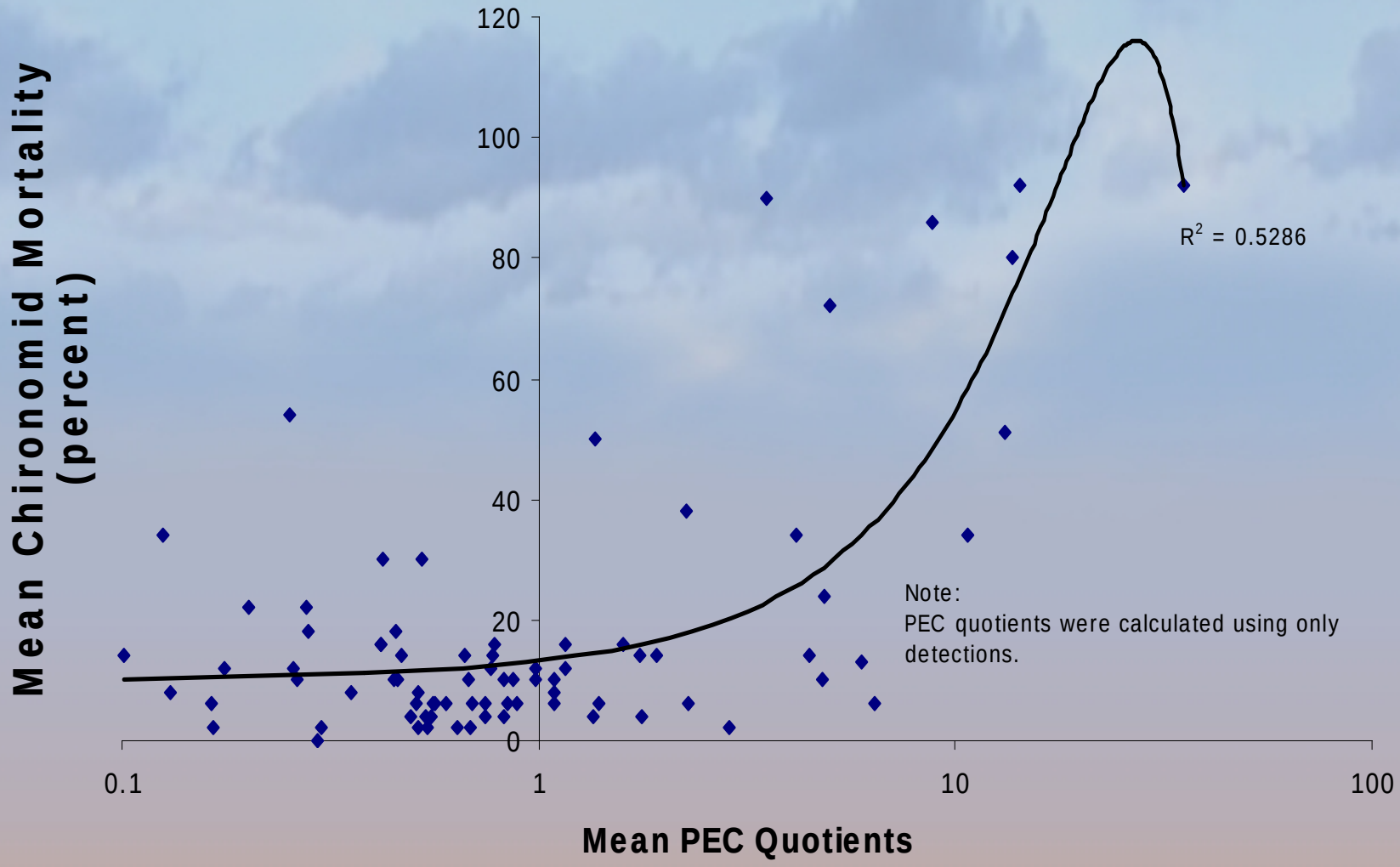
Notes:

Prey fish are consumed by wildlife and are evaluated on a whole body basis. Sport fish are consumed by humans and are evaluated on a fillet basis.

Current concentrations for prey fish (< 18 cm and > 18 cm in length) are mean concentrations from the BERA (TAMS, 2002a). Current concentrations for sport fish (i.e., fish of edible size) are 95 percent UCL on the mean concentrations from the HHRA (TAMS, 2002b).

Target tissue concentration ranges as determined in Appendix G, fish tissue goals

Chironomid Mortality vs. Mean PEC Quotients Using Revised 2 Grouping Method (1992)



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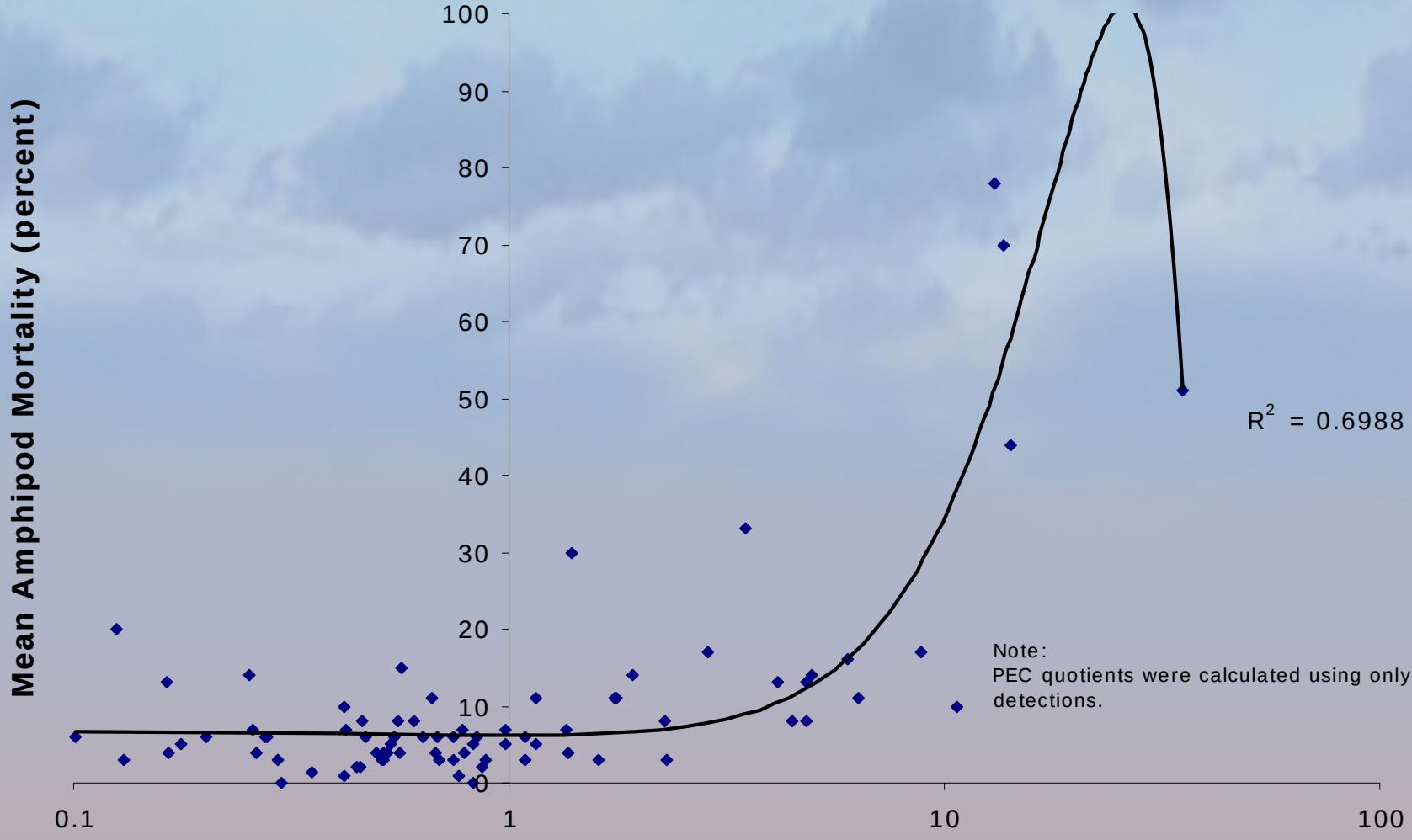
Amphipod Mortality vs. Mean PEC Quotients Using Revised 2 Grouping Method (1992)



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TAMS
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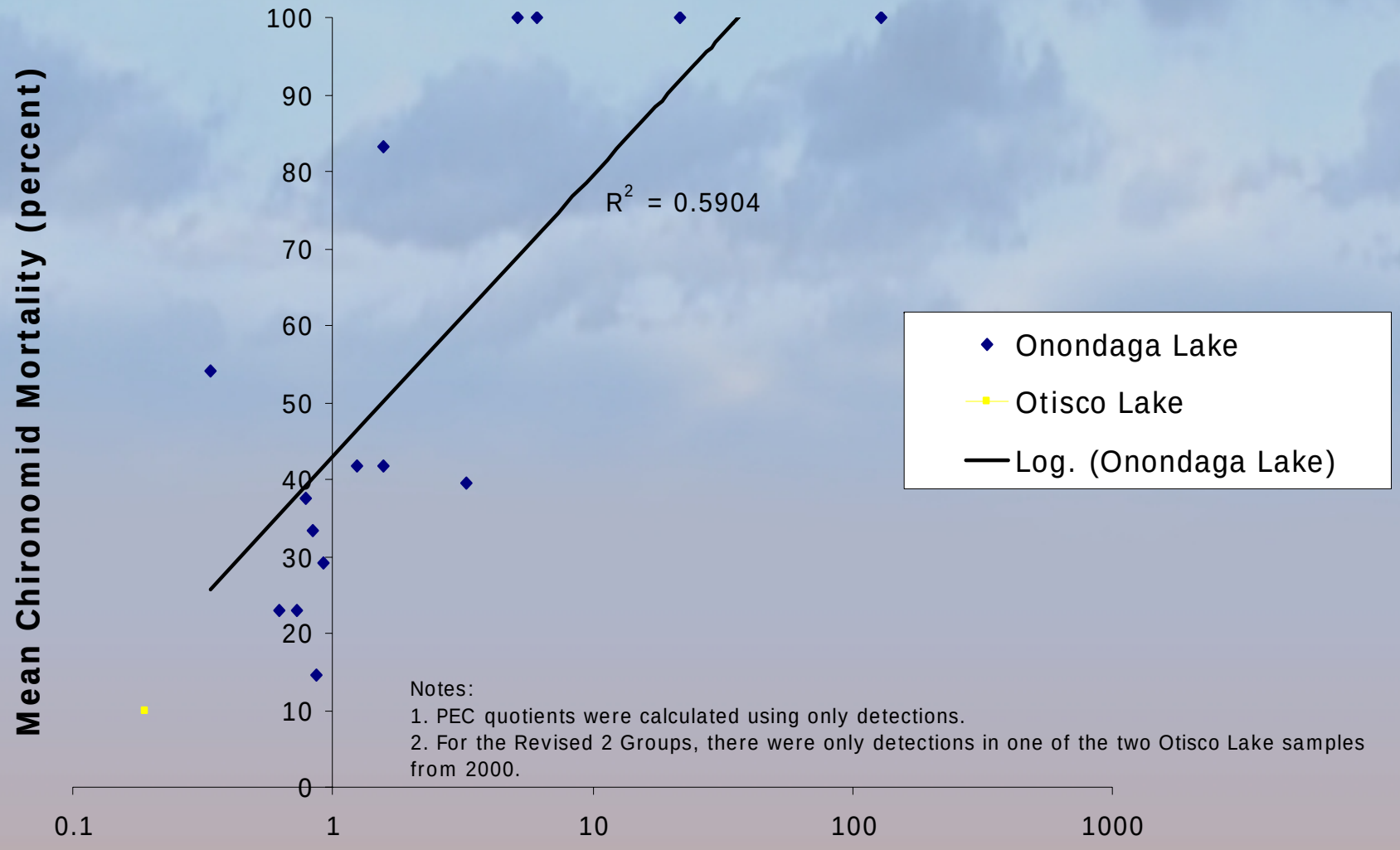
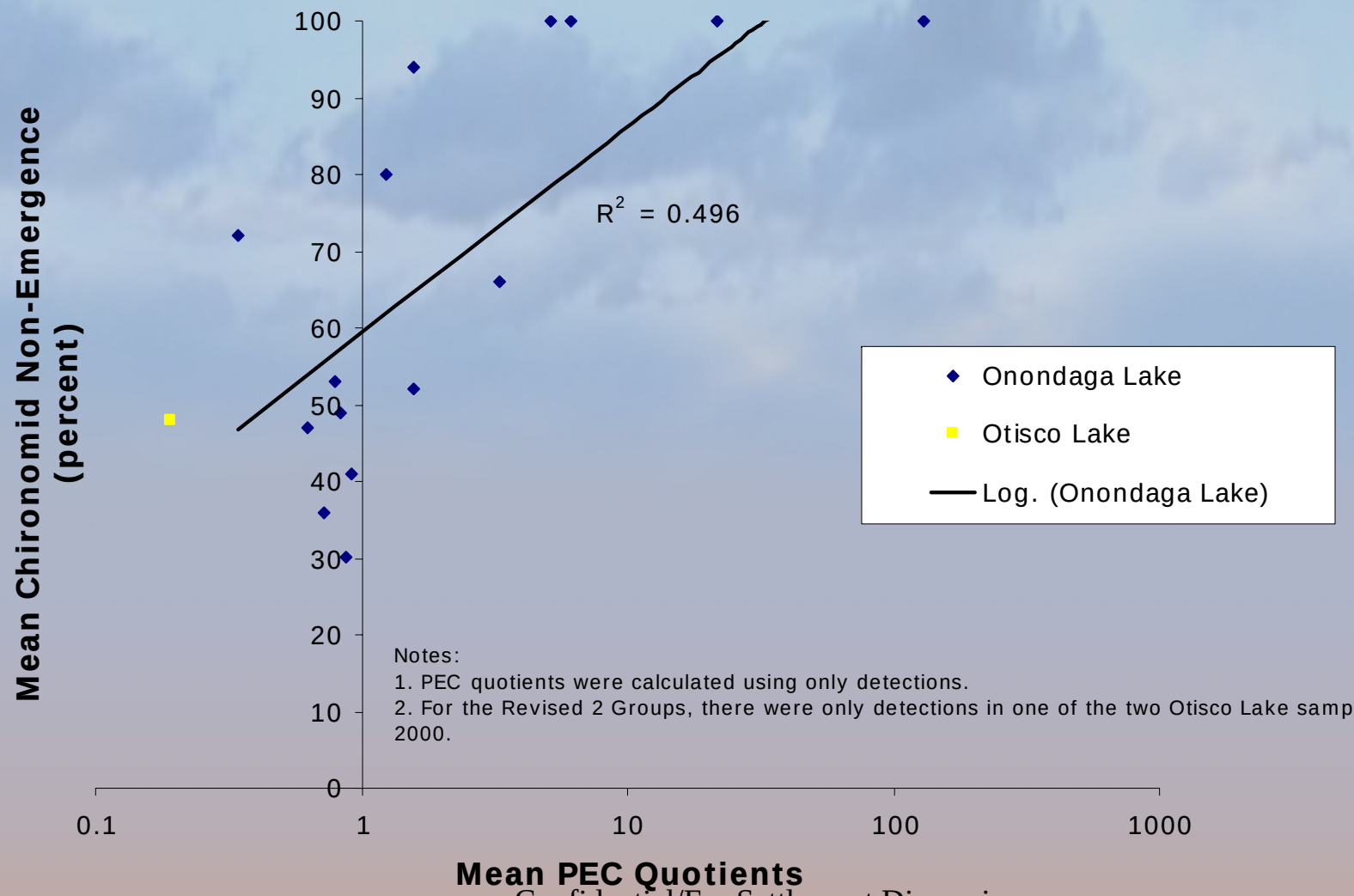
Chironomid Mortality vs. Mean PEC Quotients Using Revised 2 Grouping Method (2000)



Notes:
1. PEC quotients were calculated using only detections.
2. For the Revised 2 Groups, there were only detections in one of the two Otisco Lake samples from 2000.

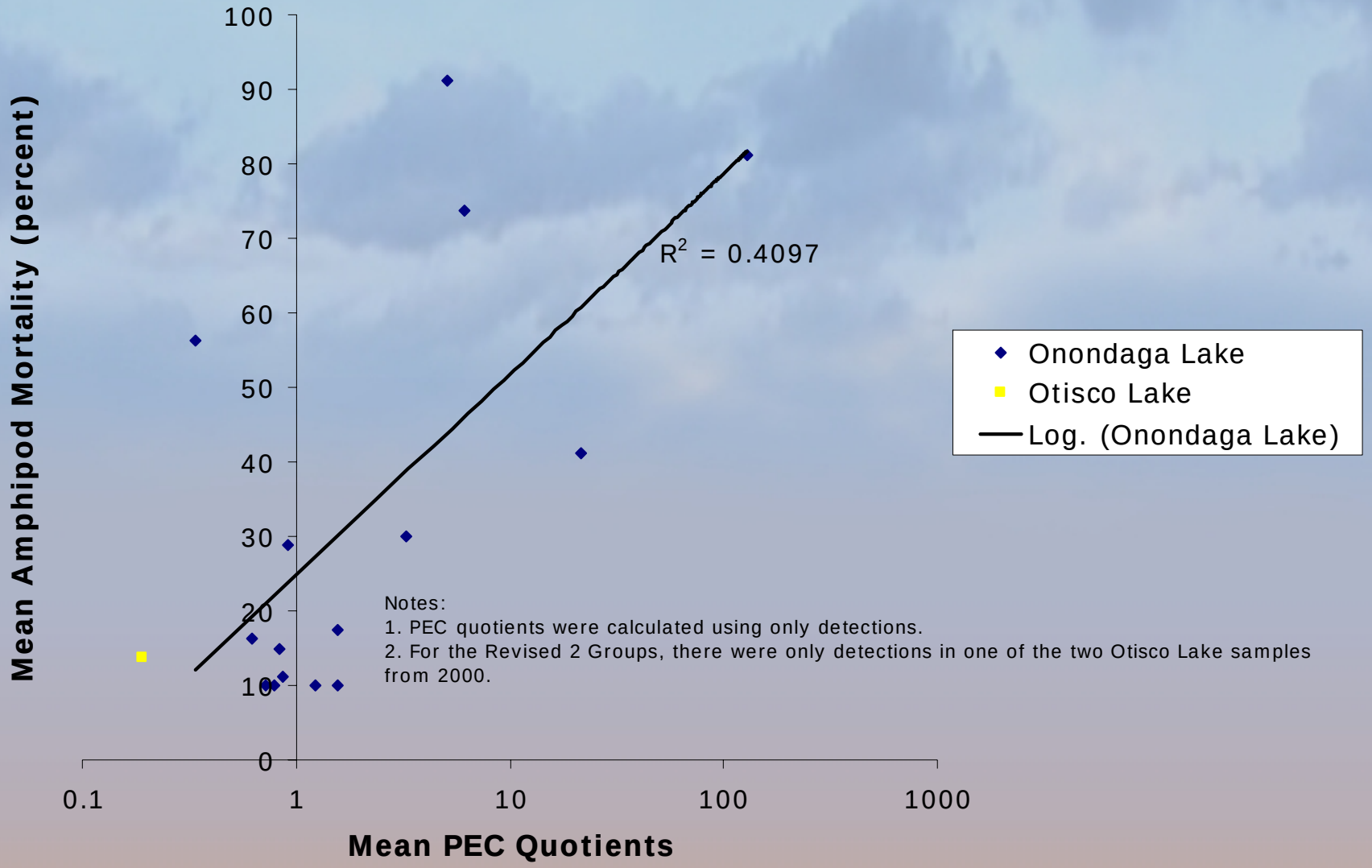
TAMS
AN EARTH TECH COMPANY

Chironomid Non-Emergence vs. Mean PEC Quotients Using Revised 2 Grouping Method (2000)



Notes:
1. PEC quotients were calculated using only detections.
2. For the Revised 2 Groups, there were only detections in one of the two Otisco Lake samples from 2000.

Amphipod Mortality vs. Mean PEC Quotients Using Revised 2 Grouping Method (2000)



Notes:
1. PEC quotients were calculated using only detections.
2. For the Revised 2 Groups, there were only detections in one of the two Otisco Lake samples from 2000.