From: Gray, Jennifer (DHHS)
Sent: Friday, October 16, 2015 4:12 PM
To: Sygo, Jim (DEQ);Dykema, Linda D. (DHHS)
Cc: Groetsch, Kory J. (DHHS);Flaga, Christine (DEQ);Wildfang, Eric (DEQ);Sills, Robert (DEQ);MacKenzie-Taylor, Deb (DEQ)
Subject: RE: DRAFT DELIBERATIVE; NOT SUBJECT TO FOIA - drinking water lead level
Attachments: draft deliberative TSG Subcommittee drinking water lead levels 10-16-2015.pdf

Linda and Jim,

Please find the executive summary version of the technical support document for use in evaluating school and daycare drinking water lead levels.

Thank you,
Jennifer

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From: Gray, Jennifer (DHHS)
Sent: Friday, October 16, 2015 2:56 PM
To: Groetsch, Kory J. (DHHS); 'Flaga, Christine (DEQ) (FLAGAC@michigan.gov)'; 'Wildfang, Eric (DEQ) (WILDFANGE@michigan.gov)'; 'Sills, Robert (DEQ) (SILLSR@michigan.gov)'; 'MacKenzie-Taylor, Deb (DEQ) (MACKENZIE-TAYLORD@michigan.gov)'
Subject: RE: DRAFT DELIBERATIVE; NOT SUBJECT TO FOIA - final draft

All:

Thank you for your comments. Some people had word choice suggestions on the same items, I resolved those differences. The group consensus was okay with leaving a daily 50% from the drinking water "fountains". I added a couple of sentences describing this uncertainty.

Here is the draft deliberative version that will be sent to Linda and Jim at 4 pm.

Thanks,
Jennifer

Justification of the drinking water "no corrective action" lead level for use in the Flint school and daycare drinking water sample decision tree

The Michigan Department of Health and Human Services (MDHHS) requested that the Toxic Steering Group (TSG) provide endorsement of a health-based drinking water lead level that would require "no corrective action" to put back into service drinking water faucets and fountains used by Flint school and daycare children. Selection of the "corrective actions" was not included in the charge question and is not discussed in this document. A TSG subcommittee was convened to examine this issue. Subcommittee members included Deb Mackenzie-Taylor (Michigan Department of Environmental Quality [MDEQ]), Robert Sills (MDEQ), Eric Wildfang (MDEQ), Jennifer Gray (MDHHS), Christine Flaga (MDEQ), and Kory Groetsch (MDHHS).

Neither the Centers for Disease Control and Prevention's Agency for Toxic Substances and Disease Registry (ATSDR) nor the U.S. Environmental Protection Agency (EPA) have derived toxicity endpoints (e.g. reference dose, minimal risk level) for lead to be used in risk assessments. Both agencies have stated that no blood lead level has been found to be safe and precautionary actions to reduce exposure to lead, such as running tapwater briefly before use, should always be followed. Due to the pharmacokinetic data and initial acceptable blood lead, the EPA developed a biokinetic model for evaluating lead exposure from multiple media. Lead levels in air, soil, house dust, diet, drinking water, and maternal blood are used to estimate geometric mean blood lead levels for a population of children and the probability that a child would be above a specified blood lead level[1]. The model results are compared to an EPA population health protection goal for young children exposed to lead at residential properties of 5% or lower risk of a child having a blood level greater than the CDC reference value of 5 micrograms lead per deciliter blood (µg/dL)[2]. The model, however, does not include inputs to account for direct paint chip ingestion and assumes that children are not exposed to elevated lead in soil and house dust from lead based paint.

Use of the EPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model

The EPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children version 1.1 Build 11 was used to evaluate exposure to children one year old or younger and children seven years old or younger. Default values were retained unless otherwise noted below. See Table 2-1 in the "User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) Windows©" for the listing of all the default values[3]. Values selected that are more appropriate for a Michigan urban area, Flint, are described briefly below.

[1] The modeling output includes the percent of children in a population that are above a specified blood lead level, but that value can be also be viewed as the probability (risk) that a certain child would be above the specified blood lead level.
[2] As stated on the EPA's Lead at Superfund Sites: Frequent Questions from Risk Assessors on the Integrated Exposure Uptake Biokinetic (IEUBK) Model webpage, found at http://www2.epa.gov/superfund/lead-superfund-sites-frequent-questions-risk-assessors-integrated-exposure-uptake#mean.
[3] The model itself and documentation, including the user's guide for the model can be found at http://www2.epa.gov/superfund/lead-superfund-sites-software-and-users-manuals.

Air data

MDEQ performs monitoring for lead in ambient air (as measured in Total Suspended Particulates; lead [TSP]) at a number of fixed stations in Michigan. Some of these monitoring stations (e.g., in Belding, Port Huron, and Vassar) were established to intentionally capture the influence of specific nearby industrial emissions, while others were established to provide data reflecting the general ambient air lead levels in urban areas. The TSG Subcommittee reviewed the ambient air monitoring data, focusing on urban ambient air lead data that would be representative of contemporary Flint conditions. The most recent MDEQ annual air monitoring report is for 2014[4]. The summary statistics provided in the MDEQ annual air quality reports include 3-month average (mean) levels, the highest value (24-hour sample), and the 2nd highest value (24-hour sample). The National Ambient Air Quality Standard (NAAQS) for lead (0.15 micrograms per cubic meter [$\mu g/m^3$]) has a 3-month averaging time.

Ambient air lead was monitored by MDEQ in Flint (Whaley Park; 3610 Iowa Ave.) until early 2007. The 2005 calendar quarter arithmetic mean values were 0.008, 0.010, 0.011, and 0.012 $\mu g/m^3$. The 2006 calendar quarter arithmetic mean values were 0.005, 0.007, 0.012, and 0.006 $\mu g/m^3$. Although Flint data more recent than 2007 are not available, MDEQ staff considered other urban lead monitoring sites to be fairly representative of Flint conditions. Grand Rapids, Allen Park, and Dearborn each had a highest rolling 3-month arithmetic mean lead (TSP) level of 0.01 $\mu g/m^3$ in 2013; for 2014, these values were 0.01 $\mu g/m^3$ for Grand Rapids and Allen Park and 0.02 $\mu g/m^3$ for Dearborn. These data indicate that the IEUBK model default value of 0.1 $\mu g/m^3$ is not the most appropriate air lead level for Flint, and support a representative value of 0.01 $\mu g/m^3$ for the air data model input assumption. While a slightly higher air lead level was obtained for Dearborn, the small difference between 0.01 and 0.02 $\mu g/m^3$, would not impact model outputs.

Water consumption

The default drinking water intakes are age-dependent and based on national averages[5]. These were updated to match the mean drinking water intakes (direct and indirect) in Table 3-1 from the U.S. EPA Exposure Factors Handbook: 2011 Edition[6].

- 0-1 years old - 0.32 liter/day (L/d) (age-adjusted from the values in Table 3-1)
- 1-2 years old - 0.271 L/d
- 2-3 years old - 0.317 L/d
- 3-4 years old - 0.327 L/d (3 to 6 years old in Table 3-1)
- 4-5 years old - 0.327 L/d (3 to 6 years old in Table 3-1)

[4] The MDEQ 2014 Annual Air Quality Report can be found at http://www.michigan.gov/documents/deq/deq-aqd-amu-2014_Annual_Air_Quality_Report_492732_7.pdf?20151014123800.

[5] Per the "User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) Windows©", "The default consumption rates are age-dependent and based on national averages. These consumption rates should be changed only when valid site-specific monitoring data is available."

[6] The U.S. EPA Exposure Factors Handbook: 2011 Edition can be found at file:///C:/Users/grayj/Downloads/EFH-COMPLETE.PDF.

- 5-6 years old - 0.327 L/d (3 to 6 years old in Table 3-1)
- 6-7 years old - 0.414 L/d (6 to 11 years old in Table 3-1)

Drinking water data for alternate drinking water sources
The alternate drinking water sources used for these modeling runs are listed below with a brief description.

- "Percent of Total Consumed as First Draw" – This value applies to household tap water. This was set to 0% as Genesee County issued an Public Health Emergency Advisory[7] recommending that no one drink the City of Flint water until it has been tested or unless it is being filtered through a filter meeting the National Sanitation Foundation (NSF)/American National Standards Institute (ANSI) standard 53.
- "Concentration of Lead in First Draw (µg/L)" – With the "Percent of Total Consumed as First Draw" set to 0%, this value will not alter the model run output so the default of 4 micrograms per liter (µg/L or parts per billion [ppb]) was retained.
- "Concentration of Lead in Flushed (µg/L)" – This value applies to household tap water. This was set to 1 µg/L (ppb) as filters meeting NSF/ANSI standard 53 are recommended for use in all households. The filters distributed remove greater than 99% of the lead and would result in filtered water containing lead levels of approximately 1 µg/L (ppb) or less.
- "Percentage of Total Consumed from Fountains" – This was set to 50%, as children in school and daycare settings spend around eight hours or more in those locations. Eight hours could be expected to be approximately half of their waking hours in a day. This value also assumes daily intake of drinking water from a school or daycare source. There could be variation in the amount of time children would actually be drinking water from these locations based on involvement in before- or after-school or daycare programs, activities, or events.
- "Concentration of Lead in Fountain Water (µg/L)" – Modeling runs were carried out for every 1 µg/L (ppb) step between zero and 15 µg/L, and also 30 and 100 µg/L (ppb). Modeling runs for the zero to 15 µg/L (ppb) steps were carried out to perform a sensitivity analysis to evaluate how a one µg/L (ppb) change in lead water concentrations alters the outputs of the model. The 30 and 100 µg/L (ppb) levels were included as preliminary representatives of high-end lead levels obtained from school drinking water fountains.

Site-specific soil data
Soil lead levels on residential properties vary greatly[8]. The primary influence is from pre-1978 use of lead paint on the outside of buildings[9,10,11]. Lead-paint was banned in 1978. In addition, the age of

[7] The Genesee County Public Health Emergency Declaration can be found at http://www.gchd.us/docs/public_health_emergency_announcement_10_1_15.pdf.
[8] Datko-Williams, L., A. Wilkie, et al. (2014). "Analysis of U.S. soil lead (Pb) studies from 1970 to 2012." Science of The Total Environment **468-469**: 854-863.
[9] Francek, M. A. (1992). "Soil lead levels in a small town environment: a case study from Mt Pleasant, Michigan." Environ Pollut **76**(3): 251-257.

housing[8,9], paint condition, and distance from the building can greatly impact the concentration of lead in soil. The soil lead concentrations near the foundation of houses with lead paint are frequently over 1,000 ppm[9,11,12,13]. Historic vehicle emissions from leaded gasoline are another source of residential soil lead, so distance from road and traffic volume at the time leaded gasoline was in use are also influential factors on residential soil concentrations[10,11,13]. Other potential influences are fill material (e.g., foundry sand, smelter slag), and/or local industrial emission sources. The highest soil lead concentrations are typically found in urban areas with high population density.

Soil lead data for residential soils in Flint are not currently available. Flint park data and other relevant residential soil lead studies were reviewed to evaluate appropriate surrogate concentrations for this assessment.

The MDEQ[14] reported soil lead concentrations from urban parks including Flint. This data set included 12 sample locations from 10 Flint parks. Surface soil samples were collected at 0-2 inches and subsurface samples were collected at 4-6 inches. This dataset may not adequately represent residential soil samples with a lead paint contribution from buildings. Other studies have shown that open spaces may have much lower soil lead concentrations than areas near residential buildings that were built prior to 1978[11,15]. The geometric mean and geometric mean plus two standard deviation surface soil concentrations (see below) from this Flint park dataset were used for this assessment. The geometric mean plus two standard deviation surface soil concentration represents an upper percentile value that may partially account for the higher soil lead levels expected around buildings with lead paint.

Another data source is from soil samples collected from the Rouge River watershed between 1992 and 2002[16]. This dataset was compiled from MDEQ files and Clayton Group Services files for the Rouge River watershed area in southeast Michigan. Although some data is from Part 201 sites of environmental contamination, most of the samples were collected as a result of other regulatory or real estate due diligence requirements. Sites with known industrial metal sources or that had near surface soil with unknown fill material were excluded from the dataset. The dataset included 28 residential sites that had

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[10] Francek, M. A., B. Makimaa, et al. (1994). "Small town lead levels: a case study from the homes of pre-schoolers in Mt. Pleasant, Michigan." Environ Pollut **84**(2): 159-166.
[11] Schwarz, K., S. T. Pickett, et al. (2012). "The effects of the urban built environment on the spatial distribution of lead in residential soils." Environ Pollut **163**: 32-39.
[12] Andra, S. S., D. Sarkar, et al. (2006). "Lead in Soils in Paint Contaminated Residential Sites at San Antonio, Texas, and Baltimore, Maryland." Bulletin of Environmental Contamination and Toxicology **77**(5): 643-650.
[13] Yesilonis, I. D., R. V. Pouyat, et al. (2008). "Spatial distribution of metals in soils in Baltimore, Maryland: role of native parent material, proximity to major roads, housing age and screening guidelines." Environ Pollut **156**(3): 723-731.
[14] "Draft Michigan Urban Park Topsoil Survey 1997, MDEQ" David Slayton, Office of Waste Management and Radiological Protection, MDEQ
[15] Zahran, S., H. W. Mielke, et al. (2013). "Determining the relative importance of soil sample locations to predict risk of child lead exposure." Environ Int **60**: 7-14.
[16] Murray, K. S., D. T. Rogers, et al. (2004). "Heavy metals in an urban watershed in southeastern Michigan." J Environ Qual **33**(1): 163-172.

535 surface soil samples with data reported for lead. Sample depth was 0 – 0.5 meters. The geometric mean value for residential surface soils reported from this study (see below) was used for this assessment.

The current Part 201 residential direct contact risk-based soil level was also used for this assessment for comparison. This value was generated from the IEUBK model using an acceptable blood lead concentration of 10 µg/dL, a drinking water concentration of 4 µg/L (ppb) and an Michigan-specific average air concentration of 0.04 $\mu g/m^3$ were used in the model at the time of criteria development.

Soil levels examined in the model runs were:

- 47.5 parts per million (ppm) – based on the geometric mean of 0-2 inch soil concentrations in Flint urban parks.
- 155 ppm – based on the geometric mean + two standard deviations of 0-2 inch soil concentrations in Flint urban parks.
- 160 ppm – based on the geometric mean for residential surface soil (0-0.5 meter) from Rouge River water shed[17].
- 400 ppm - the MDEQ Residential Direct Contact Risk-Based Screening Level for soil.

Both the residential soil geometric mean from the Rouge River watershed and the upper percentile from the Flint park data appear to represent the best surrogates for residential soil concentrations in Flint for this assessment. Although not from Flint, the Rouge River watershed residential soil data appears to be a fairly robust data set for urban residential soils in Michigan. The Flint park data upper percentile (geometric mean plus two standard deviations is approximately equivalent to the 97.5 percentile) may better account for potential building paint contributions to soil concentrations for urban residential soils than the geometric mean concentration of this dataset. The Flint park upper percentile (155 ppm) reported as two significant digits is equivalent to the Rouge River watershed residential soil lead geometric mean (160 ppm). The soil lead concentration of 160 ppm was selected for use in the calculation of the TSG Subcommittee's recommended health-based drinking water lead levels.

Maternal data

Maternal blood lead levels were changed to 0.8 µg/dL to match the NHANES (2011-2012) geometric mean lead level for women[18].

Blood level of concern (cutoff) for risk estimation

A cutoff value of 5 µg/dL was selected as the current Centers for Disease Control and Prevention blood reference level to identify children with blood lead levels that require follow-up actions. It is based on the blood lead level for the 97.5th percentile for the U.S. population of children, ages one to five[19].

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[17] The value is from Table 5 in Murray, K. S., D. T. Rogers, et al. (2004). "Heavy metals in an urban watershed in southeastern Michigan." J Environ Qual **33**(1): 163-172.

[18] The Fourth National Report on Human Exposure to Environmental Chemicals, dated February 2015, can be found at http://www.cdc.gov/biomonitoring/pdf/FourthReport_UpdatedTables_Feb2015.pdf.

<u>Outputs of the modeling runs and recommendation of drinking water lead levels for use during the evaluation of Flint school and daycare drinking water samples</u>

The soil lead level of 160 ppm was selected as being the best surrogate for soil lead levels in the city of Flint. In the event that site-specific soil data is collected, the drinking water lead levels may need to be reevaluated. The entire set of modeling runs and graphs can be found in Attachment 1.

The recommended drinking water lead levels resulted in a 5% risk or lower that a child had a blood lead level above 5 µg/dL. The 5% is an EPA health protection goal for young children exposed to lead at residential properties.

Evaluating school and daycare drinking water samples together

The recommended lead screening level for use while evaluating both school and daycare drinking water samples is 2 µg/L (ppb). This lead level in drinking water samples results in no more than a 5% risk that children age 7 or younger would have blood lead levels above 5 µg/dL.

Age range	Blood lead geometric mean (in micrograms per deciliter [µg/dL])	Risk that a child could have a blood lead level above 5 µg/dL
0-1 year olds	2.308	5.004%
0-7 year olds	2.056	2.934%

Assumptions integral to the use of the health-based school and daycare drinking water lead level
This calculation includes two assumptions. One is that people have lead levels in home drinking water of no more than 1 µg/L (ppb) or are using filters to reduce lead levels to 1 µg/L (ppb) or below. The second is that children do not live in homes with highly elevated levels of lead in home dust or soil. The modeled lead dust levels do not account for lead coming from pre-1978 paint. Eighty-two percent of city of Flint houses were built before 1970[20]. Soil highly impacted with lead paint may have lead levels higher than the 160 ppm used in this calculation. If children are not drinking filtered water at home, are ingesting lead paint chips, or have elevated levels of lead in home dust or soil, a lead level lower than the one recommended above may need to be selected for the evaluation of school and daycare drinking water samples.

Evaluating school and daycare drinking water samples separately

The recommended lead screening level for use while evaluating daycare drinking water samples is

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[19] The blood reference level and additional information can be found at http://www.cdc.gov/nceh/lead/ACCLPP/blood_lead_levels.htm.
[20] As determined by the U.S. Census and can be found at http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_1YR_S1101&prodType=table.

2 µg/L (ppb). This lead level in drinking water samples results in no more than a 5% risk that children age 1 or younger would have blood lead levels above 5 µg/dL.

Age range	Blood lead geometric mean (in micrograms per deciliter [µg/dL])	Risk that a child could have a blood lead level above 5 µg/dL
0-1 year olds	2.308	5.004%
0-7 year olds	2.056	2.934%

Assumptions integral to the use of the health-based daycare drinking water lead level
This calculation includes two assumptions. One is that people have lead levels in home drinking water of no more than 1 µg/L (ppb) or are using filters to reduce lead levels to 1 µg/L (ppb) or below. The second is that children do not live in homes with highly elevated levels of lead in home dust or soil. The modeled lead dust levels do not account for lead coming from pre-1978 paint. Eighty-two percent of city of Flint houses were built before 1970. Soil highly impacted with lead paint may have lead levels higher than the 160 ppm used in this calculation. If children are not drinking filtered water at home, are ingesting lead paint chips, or have elevated levels of lead in home dust or soil, a lead level lower than the one recommended above may need to be selected for the evaluation of school and daycare drinking water samples.

The recommended lead screening level for use while evaluating K-12 school drinking water samples is 11 µg/L (ppb). This lead level in drinking water samples results in no more than a 5% risk that children age 7 or younger would have blood lead levels above 5 µg/dL. However, when evaluating a population of children age 1 or younger, their risk of having a blood lead level above 5 µg/dL was 8.335%. The 11 µg/L (ppb) screening level is not adequately protective for children under the age of 1.

Age range	Blood lead geometric mean (in micrograms per deciliter [µg/dL])	Risk that a child could have a blood lead level above 5 µg/dL
0-1 year olds	2.61	8.335%
0-7 year olds	2.299	4.917%

Assumptions integral to the use of the health-based school drinking water lead level
This calculation includes two assumptions. One is that people have lead levels in home drinking water of no more than 1 µg/L (ppb) or are using filters to reduce lead levels to 1 µg/L (ppb) or below. The second is that children do not live in homes with highly elevated levels of lead in home dust or soil. The modeled lead dust levels do not account for lead coming from pre-1978 paint. Eighty-two percent of city of Flint houses were built before 1970. Soil highly impacted with lead paint may have lead levels higher than the 160 ppm used in this calculation. If children are not drinking filtered water at home, are ingesting lead paint chips, or have elevated levels of lead in home dust or soil, a lead level lower than the one recommended above may need to be selected for the evaluation of school and daycare drinking water samples.

Attachment 1

IEUBK model outputs - sorted by water lead concentrations

		0-1 year olds		0-7 year olds	
Soil lead levels (ppm)	Fountain water (ppb)	Geometric mean Blood lead level (ug/dL)	%>5 ug/dL	Geometric mean Blood lead level (ug/dL)	%>5 ug/dL
47.6	0	1.184	0.109	0.92	0.016
155.3	0	2.198	4.014	1.958	2.302
160	0	2.24	4.381	2.002	2.573
400	0	4.268	36.82	4.135	34.306
2000	0	13.431	98.224	14.549	98.847
47.6	1	1.22	0.135	0.949	0.02
155.3	1	2.232	4.306	1.985	2.468
160	1	2.274	4.687	2.029	2.75
400	1	4.298	37.376	4.16	34.772
2000	1	13.447	98.235	14.564	98.954
47.6	2	1.257	0.165	0.977	0.026
155.3	2	2.266	4.609	2.012	2.64
160	2	2.308	5.004	2.056	2.934
400	2	4.327	37.929	4.184	35.236
2000	2	13.464	98.247	14.579	98.86
47.6	3	1.293	0.201	1.006	0.032
155.3	3	2.3	4.923	2.039	2.82
160	3	2.342	5.332	2.083	3.126
400	3	4.357	38.48	4.209	35.699
2000	3	13.48	98.258	14.595	98.867
47.6	4	1.33	0.241	1.034	0.04
155.3	4	2.334	5.248	2.067	3.007
160	4	2.376	5.671	2.11	3.324
400	4	4.386	39.029	4.233	36.161
2000	4	13.496	98.269	14.61	98.874
47.6	5	1.366	0.288	1.063	0.049
155.3	5	2.368	5.585	2.094	3.201
160	5	2.41	6.02	2.138	3.53
400	5	4.416	39.575	4.258	36.622
2000	5	13.513	98.28	14.625	98.88
47.6	6	1.402	0.341	1.091	0.06
155.3	6	2.401	5.932	2.121	3.402
160	6	2.443	6.381	2.165	3.743
400	6	4.445	40.118	4.282	37.082
2000	6	13.529	98.29	14.641	98.887
47.6	7	1.438	0.401	1.12	0.073
155.3	7	2.435	6.289	2.148	3.611
160	7	2.477	6.752	2.192	3.964
400	7	4.474	40.659	4.307	37.54
2000	7	13.545	98.301	14.656	98.893
47.6	8	1.474	0.468	1.148	0.087
155.3	8	2.468	6.658	2.175	3.827
160	8	2.51	7.133	2.219	4.191
400	8	4.504	41.196	4.331	37.997

Attachment 1 IEUBK model outputs - sorted by water lead concentrations

		0-1 year olds		0-7 year olds	
Soil lead levels (ppm)	Fountain water (ppb)	Geometric mean Blood lead level (ug/dL)	%>5 ug/dL	Geometric mean Blood lead level (ug/dL)	%>5 ug/dL
2000	8	13.561	98.312	14.671	98.9
47.6	9	1.51	0.542	1.176	0.104
155.3	9	2.502	7.036	2.202	4.05
160	9	2.544	7.524	2.245	4.426
400	9	4.533	41.731	4.355	38.453
2000	9	13.577	98.323	14.686	98.906
47.6	10	1.546	0.625	1.205	0.123
155.3	10	2.535	7.425	2.229	4.28
160	10	2.577	7.925	2.272	4.668
400	10	4.562	42.263	4.38	38.907
2000	10	13.594	98.333	14.702	98.912
47.6	11	1.581	0.715	1.233	0.145
155.3	11	2.569	7.823	2.256	4.518
160	11	2.61	8.335	2.299	4.917
400	11	4.591	42.792	4.404	39.359
2000	11	13.61	98.344	14.717	98.919
47.6	12	1.617	0.815	1.261	0.169
155.3	12	2.602	8.231	2.283	4.762
160	12	2.643	8.755	2.326	5.174
400	12	4.62	43.317	4.428	39.81
2000	12	13.626	98.354	14.732	98.925
47.6	13	1.652	0.924	1.289	0.197
155.3	13	2.635	8.648	2.309	5.014
160	13	2.677	9.183	2.353	5.437
400	13	4.649	43.84	4.453	40.259
2000	13	13.642	98.364	14.747	98.931
47.6	14	1.688	1.043	1.317	0.227
155.3	14	2.668	9.075	2.336	5.273
160	14	2.71	9.621	2.38	5.707
400	14	4.677	44.359	4.477	40.707
2000	14	13.658	98.374	14.763	98.937
47.6	15	1.723	1.171	1.346	0.261
155.3	15	2.701	9.51	2.363	5.539
160	15	2.743	10.067	2.406	5.984
400	15	4.706	44.875	4.501	41.153
2000	15	13.674	98.385	14.778	98.944
47.6	30	2.243	4.406	1.762	1.325
155.3	30	3.188	16.918	2.76	10.313
160	30	3.228	17.593	2.803	10.908
400	30	5.131	52.202	4.861	47.608
2000	30	13.914	98.528	15.005	99.031
47.6	100	4.451	40.23	3.603	24.294
155.3	100	5.267	54.406	4.521	41.511
160	100	5.302	54.957	4.56	42.227

Attachment 1

IEUBK model outputs - sorted by water lead concentrations

		0-1 year olds		0-7 year olds	
Soil lead levels (ppm)	Fountain water (ppb)	Geometric mean Blood lead level (ug/dL)	%>5 ug/dL	Geometric mean Blood lead level (ug/dL)	%>5 ug/dL
400	100	6.967	75.99	6.463	70.746
2000	100	14.992	99.026	16.034	99.342

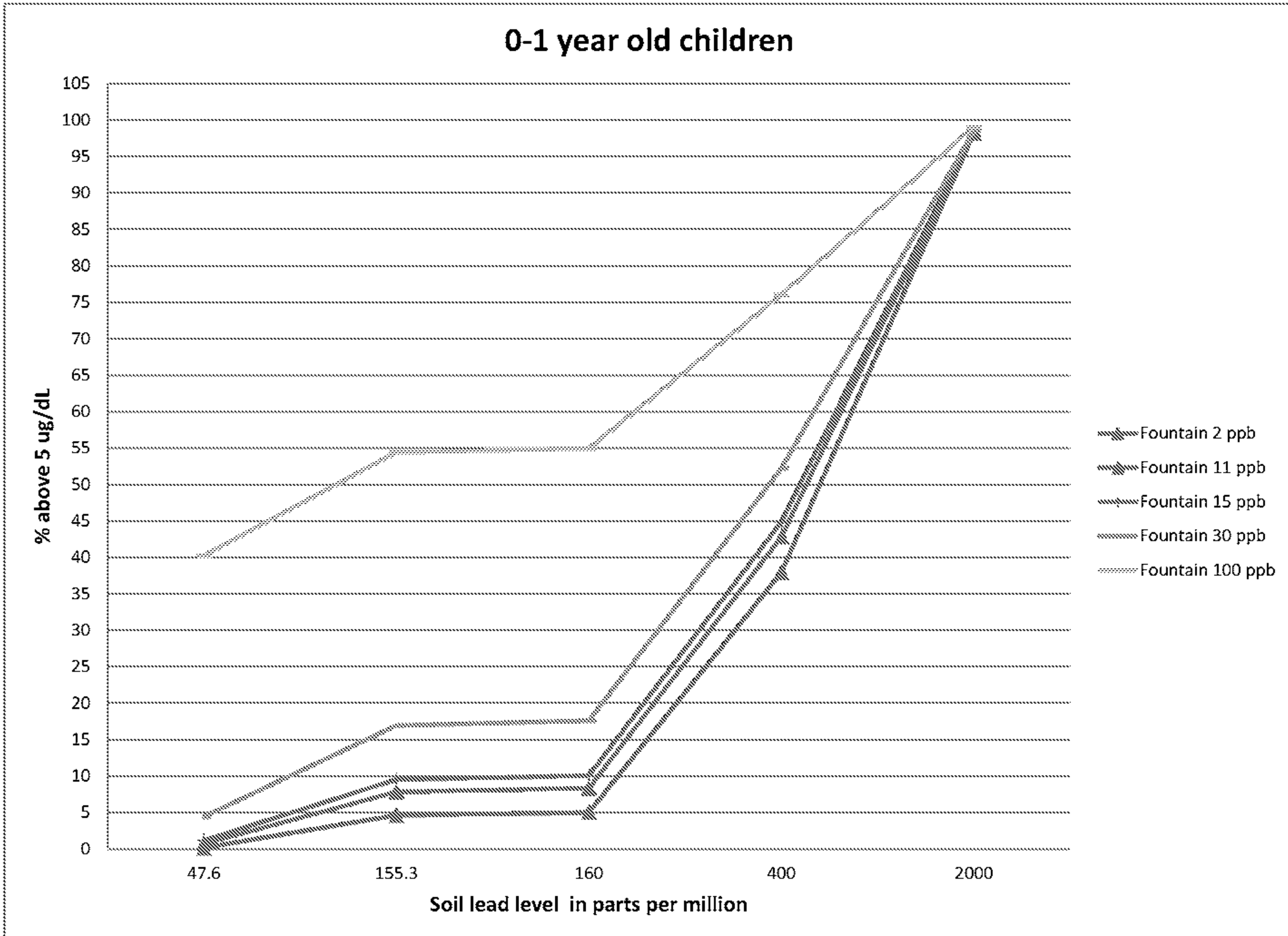
Attachment 1 IEUBK model outputs - sorted by soil lead level

		0-1 year olds		0-7 year olds	
Soil lead levels (ppm)	Fountain water (ppb)	Geometric mean Blood lead level (ug/dL)	%>5 ug/dL	Geometric mean Blood lead level (ug/dL)	%>5 ug/dL
47.6	0	1.184	0.109	0.92	0.016
47.6	1	1.22	0.135	0.949	0.02
47.6	2	1.257	0.165	0.977	0.026
47.6	3	1.293	0.201	1.006	0.032
47.6	4	1.33	0.241	1.034	0.04
47.6	5	1.366	0.288	1.063	0.049
47.6	6	1.402	0.341	1.091	0.06
47.6	7	1.438	0.401	1.12	0.073
47.6	8	1.474	0.468	1.148	0.087
47.6	9	1.51	0.542	1.176	0.104
47.6	10	1.546	0.625	1.205	0.123
47.6	11	1.581	0.715	1.233	0.145
47.6	12	1.617	0.815	1.261	0.169
47.6	13	1.652	0.924	1.289	0.197
47.6	14	1.688	1.043	1.317	0.227
47.6	15	1.723	1.171	1.346	0.261
47.6	30	2.243	4.406	1.762	1.325
47.6	100	4.451	40.23	3.603	24.294
155.3	0	2.198	4.014	1.958	2.302
155.3	1	2.232	4.306	1.985	2.468
155.3	2	2.266	4.609	2.012	2.64
155.3	3	2.3	4.923	2.039	2.82
155.3	4	2.334	5.248	2.067	3.007
155.3	5	2.368	5.585	2.094	3.201
155.3	6	2.401	5.932	2.121	3.402
155.3	7	2.435	6.289	2.148	3.611
155.3	8	2.468	6.658	2.175	3.827
155.3	9	2.502	7.036	2.202	4.05
155.3	10	2.535	7.425	2.229	4.28
155.3	11	2.569	7.823	2.256	4.518
155.3	12	2.602	8.231	2.283	4.762
155.3	13	2.635	8.648	2.309	5.014
155.3	14	2.668	9.075	2.336	5.273
155.3	15	2.701	9.51	2.363	5.539
155.3	30	3.188	16.918	2.76	10.313
155.3	100	5.267	54.406	4.521	41.511
160	0	2.24	4.381	2.002	2.573
160	1	2.274	4.687	2.029	2.75
160	2	2.308	5.004	2.056	2.934
160	3	2.342	5.332	2.083	3.126
160	4	2.376	5.671	2.11	3.324
160	5	2.41	6.02	2.138	3.53
160	6	2.443	6.381	2.165	3.743
160	7	2.477	6.752	2.192	3.964
160	8	2.51	7.133	2.219	4.191
160	9	2.544	7.524	2.245	4.426
160	10	2.577	7.925	2.272	4.668
160	11	2.61	8.335	2.299	4.917
160	12	2.643	8.755	2.326	5.174
160	13	2.677	9.183	2.353	5.437
160	14	2.71	9.621	2.38	5.707
160	15	2.743	10.067	2.406	5.984
160	30	3.228	17.593	2.803	10.908
160	100	5.302	54.957	4.56	42.227

Attachment 1

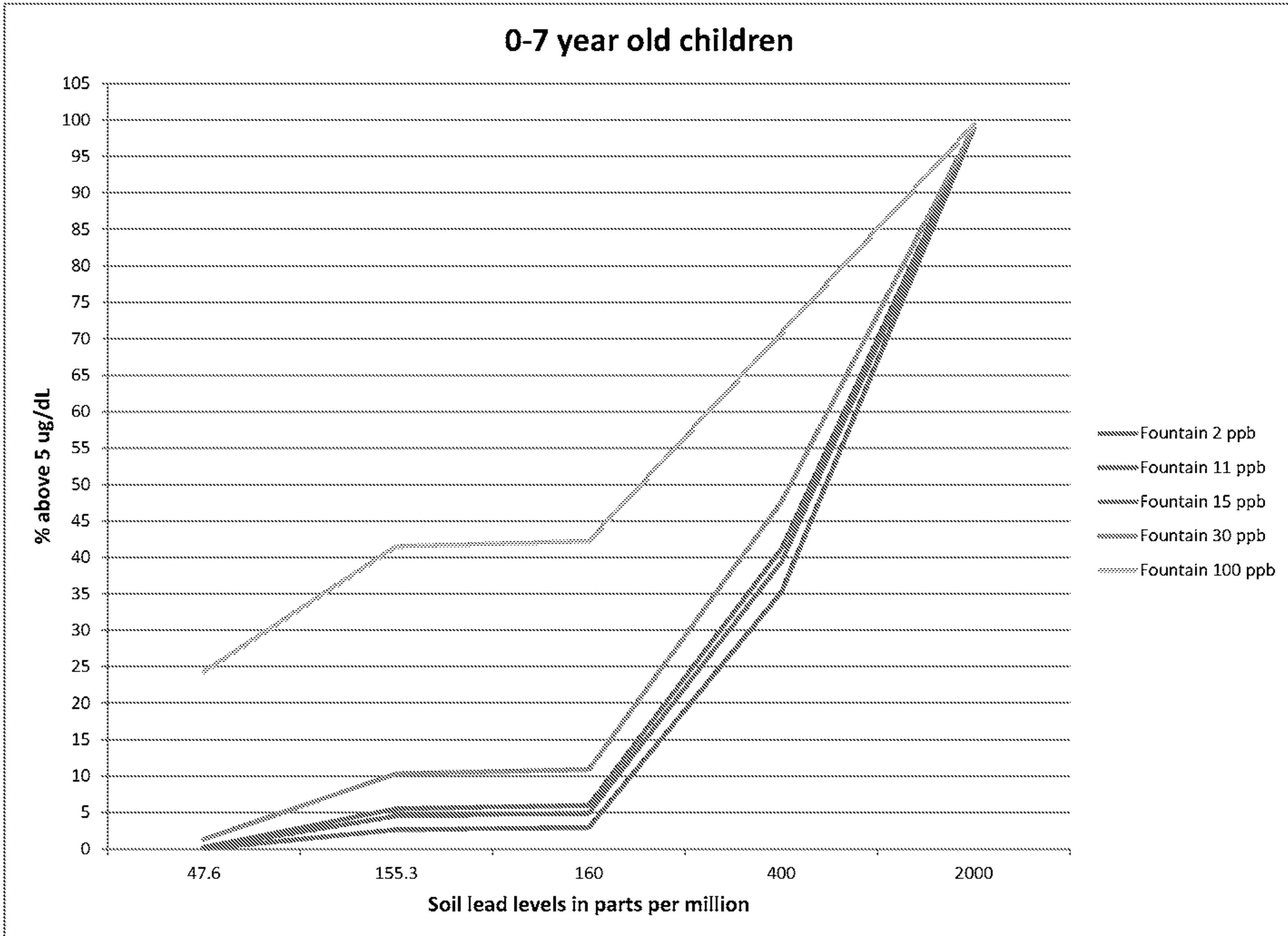
IEUBK model outputs - sorted by soil lead level

		0-1 year olds		0-7 year olds	
Soil lead levels (ppm)	Fountain water (ppb)	Geometric mean Blood lead level (ug/dL)	%>5 ug/dL	Geometric mean Blood lead level (ug/dL)	%>5 ug/dL
400	0	4.268	36.82	4.135	34.306
400	1	4.298	37.376	4.16	34.772
400	2	4.327	37.929	4.184	35.236
400	3	4.357	38.48	4.209	35.699
400	4	4.386	39.029	4.233	36.161
400	5	4.416	39.575	4.258	36.622
400	6	4.445	40.118	4.282	37.082
400	7	4.474	40.659	4.307	37.54
400	8	4.504	41.196	4.331	37.997
400	9	4.533	41.731	4.355	38.453
400	10	4.562	42.263	4.38	38.907
400	11	4.591	42.792	4.404	39.359
400	12	4.62	43.317	4.428	39.81
400	13	4.649	43.84	4.453	40.259
400	14	4.677	44.359	4.477	40.707
400	15	4.706	44.875	4.501	41.153
400	30	5.131	52.202	4.861	47.608
400	100	6.967	75.99	6.463	70.746
2000	0	13.431	98.224	14.549	98.847
2000	1	13.447	98.235	14.564	98.954
2000	2	13.464	98.247	14.579	98.86
2000	3	13.48	98.258	14.595	98.867
2000	4	13.496	98.269	14.61	98.874
2000	5	13.513	98.28	14.625	98.88
2000	6	13.529	98.29	14.641	98.887
2000	7	13.545	98.301	14.656	98.893
2000	8	13.561	98.312	14.671	98.9
2000	9	13.577	98.323	14.686	98.906
2000	10	13.594	98.333	14.702	98.912
2000	11	13.61	98.344	14.717	98.919
2000	12	13.626	98.354	14.732	98.925
2000	13	13.642	98.364	14.747	98.931
2000	14	13.658	98.374	14.763	98.937
2000	15	13.674	98.385	14.778	98.944
2000	30	13.914	98.528	15.005	99.031
2000	100	14.992	99.026	16.034	99.342


0-1 year old children
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
% above 5 ug/dL
47.6
155.3
160
400
2000
Soil lead level in parts per million
Fountain 2 ppb
Fountain 11 ppb
Fountain 15 ppb
Fountain 30 ppb
Fountain 100 ppb

Attachment 1

Graph of IEUBK model outputs for selected water lead levels for 0-7 year old choldren



From: Flaga, Christine (DEQ)
Sent: Monday, December 07, 2015 11:51 AM
To: Sygo, Jim (DEQ);Wagner, Robert (DEQ)
Cc: Wildfang, Eric (DEQ);Schrantz, Phil (DEQ);Shaler, Karen (DEQ);Winters, Bobbie Jo (DEQ)
Subject: FW: lead values

Jim and Bob,

Eric ran the Lead Model this morning as requested by you, Jim, on Friday. The model was run using the updated blood lead reference value of 5 µg/dl as well as all of the other updated input parameters. These are the same updated parameters as used by DHHS in conducting their risk assessment for Flint drinking water i.e., the drinking water ingestion rates, maternal blood lead concentration and the Michigan-specific outdoor air concentration of 0.01 µg/m^3. Assuming a drinking water lead concentration of 0, the resulting acceptable soil lead concentration is 195 ppm.

Let us know if you have any further questions.

Christine Flaga
Toxicology Unit Manager
Remediation and Redevelopment Division
Department of Environmental Quality
P.O. Box 30426
Lansing, MI 48909-7926
Phone #: 517-284-5098
flagac@michigan.gov

From: Wildfang, Eric (DEQ)
Sent: Monday, December 07, 2015 9:03 AM
To: Flaga, Christine (DEQ)
Subject: lead values

Per Sygo's request:

IEUBK Parameter	IEUBK Default Value	Modeled Value
Blood lead concentration reference level (µg/dl)	10	5
Maternal blood lead concentration at childbirth (µg/dl)	1.0	0.8
Outdoor air lead concentration (µg/m^3)	0.1	see below
Drinking water ingestion rates (L/day)		
0-1 year	0.2	0.32
1-2 year	0.5	0.271
2-3 year	0.52	0.317
3-4 year	0.53	0.327
4-5 year	0.55	0.327
5-6 year	0.58	0.327
6-7 year	0.59	0.414

IEUBK model results (assuming 5% probability of exceeding the blood lead concentration level):

Drinking Water Pb concentration (µg/L)	Air Pb concentration (µg/m^3)	Soil Pb concentration (mg/kg)
15	0.01	108
4	0.01	172
0	0.01	195
0	0	196

From: Shekter Smith, Liane (DEQ)
Sent: Thursday, October 16, 2014 8:21 AM
To: Sygo, Jim (DEQ)
Subject: RE: Flint - water

Thanks.

From: Sygo, Jim (DEQ)
Sent: Wednesday, October 15, 2014 7:34 PM
To: Shekter Smith, Liane (DEQ)
Subject: Fwd: Flint - water

Expect a call from Saxton

Sent from my iPhone

Begin forwarded message:

> **From:** "Saxton, Thomas (Treasury)" <SaxtonT@michigan.gov>
> **Date:** October 15, 2014 at 5:23:02 PM EDT
> **To:** "Sygo, Jim (DEQ)" <SygoJ@michigan.gov>
> **Cc:** "Workman, Wayne (TREASURY)" <WorkmanW@michigan.gov>, "Koryzno, Edward (Treasury)" <KoryznoE@michigan.gov>
> **Subject: Flint - water**
>
> Jim – as you know Treasury (thru its EM) is engaged in Flint. Obviously the recent stories re their water quality have raised some concerns. Wayne who is the overall lead for us on this had a conversation with the City today including some of their public works staff. Is there someone we could talk to @ DEQ to get your perspective & corroborate what we are hearing from Flint ? Thanks

From: Smith, Laura (DEQ)
Sent: Thursday, November 06, 2014 2:38 PM
To: DEQ-Legislative-Contact
Cc: Thelen, Mary Beth (DEQ);Sygo, Jim (DEQ);Shaler, Karen (DEQ);Datema, Maggie (DEQ);Howes, Sarah (DEQ);Creal, William (DEQ);Fish, Kim (DEQ);Ostlund, Peter (DEQ);Fulcher, Jerry (DEQ);Cervelli, Donna (DEQ);Vanderlaan, Mary (DEQ);Jesko, Roxanne (DEQ);Vanportfleet, Jennifer (DEQ)
Subject: FW: Michael Foster Floodplain Service, Holloway Reservoir
Attachments: 14440003 11-3-2014 11.1LOMA.pdf; FM26087C0250E.pdf; FM26049C0250D.pdf; RE: WRD/LEG00242/Daley/Holloway Reservoir

I received this as a bcc: so I'm not sure who received this but I'm forwarding to let you know that this is in follow up to LEG00242 (see attached e-mail).

Thanks,
Laura

From: Jesko, Roxanne (DEQ)
Sent: Thursday, November 06, 2014 8:57 AM
To: Dist082@house.mi.gov; supervisor@oregontownship.org; 'clerk@oregontownship.org'; Thomas, Les (DEQ)
Subject: Re: Michael Foster Floodplain Service, Holloway Reservoir

Attached is correspondence to Mr. Foster from Ms. Donna Cervelli, P.E., District Floodplain Engineer,
Water Resources Division, regarding a letter that he sent to the DEQ on Sept 22, 2014.
Please contact her with any questions you may have. She can be reached by phone at 517-243-6951 or via email at cervellid@michigan.gov.

Sincerely,

Roxanne Jesko, Secretary
Water Resources Division
517-284-6665

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING DISTRICT OFFICE

RICK SNYDER
GOVERNOR

DAN WYANT
DIRECTOR

November 5, 2014

Mr. Michael Foster
5200 Stanley Road
Columbiaville, Michigan 48421

Dear Mr. Foster:

SUBJECT: Floodplain Service No. 14-44-0003-FP,
Section 8, T8N, R9E, Oregan Township, Lapeer County,
Holloway Reservoir (Flint River), Letter of Map Amendment (LOMA)

Thank you for your letter dated September 22, 2014, regarding questions about the FEMA National Flood Insurance Program (NFIP) and the regulatory 100-year flood elevation for Holloway Reservoir. The letter also expressed concerns with the Flood Insurance Rate Map(s) (FIRM(s)) for Holloway Reservoir and noted mapping differences between Lapeer County and Genesee County. This letter is intended to help answer your questions and provide direction for you and/or the community.

Prior to mapping the floodzone areas the FEMA uses the best topographic information available at the time of mapping, which differs by county. For Lapeer County the United States Geological Survey (USGS) topographic maps with 10 foot contour intervals were used for elevation data. For the Genesee County maps the use of digital elevation models were produced using light detecting and radar (LIDAR) data with a contour interval of two feet. The same flood elevation was used on both maps, however the background elevation contours in Lapeer County were not as detailed compared to Genesee County.

In NFIP communities, flood insurance must be purchased as a condition of obtaining a federally insured mortgage if the structure is in a federally identified 100-year Special Flood Hazard Area (SFHA) as identified on the FIRM. The 100-year flood elevation, or Base Flood Elevation, of the Holloway Reservoir (Flint River) is 755 N.G.V. Datum of 1929, however; the City of Flint who owns the dam also owns flowage rights (easements) to elevation 760 N.G.V. Datum of 1929 at this location.

With regards to map amendment options and exclusion from SFHA via the FEMA processes, there are actually three vehicles:

1. Single-lot LOMA, with each homeowner submitting lowest adjacent grade for their own homes prepared by a registered surveyor ;

2. Multiple-lot LOMA, with community official, registered land surveyor and/or property owners group submitting lowest adjacent grade for homes contained as a listed set of parcels; and

3. Letter Of Map Revision (LOMR) in which the community official, registered land surveyor and/or property owners group submit certified topographic data for a significant

perimeter length to show a revised delineation. For this option, FEMA will require LIDAR or other high resolution contours over a very large length of shoreline in order to revise a flood map panel, which will require discussing this possibility with the FEMA mapping center. Detailed information on these options can be found at https://www.fema.gov/letter-map-amendment-letter-map-revision-based-fill-process

Below are the steps to follow for a Single-lot LOMA (option 1), if you believe that your structure is not in the 100-year floodplain to possibly remove the flood insurance purchase requirements.

1. Hire a registered land surveyor to survey the lowest adjacent grade to the house and the lowest floor including basement. The surveyor should fill out an elevation certificate (available online at: http://www.fema.gov/business/nfip/elvinst.shtm).

2. Determine the date when the structure was built. The current effective date of the Flood Insurance Rate Map (FIRM) for Oregon Township is September 19, 2007, which is also the first map for this community.

    a. If the structure was built before the date of the first published map then the lowest adjacent existing grade needs to be above the estimated 100 year floodplain.

    b. If the structure was built after the date of the first published map and no fill was placed, then the lowest adjacent grade needs to be above the 100 year floodplain. The property owner also needs to get a letter from the local building official indicating that no fill was placed before the structure was constructed.

3. If the structure is found to be outside the floodplain then the property owner should submit to the Federal Emergency Management Agency (FEMA), form MT-EZ (available online at: http://www.fema.gov/plan/prevent/fhm/frm_form.shtm) entitled "Federal Emergency Management Agency Application Form for Single Residential Lot of Structure Amendments and Revisions to National Flood Insurance Program Maps". If all the appropriate information is sent in, the FEMA will usually respond in 4-6 weeks.

4. The property owner should take the FEMA response, if positive, to the lender and ask that the flood insurance purchase requirements be waived.

The LOMA officially amends the FIRM and removes the federally required flood insurance purchase requirement. However, lenders still have the option of requiring the purchase of flood insurance to protect their investment. The property owner may want to contact the lender to see if they will accept a LOMA. If the lender will not accept a LOMA and waive the flood insurance purchase requirements then the option is to switch mortgage lenders.

If the lender accepts the LOMA and does not require the purchase of flood insurance, the current year's flood insurance premium can be refunded (provided no claims have been paid). If the flood insurance waiver from the lender is taken to the insurance agent, the agent will be able to process a refund.

It is important to note that the issuance of a LOMA does not mean the risk of flooding has been eliminated. In fact, approximately 30 percent of all flood insurance claims occur in areas designated as moderate or minimal flood risk. For more information about the effects of flooding and flood insurance, visit www.floodsmart.gov.

You are advised to keep a copy of the LOMA to avoid flood insurance purchase requirements should the house be refinanced or sold sometime in the future.

If you have any questions on the LOMA process, please contact the FEMA at their toll-free number, 1-877-336-2627. If you have any other questions, of if you need further assistance, please contact me.

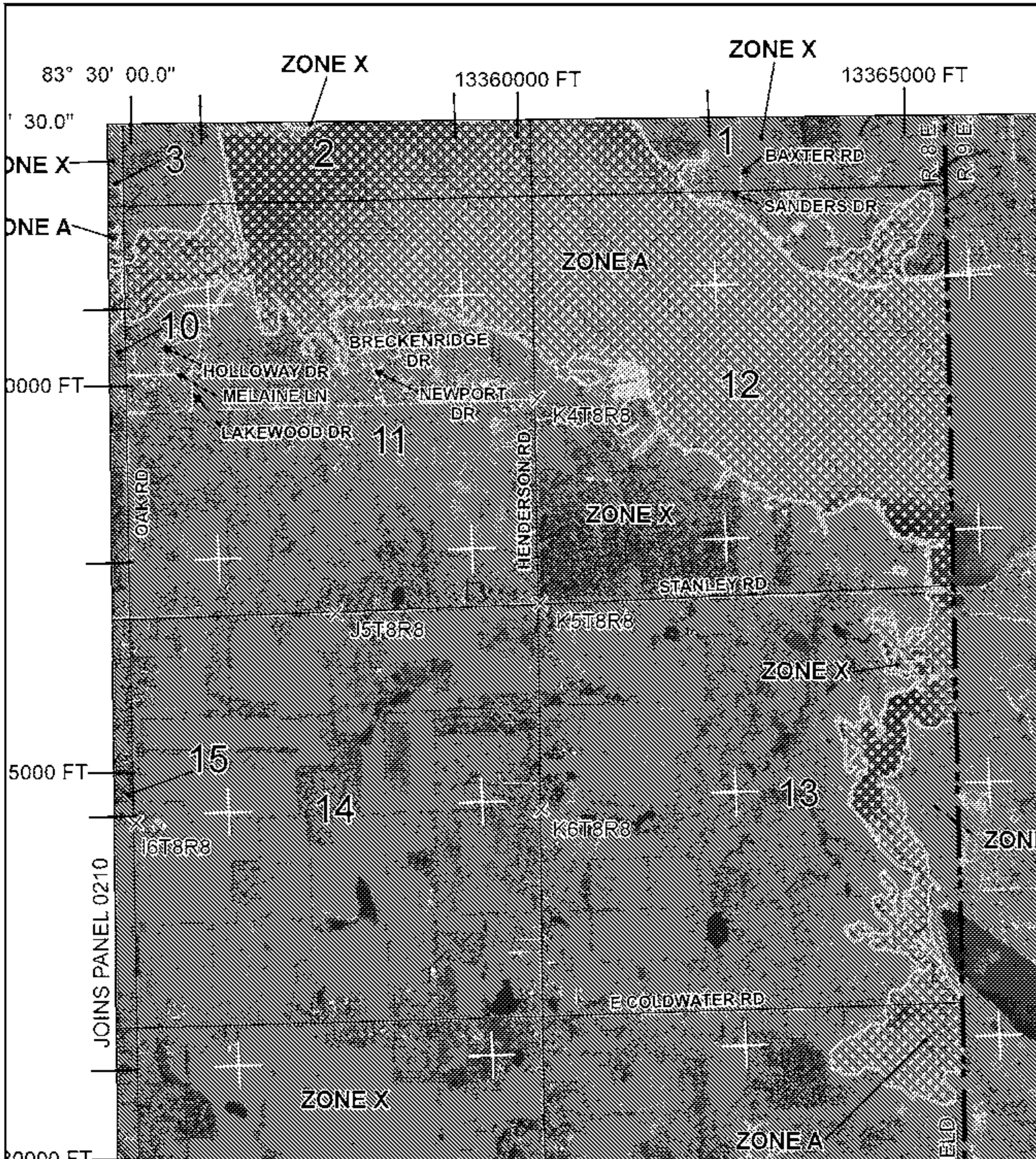
Sincerely,

Donna Cervelli

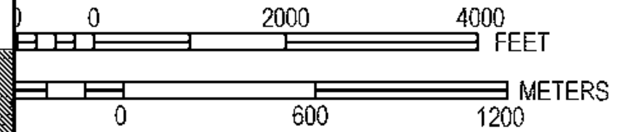
Donna Cervelli, P.E.
District Floodplain Engineer
Water Resources Division
517-243-6951

Enclosures

cc: Representative Kevin Daley, Dist082@house.mi.gov
Supervisor Eldon R Card, Oregon Township, supervisor@oregontownship.org
Mr. H Paul Spencer, Oregon Township Clerk, clerk@oregontownship.org
Mr. Les Thomas, DEQ-WRD, NFIP Coordinator



MAP SCALE 1" = 2000'



NATIONAL FLOOD INSURANCE PROGRAM

NFIP

PANEL 0250D

FIRM

FLOOD INSURANCE RATE MAP

GENESEE COUNTY, MICHIGAN

(ALL JURISDICTIONS)

PANEL 250 OF 475

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
DAVISON, TOWNSHIP OF	260654	0250	D
RICHFIELD, TOWNSHIP OF	260402	0250	D

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
26049C0250D

EFFECTIVE DATE
September 25, 2009

Federal Emergency Management Agency