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I have been asked to evaluate the environmental chemical data available on the Harold J. Guidry property in St. Martin Parish, Louisiana and to assess any potential human health implications related to the chemicals present on the property. The property is described in Plaintiff's Petition for Damages for the matter captioned *Harold J. Guidry, et al. v. BP America Production Co., et al,* Docket No. 82537, Div. "G", 16th JDC, St. Martin Parish, Louisiana.

I hold board certifications in Medical Toxicology and Emergency Medicine through the American Board of Medical Specialties, and a certification in Toxicology through the American Board of Toxicology. I earned a doctorate in Analytical Chemistry from the University of Iowa in 1980 and a doctorate in Medicine from the University of Texas Southwestern Medical School in 1987. I have practiced and taught medicine and toxicology for over 25 years, including in Mississippi for the past 21 years and in Georgia for the preceding 5 years. I am currently employed as a professor in the School of Medicine at the University of Mississippi Medical Center. I am the Director of the Mississippi Poison Control Center and the Medical Toxicology Clinical Service at the University of Mississippi Medical Center.

I toured the site and surrounding area on March 3, 2017. Overall the vegetation on the site appeared healthy. I did not personally observe any visible chemical contamination on the Guidry property, but there was a leaking saline drain line adjacent to the property. There are also several active oil and gas wells adjacent to the property. There was some trash burning approximately 50 feet from well sites GC-12D and GC-12DD.

The data that I used in my evaluation has been previously summarized in the Data Report by Hydro-Environmental Technology, Inc. (HET). In performing my evaluation, I considered all the available data, including data collected by the plaintiffs, identified as ICON samples and analytical data collected for BP, identified as HET and MP&A samples.

A brief description of the methods that I used in performing my evaluation included the following:

1. Define potential exposure pathways and determining if data exist to evaluate a potential pathway. Opining on a potential pathway in the absence of data that could have been easily collected is nothing more than speculation.
2. Statistically evaluating the data for a given medium. Analytical data should not automatically be taken at face value. Human exposures cannot be estimated by selecting out a few maximum values. Any attempt to do this is invalid and unscientific. There is a world of difference between using maximum values as a screening tool to determine if additional analyses are necessary and attempting to apply a maximum value to benchmark toxicology values as a "risk analysis".
3. Central statistical values and distributions were compared to local or national ranges for each constituent of interest as well as toxicological benchmark values for each medium/exposure pathway. Where appropriate, calculations were performed to compare potential doses and risks from ingesting soil, inhaling dust or drinking water for a 2-year-old child and an adult to compare these doses to EPA reference doses (RfD) and ATSDR Minimum Risk Levels (MRLs). When appropriate, the water concentrations found were compared to the EPA drinking water standards. However, the toxicological exposure/dose calculations used for EPA's reference doses do not always agree with the drinking water standards. Hazard Quotients were calculated to mathematically compare the exposure dose to the toxicological standard. A hazard quotient less than one suggests a very low likelihood of adverse human health effect.
4. The final step in my analysis (if needed) was to evaluate the likelihood of exposure pathway occurring and consider the safety factors used in deriving the

toxicological benchmark. For example, if a chemical concentration was measured in the superficial aquifer, this is unlikely to be used for a drinking water well. Just because a given parameter exceeds the toxicological benchmark it does not mean that an adverse health effect will occur. Many toxicological benchmarks are based on animal studies and the health effect has never been seen in humans associated with the parameter of concern. Then safety factors from 100-1000 are applied.

It is inappropriate to discuss general causation for a chemical or other parameter without considering a quantitative exposure/dose analysis. The only data available at this time are for chemical concentrations in soils and groundwater. The exposure routes that I considered are incidental ingestion of soil, inhalation of dust and drinking groundwater. Long-term dermal exposure to the soil or groundwater are unlikely significant exposure pathways. There is no data to support plant uptake and/or consumption of animals living on the property. For any focal soil contamination, it is highly unlikely/impossible that an animal will only eat plants in a small focal area for its entire life. Soil and groundwater data were each evaluated at three different depths since the likelihood of human exposure varies significantly at different depths for each. The greatest likelihood of human exposure to soils would be for superficial soils. For groundwater, the deep aquifer is most likely to be used for drinking water wells.

At the present time, nobody lives on the Guidry property. There are no health risks of incidental contact with soils or groundwater for an individual walking across the property. I was asked to perform the risk analysis considering that someone lived on the property.

Potential Human Health Impacts for Soils

The results for the toxicological evaluation of the potential adverse human health effects for chemicals present in soils are summarized below.

1. Arsenic - There is no evidence of arsenic contamination on the Guidry property. Arsenic is naturally occurring in the earth's crust and seawater. The concentrations of arsenic found in the superficial soils on the Guidry property are normally distributed and well within the background ranges for St. Martin Parish and the United States. Any risk from ingesting soil or inhaling dust containing arsenic on the property would be no greater than anywhere else in the United States.

2. Barium – The total barium concentrations on the Guidry property are within the normal ranges for soils. The data were not normally distributed with several high values being outliers for the ICON data. Even when adjusting for percent moisture, the ICON data were 1.3-1.7 times higher than the HET data. The mean and median barium concentrations in the soil were well within the LDEQ RECAP screening limit and Management Option 1 for non-industrial situations. I calculated the daily intake for a child and adult and Hazard Quotients against the EPA RfD and ATSDR MRL and these were well less than 1. There is no significant risk to human health from barium concentrations on the Guidry Property. The few sites that did demonstrate elevated concentrations in superficial soils did not show elevations in deeper soils. This suggests that the barium present in superficial soils is insoluble and nontoxic.

3. Mercury – Mercury concentrations on the Guidry property was not normally distributed and skewed toward high concentrations. Mercury concentrations in superficial soils were very low except for two sites, GC-1 and GC-2. The mean and median mercury concentrations in superficial soils were well below the LDEQ RECAP screening limit and Management Option 1 for non-industrial situations. A single highest concentration from site GC-2 was less than the LDEQ RECAP Management Option 1 for non-industrial situations. I calculated the daily intake for a child and adult and Hazard Quotients against the EPA RfD and ATSDR MRL and these were well less than 1. There is no significant risk to

human health from mercury concentrations on the Guidry Property. The two sites that did show some mercury elevation showed very low concentration in soils deeper than 2 feet.

4. Strontium - Strontium is naturally occurring in the earth's crust and seawater. The concentrations of strontium found in the superficial soils on the Guidry property are normally distributed and less than background ranges for soils. Two sites (SB-6, GC-5) had strontium concentrations above the other samples, but were still well within normal ranges for soil. Any risk from ingesting soil or inhaling dust containing strontium on the property would be no greater than anywhere else in the United States.

5. Total Petroleum Hydrocarbons – ICON analyzed 10 intermediate soil samples and 5 deep soil samples for total petroleum hydrocarbons using the TPH-DRO and TPH-ORO methods. Each of these registered values that exceeded the LDEQ RECAP screening limit. However, these nonspecific methods only separate hydrocarbons by boiling points and are difficult to apply to toxicological analyses. The more specific method is to measure narrow hydrocarbon fractions for aliphatic and aromatic hydrocarbons. This was done on 13 samples from 6 sites at various depths by HET. Hydrocarbon fractions were detected at two sites, GC-7 at various depths and SB-7 at 6-8 feet depth. All other samples showed non-detectable results. None of the hydrocarbon fraction results exceeded the LDEQ RECAP screening limits (RECAP Table 1).

   LDEQ has addressed the issue of the TPH-DRO test results exceeding the screening standard and hydrocarbon fractionation results not exceeding standards: "Site management decisions should be based on the fractionation data (assuming it meets all QA/QC requirements) since this data is more specific and thus more representative of site conditions." (Source: *RECAP Frequently Asked Questions.*

Accessed at: *http://www.deq.louisiana.gov/portal/Portals/0/RemediationServices/RPform_5340.pdf* . There was no sampling of superficial soils for petroleum hydrocarbons. Since it is highly unlikely that humans living on the Guidry Property will have contact with soils more than 4 feet below the surface and none of the hydrocarbon fractions exceeded the RECAP screening standards for soils more than 4 feet beneath the surface, my conclusion is that there is no evidence that concentrations of petroleum hydrocarbons exist that will pose a threat to human health.

6. In reviewing the chemical data, I found no evidence that any soil sample analysis for cadmium, chromium, lead, selenium, silver or zinc exceeded or even came close to the RECAP Human-Health Screening Standards. There is no significant human toxicity for salinity, calcium, magnesium, sodium, chloride, bicarbonate, sulfate or electrical conductivity short of physiological derangements or supratherapeutic intravenous or oral dosing. LDEQ states: "Under RECAP, soil standards consider the protection of human health, groundwater, and aesthetics. The presence of sodium chloride in soil does not pose a risk to human health (TNRCC 2001; Bright and Addison 2002) therefore, a $Soil_{ni}$ or $Soil_{i}$ is not needed for site evaluation. (Source: *Appendix D. Guidelines for Assessing Constituents with Special Considerations. LDEQ RECAP*)

7. My summary after evaluating all the chemical data on soil analysis from the Guidry property is that the available data do not suggest any parameter that would pose a significant threat or risk to human health.

Potential Human Health Impacts for Groundwater

The results for my toxicological evaluation of the potential adverse human health effects for chemicals present in groundwater are summarized below. For groundwater, it is necessary to analyze the data in several ways. Depth is critical since only the deep zone is likely to be used for a drinking well. Although statistically it can be considered that any well would be randomly placed on the property, if there are areas that are contaminated and a well should not be used for drinking water, then the location of the well should be known. Thus, groundwater data were examined individually as well as in congregate. I will discuss groundwater findings by individual chemical of concern and by any individual sites that have problems.

1. Arsenic – The superficial aquifer was sampled at 16 sites on the Guidry property. The arsenic concentrations were low, ranging from less than the detection limit (<0.01) to 0.02 mg/L for the ICON samples to 0.016 for the for the HET samples. The HET samples were also analyzed after filtering. After filtering 94% of all samples showed no detectable levels and the two remaining positive samples averaged 0.011 mg/L. This shows that what arsenic that was in the superficial aquifer was associated with particulate matter, likely soil particles that naturally contain arsenic. In the intermediate aquifer 90% of the samples contained no detectable arsenic. Only 2 samples contained arsenic with a maximal concentration of 0.012 mg/L. After filtering, no samples contained detectable arsenic. In the deep aquifer, only three samples contained arsenic concentrations at the detection limit of 0.01mg/L with the remainder showing non-detectable levels. None of the HET samples showed detectable concentrations of arsenic. Very low levels of arsenic were found in the superficial and intermediate aquifers and it was removed by filtering. Any groundwater used for drinking would be filtered prior to use. The new arsenic drinking water MCL value for arsenic is 0.01 mg/L. Given that 10% of the groundwater in the United States naturally exceeds this value and that 2.6% of the wells in Louisiana exceed this value, there is no evidence of any arsenic contamination or risk from using this water for drinking.

2. Barium – There were no sites that exceeded the LDEQ RECAP drinking water screening standard of 2 mg/L in the superficial aquifer. In the intermediate aquifer site GC-8 had elevated barium concentrations exceeding the RECAP screening standard. The average for nine samples at this site was 3.4 mg/L. This was soluble barium, not removable by filtering. No other site had barium concentrations that exceeded the RECAP screening standard. No sites exceeded the screening standard in the deep reservoir. The EPA MCL for barium is 2 mg/L. This is based on the possibility of barium causing hypertension in humans. ATSDR does not consider this a reliable target effect for a toxicological benchmark. The EPA oral Reference Dose (RfD) for barium is 0.2 mg/kg/day and is not based on hypertension. The ATSDR chronic Minimal Risk Level (MRL) for barium is 0.2 mg/kg/day. The hazard quotients would be 0.2-0.4 for an adult and 0.2-0.7 for a child. Thus, even if the intermediate well GC-8 were used for drinking water, the barium concentration would not pose an appreciable risk to human health.

3. Sodium – As already mentioned, sodium and other salts such as calcium and magnesium and chloride are essential to life and nontoxic under normal dietary conditions. The issue of sodium contributing to hypertension remains controversial to this day. When sodium concentrations exceed 200 mg/L this affects the taste of water, producing a very salty taste. Sodium concentrations exceeded 1000 mg/L in well GC-4 in the superficial aquifer, and wells GC-8 and GC-12 in the intermediate aquifer. The average sodium concentration in samples from GC-8 was 2937 mg/L and in GC-12 was 1756 mg/L. This high sodium concentration would make the taste of the water in these wells unsuitable for human consumption. None of the wells in the deep aquifer demonstrated elevated sodium concentrations, although it appears that site GC-8 was not sampled in the deep aquifer. The deep aquifer would most likely be used as a drinking water source. Water from these superficial and intermediate aquifers at these sites would not be potable due to an extreme salty taste.

4. Strontium – Of 16 sites tested in the superficial aquifer, all sites had low concentrations consistent with drinking water sources in the United States. One site, GC-4 had an average concentration of 2.8 mg/L, that was above the rest but still within U.S. background ranges for drinking water. In the intermediate aquifer, the two sites that had elevated salts, GC-8 and GC-12, also had mildly elevated concentrations of strontium. GC-8 had an average concentration of 4.8 mg/L and GC-12 was 2.7 mg/L. There were no elevations of strontium in the deep aquifer. There currently is no drinking water standard for strontium, but EPA is considering one. EPA has defined a reference dose of 0.6 mg/kg/day for strontium based on a NOEL for bone effects in young rats and an uncertainty factor of 300. ATSDR has developed an intermediate-duration MRL of 2.0 mg/kg/day using the same endpoint and an uncertainty factor of 30. Using these benchmarks, the hazard quotients for a 2-year-old child drinking water containing 4.8 mg/L strontium are 0.21-0.67 for the RfD and 0.06-0.2 for the MRL. Thus, using current toxicological benchmarks, the quantity of Strontium in wells GC-8 and GC-12 does not pose a health risk. As previously mentioned, water from the intermediate aquifer at these sites is not potable due to taste issues.

5. Total Petroleum Hydrocarbons – As with soils, ICON ran the screening TPH-DRO & ORO tests on water samples from the well sites. These samples were split and also run by HET. These tests were positive for most samples in the superficial aquifer and GC-8, GC-12 and MW-7 in the intermediate aquifer. TPH-DRO was positive in some samples from MW-1, 4, 6 and 7 in the deep aquifer. Water samples were also analyzed by the hydrocarbon fractionation method by HET. None of the hydrocarbon fractionation analyses had positive results. As discussed above, the hydrocarbon fractionation method is the more specific test that can be used for toxicological analyses. Since these were all negative, there is no evidence of human health risk from hydrocarbons in the groundwater at any depth.

No samples for TPH-GRO showed positive results. There were several isolated positive results for ethylbenzene in the shallow and deep aquifers. These were well below the RECAP screening standards. None of the other BTEX compounds showed any positive results.

6. Radium – Radium 226 and radium 228 are naturally occurring isotopes of radium that are radioactive. The EPA maximum contaminant level (MCL) for combined radium 226 and radium 228 is 5 pCi/L. None of 16 sites sampled in the superficial aquifer exceeded the MCL. In the intermediate aquifer, sites GC-8 had an average combined radium level of 8.9 pCi/L and well GC-12 had an average radium level of 6.0 pCi/L. None of the GC well sites in the deep aquifer had levels of combined radium above the MCL. Well MW-3, that is not on the Guidry property (Bundrick) and well MW-4 had elevated radium concentrations in the deep aquifer on HET analysis but were normal on ICON analyses.

   Outside of the drinking water standard, neither EPA nor ATSDR has established any toxicological benchmarks for radium such a reference dose or MRL for non-cancer endpoints or a cancer slope. There are a significant number of studies on dose response for radium in humans. It has been used as a medication in the past and was used industrially by watch painters. Each population had significant exposures and associated health effects in the past. Radium seems to demonstrate a minimal dose for health effects. Estimates of minimal doses associated with malignancy are 1.03 µCi/kg – 12 µCi/kg. Cataracts in children have been associated with 15.6 µCi/kg (ATSDR Toxicology Profile). Drinking a concentration of combined radium of 10 pCi/L for a lifetime would give a dose of approximately 0.0082 µCi/kg. This is 125 times less than the minimal dose of radium that has been associated with adverse health effects in humans.

   Since radium is naturally occurring, approximately 20% of drinking water from ground water sources are in excess of the 5 pCi/L MCL. The average concentration of combined radium for those water supplies exceeding the MCL is 10 pCi/L. To my knowledge, no adverse health effects have ever been described for the populations drinking this water. Benchmarks do not exist to quantitatively compare the combined radium concentrations in these wells. There is no obvious significant risk of adverse health effects. Also, the water in GC-8 and GC-12 is not potable due to taste issues.

7. Other parameters – I found no evidence that any groundwater sample analysis for cadmium, chromium, lead, mercury, selenium, silver or zinc exceeded the RECAP Human-Health Screening Standards. There is no significant human toxicity for salinity, calcium, magnesium, sodium, chloride, bicarbonate, sulfate or electrical conductivity short of physiological derangements or supratherapeutic intravenous or oral dosing.
8. My summary after evaluating all the chemical data on groundwater analysis from the Guidry property is that the available data do not suggest any parameter that would pose a significant threat or risk to human health.

In summary, I found nothing on the Guidry property that is a human health risk for someone with any incidental exposure on the property. If someone were to live on the property, the only limitation is that the water near well sites GC-8 and GC-12 in the intermediate aquifer is not suitable for human consumption. Water from the deep aquifer at site GC-8 should be sampled prior to using at this site.

All my opinions are expressed to a reasonable degree of medical and scientific certainty. I reserve the right to supplement or change any opinions if additional information is produced.