

EXHIBIT 5

TCAS

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January 22, 2021

Ken Moll, Esq.
Moll Law Group, PC
22 W. Washington St, 15th Floor
Chicago, IL 60602

Re: Peterson v. Monsanto

Dear Attorney Moll:

Per your request with regard to this matter, I have reviewed the complete list of pertinent documents as compiled in Appendix A. Based upon the information provided and the application of generally-accepted toxicological methodology and referenced sources as cited herein, I have stated my opinions in this matter to reasonable toxicological certainty.

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Hence, this toxicological assessment has four fundamental objectives: (1) to arrive at a scientifically-reliable exposure dose estimation for Mr. Peterson (*in units of 8-hour time-weighted exposure days*) based upon the available objective evidence, (2) to assess the potential of confounding toxicological risk factors contributing to his NHL onset, (3) to provide a general causation assessment of personal protective gear (PPE), product formulation, toxicological factors such as absorption, distribution, metabolism and excretion (ADME) and mechanism of action of Roundup and (4) to render a scientifically-supported and reliable opinion as to whether Mr. Peterson's Roundup exposures (dose) were sufficiently above the thresholds within the peer-reviewed studies to substantially contribute to the development of his NHL.

2. Plaintiff Background Summary

James Peterson was born on [REDACTED] in Chicago, Illinois and is currently 77 years of age.

NHL Diagnosis and Pathology

Mr. Peterson began experiencing symptoms related to his lymphoma in January of 2017 and was diagnosed with diffuse large B-cell lymphoma (DLBCL) on February 6, 2017.

Approximately one month prior to his diagnosis, Mr. Peterson began experiencing fatigue, poor appetite, intermittent abdominal pain, nausea and a 12-pound weight loss.³ He presented to the emergency department on January 22, 2017, for abdominal distension and lower back pain. He underwent an upper and lower endoscopy and was believed to have diverticulitis.

Following an MRI and biopsy of a left supraclavicular mass, Mr. Peterson was diagnosed with diffuse large B-cell lymphoma (DLBCL) with a very high mitotic rate. His pathology report reviewed the associated clinical findings in some detail:

Illyassou, K., et al., "Risk Assessment for Small Farmers Exposed to Plant Protection Products in the Niger River Valley," 2017, Comm. Appl. Biol. Sci.

EPA, "Risk Assessment Methodology for Hazardous Substances: How to assess the risk, cost and benefit of new hazardous substances for use in New Zealand," 2018, Environmental Protection Authority.

³ Northwest Community Healthcare, p. 840.

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- *The core biopsy is replaced by a diffuse population of cells with extensive crush artifact, favor lymphoid population. The morphology is difficult to appreciate secondary to artifactual distortion; however, the cells appear medium to large in size. According to the electronic medical record, the patient has cervical, retroperitoneal and upper abdominal lymphadenopathy.*
- *Flow cytometry confirms the presence of a neoplastic B-cell population, a subset of which appears to be CD-10 positive. Overall, however, the sample is limited. Immunohistochemistry is complementary, confirming the presence of CD-10 expression as well as BCL-6 and MUM1 expression suggesting the presence of a diffuse large B-cell lymphoma of follicular center derivation, “germinal center type.”⁴*
- *The fluorescence in situ hybridization (FISH) results revealed positive BCL-2 gene rearrangement; negative for BCL-6 and MYC gene arrangement.⁵*
- *A CT scan of the abdomen displayed retroperitoneal lymphadenopathy.*

Mr. Peterson subsequently underwent six cycles of R-CHOP chemotherapy starting on February 14, 2017 and ending on May 30, 2017.⁶ He tolerated treatment well, but due to fatigue and failure to thrive at home, he was placed in a nursing home between treatments. Mr. Peterson is currently in clinical remission.⁷

⁴ Id., p. 260.

⁵ Id., p. 263.

⁶ Id., pp. 603-605.

⁷ Id., p. 844.

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Personal Medical History

Mr. Peterson's pertinent medical history includes arthritis, ataxia, diverticulitis, epistaxis, GERD, hyperlipidemia, hypertension, sleep apnea and visual impairment. He has a surgical history of wrist surgery and ganglion cyst excision.⁸ He is allergic to dicloxacillin, adhesive and Sulfa.⁹ **Table 1** summarizes Mr. Peterson's medical history.

Table 1
Summary of Mr. Peterson's Medical History

Date	Procedure/Symptoms	Findings/Diagnosis	Reference/Notes
9/5/15	Comprehensive metabolic panel	Mixed hyperlipidemia	Northwest Community Medical Records, page 3.
9/30/15	Chest X-ray Cough and shortness of breath	Aorta is mildly ectatic. Mild degenerative changes in the spine and shoulders. No evidence of active disease or significant new abnormality.	Northwest Community Medical Records, page 12.
11/10/15	Near syncopal episode while at physician's office having nasal packing removed. C/O weakness. Cough, fever, chest pain, dyspnea, ¹⁰ hypotension. Reports nausea and one episode of vomiting. No shortness of breath.	Near-syncope; vasovagal. Chest X-ray unremarkable; no active disease. Height: 66" Weight: 189 lbs.	Northwest Community Medical Records, page 21-28. Four days prior, he had persistent epistaxis. Pt took a double dose of blood pressure medication by mistake.
12/29/16	MRI brain	Ataxia - mild ventricular and sulcal prominence consistent with mild atrophy. Small vessel disease. Weight: 185 lbs.	Northwest Community Medical Records, page 148-149.

⁸ Id., p. 168.

⁹ Id., p. 81.

¹⁰ Later states he denied chest pain and shortness of breath or nausea (page 36).

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Table 1
Summary of Mr. Peterson's Medical History

Date	Procedure/Symptoms	Findings/Diagnosis	Reference/Notes
1/22/17	CT abdomen and pelvis. Abdominal distension and increased flatus. Exacerbation of previous lower back pain, worse with movement. Ongoing for several days.	Extensive primarily upper abdominal lymphadenopathy involving the mesentery and retroperitoneum. Possible mass in proximal sigmoid colon adjacent to several mesenteric lymph nodes. Endoscopic correlation is suggested. Diverticulosis without CT evidence for active inflammation. Weight: 180 lbs.	Northwest Community Medical Records, pages 172-174.
1/31/17	MRI of neck Large firm mass in left lower anterior area, scheduled for needle aspiration	Left supraclavicular 6-7 cm mass is new. Differential diagnosis includes lymphoma, metastasis, or less likely, infection.	Northwest Community Medical Records, page 204. MRI neck 10/20/2014
2/1/17	X-ray chest, obstructive series. Generalized weakness for almost 2 weeks; progressive and now severe accompanied by constipation and some belching. Denies change in underlying "balance problem" and denies dizziness	Mild elevation of the right hemidiaphragm. Stable tortuosity of the descending thoracic aorta. No active disease. Non-specific non-obstructive bowel gas pattern	Northwest Community Medical Records, pages 220, 236.
2/6/17	Ultrasound - superficial lymph node core biopsy	Diffuse large B-cell lymphoma	Northwest Community Medical Records, pages 259-260.
2/7/17	Colonoscopy with biopsy, esophagogastroduodenoscopy	Abnormal findings on diagnostic imaging of abdomen, gastric polyps, diverticulosis of colon without hemorrhage. Sigmoid colon biopsy: highly suspicious for B-cell lymphoma	Northwest Community Medical Records, pages 292, 325.

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History of Tobacco, Alcohol and Drug Use

Mr. Peterson is a lifetime non-smoker. The available medical records report that he has never used illicit drugs and that he does not consume alcohol.¹¹ Further information is detailed in the interview section below.

Interview with James Peterson, January 7, 2021

I interviewed Mr. Peterson on January 7, 2021. His interview was most informative as he provided detailed information regarding his residential and employment history as well as his Roundup applications and exposures.

Mr. Peterson was born in Chicago and lived there until the age of 2. His parents divorced at that time and he moved to Palatine, Illinois, with his mother. They subsequently moved back to Chicago when Mr. Peterson was approximately five years old. The family lived in apartments in a mixed residential/commercial neighborhood. In 1956, they moved to Norridge, IL. In 1959, when Mr. Peterson was a freshman in high school, they moved to [REDACTED] Mr. Peterson has lived in this home ever since.

Mr. Peterson reported that there were no gasoline service stations, toxic waste sites or superfund sites near any of his homes. While living in Chicago, there were gasoline stations a few blocks from his apartment and an area where several large tanks were stored, but he has no knowledge of what was in the tanks. However, they were not adjacent to his residential location.

After graduating high school, Mr. Peterson started college at Northern Illinois University where he eventually received a bachelor's degree in geology. During his college years, he would take time off to work¹² and save money for his tuition.

Employment History

Mr. Peterson was drafted into the U.S. Army in the spring of 1965 after completing his third year of college. He was trained in radio teletype duties and sent to South Korea

¹¹ Northwest Community Healthcare, page 133.

¹² Mr. Peterson performed various jobs including working in a school cafeteria and packing and shipping at a book company (also headed up the freight department at this job). He worked at Echo Containers which made aluminum pans. He reported no significant toxic exposures at any of these jobs.

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where he served a 14-month tour of duty. He was not involved in active military operations or skirmishes. He returned to the U.S. to finish his last year of college in 1968.

After receiving his degree, Mr. Peterson could not find employment using his knowledge of geology. Instead he obtained a job at “Nuclear-Chicago Corporation” performing inventory and product control. This company developed and produced scanners for use in hospitals. Mr. Peterson worked at a desk, not on radiological equipment; thus, he stated that he did not experience any radiological exposures at his place of employment.

In 1969, Mr. Peterson obtained employment at Motorola (manufacturer of radios) where he again was responsible for inventory and product control. He again reported no toxic exposures. He worked at Motorola until 1976.

From 1976-1985, he worked at Baxter Labs in Wisconsin where he again held a position in product planning and inventory control. From there, he worked at a printing company in Elk Grove, Illinois, as the manager for the estimation department until 1992. He reported a one-time exposure to a chemical coating that was being applied to glass, but he had no ill effects.

Ultimately, Mr. Peterson obtained employment with the U.S. Postal Service as a mail carrier. He continued working for the Postal Service until February of 2011 when he retired. He reported a short exposure to an oil-based paint which was being applied on metal doors in the apartments to which he delivered mail. The exposure via inhalation lasted for 10-15 minutes which he characterized as “odiferous.”

Mr. Peterson has never consumed excessive alcohol (“hardly any alcohol”), smoked cigarettes or used any drugs-of abuse. In his 40s, his weight was somewhere in the 170s at 5’6” which he stated was considered overweight but not obese. His weight when he was working at Motorola increased to about 185 pounds; however, he lost weight before beginning his job for the postal service.

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Family Medical History

Mr. Peterson's mother smoked cigarettes for 43 years and died of lung cancer at the age of 66. He does not know anything about his father's medical history as his parents divorced when he was 2 years of age. His sister has never developed any malignancies. Mr. Peterson has no children of his own.

Roundup Use History

Regarding his use of Roundup, Mr. Peterson used it at the [REDACTED] beginning in 2013. He would spray every 1-2 months depending on the weather. Thus, he estimated that he made 4-5 Roundup applications per year during the spring and summer months to irradiate weeds and moss on his two patios. In total, he estimated that he spent 8 to 10 hours per year mixing and spraying Roundup. He continued to use Roundup up through the fall of 2016.

Mr. Peterson wore long pants and sometimes used blue nitrile gloves when handling Roundup. He acknowledged that when mixing and applying diluted Roundup concentrate, he would regularly get some of the product on his hands or ankles. He initially used a Roundup container with a hose attached but doing so often took more than one day to spray. In 2013/2014, he switched to a "multi-use" sprayer which sped up the job.

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Potential Confounding Exposures

Table 2 summarizes toxicological findings pertaining to potential confounding exposures as revealed in interview:

Table 2
Review of Potential Causative Factors

Potential Causative Factor	Yes/No
Family medical history ¹³	Yes Mother lung cancer - See above
Significant alcohol consumption history	None
Smoking history and pack-year calculations	None
Drugs-of-abuse	None
Any history of obesity?	No
Prior significant pharmacological regimens	Use of statins after retirement in 2011 – not significant
Any history of hematopoietic malignancies or other cancers?	Possibly a basal cell carcinoma of the skin on his ear
Ever been prescribed long-term immunosuppressive pharmaceuticals such as prednisone?	No
Ever prescribed cyclophosphamide or any other drugs to treat cancer prior to NHL treatment?	No
History of organ transplant?	No
Ever been diagnosed with HIV, AIDS?	No
Ever been diagnosed with Hepatitis B or C?	No
Ever been diagnosed with Crohn's disease?	No
Ever been diagnosed with rheumatoid arthritis?	Yes, prescribed Vioxx (NSAID) – no immune-suppressants
Ever been diagnosed with ulcerative colitis?	No
Significant radiological exposures or CT scans prior to NHL treatment?	No ¹⁴
Ever lived near or adjacent to a Superfund site?	No
Paint and/or paint solvent exposure?	No
Significant exposures to benzene?	No
Exposure to petroleum products?	No
Any unusual or chronic gasoline exposures?	No
Use of solder for pipe welding?	No
Ever welded pipes?	No

¹³ Medical genetics deferred to oncologist.

¹⁴ Recalled a plantar wart on his foot treated with radiation when still in high school.

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Table 2
Review of Potential Causative Factors

Potential Causative Factor	Yes/No
Ever used plumbing PVC glue?	No
Use of a wasp killer or other insecticide/pesticide?	Occasional
Use of herbicide other than Roundup?	Used a herbicide (name unknown) twice to control creeping vines
Use of Miracle-Gro?	No
Use of AMDRO?	No
Ever used 2,4-D?	No
Ever used Weed & Feed?	Used on lawn once every 3 years
Ever used Snake-A-Way?	No
Ever used Sevin?	Very rarely on roses
Use of any other home gardening/landscape chemicals?	Malathion on cherry tree; used twice
Use of latex paint?	No
Ever farmed or been exposed to livestock?	No
Other underlying chemical exposures?	No

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Roundup Product Applied

Mr. Peterson purchased and used the Roundup® Multi-Use Sprayer as shown in the supplied photograph of his applicator (**Figure 1**). Mr. Peterson used both Roundup concentrate and the ready-to-use formulation.



Figure 1: Roundup Spray Applicator Used by Mr. Peterson

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Residential Applications

The photos supplied by Mr. Peterson show residential areas where he regularly sprayed Roundup® as illustrated in **Figures 2, 3 and 4.**



Figure 2: Area where Mr. Peterson regularly sprayed Roundup®

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Figure 3: Area where Mr. Peterson regularly sprayed Roundup®



Figure 4: Area where Mr. Peterson regularly sprayed Roundup®

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Personal Protective Equipment (PPE)

Other than long pants and (occasionally) blue nitrile gloves while mixing, Mr. Peterson did not wear any personal protective equipment.

Summary of Exposure Factors

Mr. Peterson began using Roundup Weed Killer every 1-2 months depending on the weather for a total of 4-5 applications per year during the spring and summer from 2013 through the fall of 2016 (4 years). He applied Roundup residentially to control weeds and moss on his personal property.¹⁵

Scope of Exposures and Exposure-Day Calculations

This section assesses Mr. Peterson's exposure history to arrive at a scientifically-accurate toxicological value representing *8-hour time-weighted exposure-days*. **Table 3** presents a compilation of Mr. Peterson's episodic Roundup® exposures as obtained from his interview.

Table 3

Calculation of Mr. Peterson's 8-Hour Time-Weighted Roundup® Exposure-Days

Date	Years	Events Per Year	Total Hours/Yr.			Total Hours			Exposure Days (8 hours/day)		
			Min	Mid	Max	Min	Mid	Max	Min	Mid	Max
2013-2016	4	4.5	8	9	10	32	36	40	4	4.5	5
Totals:						32	36	40	4	4.5	5

The information compiled in **Table 3** reveals that Mr. Peterson sustained a minimum of 4 exposure-days [$32 \div 8$ hrs./day], a maximum of 5 exposure-days [$40 \div 8$ hrs./day], and a midpoint of **4.5 exposure-days** [$36 \div 8$ hrs./day] over the time period from 2013 through 2016.

NHL Latency Interval

Based on his first reported exposure to Roundup®, Mr. Peterson's latency interval to date of diagnosis was approximately **4 years** (2013-2017).

¹⁵ Plaintiff Fact Sheet, page 21.

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Glyphosate Human NHL Studies

My toxicological opinions with respect to dose are based, in part, on six (6) primary epidemiological studies that provide objective data with respect to several prongs of the Bradford Hill criteria. My toxicological opinion is grounded in animal experimental evidence, *in vitro* human studies and human epidemiological studies as summarized within this report and previously provided by Dr. Portier, et al., in the Federal Daubert motion proceedings. Specifically, I have assessed dose response, temporality, latency period, biological plausibility (toxicological mechanisms), coherence (demonstrated by molecular-based studies) and animal studies as well as the strength of association and consistency with the toxicological mechanisms of Roundup formulation ingredients. I have used the six primary epidemiological studies which include Eriksson, et al., 2008,¹⁶ McDuffie, et al., 2001,¹⁷ Andreotti, et al., 2018,¹⁸ Leon, et al., 2019,¹⁹ Zhang, et al., 2019²⁰ and Pahwa, et al., 2019,²¹ primarily with respect to dose assessment.

My toxicological focus on these studies is on study design, statistical power and exposure thresholds at different odds ratios, etc. I am using these study results in my toxicological assessment in conjunction with generally-accepted, peer-reviewed studies on genotoxicity (including direct human studies) mechanisms of action (promotion, etc.) absorption, distribution, metabolism and excretion (ADME), etc. In general, I have relied on studies that have documented the various aspects of the Bradford Hill criteria at or in excess of the 95% confidence threshold. However, I am deferring to the epidemiologist with respect to the internal statistical designs and meta-analysis bio-statistical methodologies employed within each study. Summaries of these six studies are provided below:

¹⁶ Eriksson, M., et al., "Pesticide exposure as risk factor for non-Hodgkin lymphoma including histopathological subgroup analysis," 2008, International Journal Cancer, Vol.123, pp. 1657 – 1663.

¹⁷ McDuffie H., et al., "Non-Hodgkin's lymphoma and specific pesticide exposures in men: Cross-Canada study of pesticides and health," 2001, Cancer Epidemiology, Biomarkers & Prevention, Vol.10, pp. 1155 – 1163.

¹⁸ Andreotti, G., et al., "Glyphosate Use and Cancer Incidence in the Agricultural Health Study," 2018, JNCI J Natl Cancer Inst., Vol.110 (5), doi: 10.1093/jnci/djx233.

¹⁹ Leon, Maria, et al., "Pesticide use and risk of non-Hodgkin lymphoid malignancies in agricultural cohorts from France, Norway and the USA," 2019, International Journal of Epidemiology, pp. 1–17.

²⁰ Zhang, L., et al., "Exposure to Glyphosate Based Herbicides and Risk for Non-Hodgkin Lymphoma: A Meta-Analysis and Supporting Evidence," July-September 2019, Mutation Research/Reviews in Mutation Research, Volume 781, pp. 186-206. <https://doi.org/10.1016/j.mrrev.2019.02.001>

²¹ Pahwa, M. et al., "Glyphosate use and associations with non-Hodgkin lymphoma major histological sub-types: findings from the North American Pooled Project," 2019 Jun 27, Scand J Work Environ Health. pii: 3830. doi:10.5271/sjweh.3830

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1. **Eriksson, M., et al., 2008 study:**²² This is a peer-reviewed, case-control study of exposure to pesticides as a risk factor for non-Hodgkin's lymphoma (NHL) in cases in Sweden between 1999 and 2002. Different exposure levels were classified according to days of exposure.

In this study, the association of glyphosate exposure with non-Hodgkin's lymphoma followed a dose response pattern with an odds ratio (OR) of 1.69 for 10 days of exposure or less, and 2.36 for greater than 10 days of exposure.

The human epidemiological studies have demonstrated statistically significant increased rates of NHL associated with glyphosate exposure. These studies include several different "exposure day" thresholds: "ever/never," greater than one day and <10 days and greater than 10 days.

2. **McDuffie, H., et al., 2001:**²³ This is a Canadian case-control study which investigated the association of specific pesticides and non-Hodgkin's lymphoma that created dose-response levels based on days/year of personally mixing or applying herbicides. The study revealed that glyphosate exposures between >0 and ≤ 2 days per year had an NHL odds ratio (OR) of 1.0 while exposures greater than 2 days of exposure per year had an NHL odds ratio of 2.12.

The published McDuffie, et al., study presented "Table 6" in which glyphosate exposure was stratified according to "unexposed," ">0 and ≤2 days," and ">2 days" of per year exposure. The study documented statistically significant dose-responses: an odds ratio of **2.12** (1.20–3.73) for the ">2 days" per year group which was statistically significant.

3. **Andreotti, G., et al., 2018:**²⁴ The "Agricultural Health Study" (AHS) is an ongoing cohort study which includes 54,251 licensed pesticide applicators from Iowa and North Carolina with 82.8% reporting use of glyphosate. The study is funded by the National Cancer Institute and the National Institute of Environmental Health.²⁵ An updated

²² Eriksson, M., et al., "Pesticide exposure as risk factor for non-Hodgkin lymphoma including histopathological subgroup analysis," 2008, *International Journal Cancer*, Vol.123, pp. 1657 – 1663.

²³ McDuffie H., et al., "Non-Hodgkin's lymphoma and specific pesticide exposures in men: Cross-Canada study of pesticides and health," 2001, *Cancer Epidemiology, Biomarkers & Prevention*, Vol.10, pp. 1155 – 1163.

²⁴ Andreotti, G., et al., "Glyphosate Use and Cancer Incidence in the Agricultural Health Study," 2018, *JNCI J Natl Cancer Inst.*, Vol.110 (5), doi: 10.1093/jnci/djx233.

²⁵ Id.

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evaluation of glyphosate and cancer risk was conducted in the AHS²⁶ and included cancer incidences through 2012 in North Carolina and 2013 in Iowa. The reported lifetime days' frequency of pesticide application is shown in **Table 4**.

Table 4
Demographics of "Agricultural Health Study"²⁷ Cohort (Applicators n = 54,251)

Lifetime days of glyphosate use (Quartiles)	Lifetime days of glyphosate use (Tertiles)
1 – 13.74	1 – 19.9
13.75 – 38.74	20 – 61.9
38.75 – 108.4	≥ 62.0
≥ 108.5	

Exposure days can be compared to **Table 4** with the corresponding quartiles or tertiles of the Agricultural Health Study to determine if his exposure was consistent with that of these applicators. The Agricultural Health Study did not find a statistically elevated risk of NHL; however, the study is useful with respect to comparison of other epidemiological studies.

4. **Leon, et al., 2019:**²⁸ In this analysis combining data from >300,000 farmers or agricultural workers from France, Norway and the USA and accruing more than 3.5 million person-years under risk, the possible association between pesticide use and the risk of lymphoid malignancies was investigated. Specifically, the authors investigated the relationship of the "ever use" of 14 selected pesticide chemical groups and 33 individual active chemical ingredients with non-Hodgkin's lymphoid malignancies (NHL). Pesticide use was derived from self-reported history of crops cultivated combined with crop-exposure matrices (France and Norway) or self-reported lifetime use of active ingredients (USA). Cox regression models were used to estimate cohort specific hazard ratios (HRs) and 95% confidence intervals (CIs) which were combined using random effects meta-analysis to calculate meta-hrs.

During follow-up, 2,430 NHL cases were diagnosed in 316,270 farmers accruing 3,574,815 person-years under risk. Moderately elevated meta-HRs were seen for NHL overall or certain subtypes with use of specific pesticides compared with "never" use

²⁶ Id.

²⁷ Id.

²⁸ Leon, Maria, et al., "Pesticide use and risk of non-Hodgkin lymphoid malignancies in agricultural cohorts from France, Norway and the USA," 2019, *International Journal of Epidemiology*, pp. 1–17.

of the same pesticides. In particular, elevated hazard ratios of diffuse large B-cell lymphoma (DLBCL) were seen with glyphosate use (1.36, CI: 1.00–1.85). It is noteworthy that although this study found no association between risk of *all types of NHL overall* and ever use of glyphosate, there was a statistically-elevated risk of borderline significance for DLBCL (the most common type of NHL).

5. **Zhang, L., et al., (2019):**²⁹ The Zhang, et al., study is a meta-analysis design that included the most recent update of the Agricultural Health Study (AHS) cohort published in 2018 along with five case-control studies. The study reported that glyphosate-based herbicide (GBH) exposure is associated with increased risk of NHL in humans. Using the highest exposure groups when available in each study, they further reported that the overall meta-relative risk (meta-RR) of NHL in glyphosate-based herbicide exposed individuals was increased by 41% (meta-RR = 1.41, 95% CI, confidence interval: 1.13-1.75). For comparison, a secondary meta-analysis using high-exposure groups with the earlier AHS (2005) determined a meta-RR for NHL of 1.45 (95% CI: 1.11-1.91) which was higher than the meta-RRs reported previously.
6. **Pahwa, M. et al., (2019):**³⁰ In a 2019 study, the associations between glyphosate use and NHL incidence, overall, and by histological sub-type, were evaluated in a pooled analysis of case-control studies. NHL cases were recruited from cancer registries and hospitals in four states between 1991 and 1994, as well as six Canadian provinces. This analysis included 5,131 controls and 1,690 cases of NHL; 647 diffuse large B-cell lymphoma, 468 follicular lymphoma, 171 small lymphocytic lymphoma and 404 other sub-types. The authors found that subjects who had ever used glyphosate had an excess of NHL overall (OR 1.43, 95% CI 1.11-1.83). After adjustment for other pesticides, the OR for NHL overall with "ever use" was 1.13 (95% CI 0.84-1.51) with a statistically-significant association for handling glyphosate more than two days per year (OR 1.73, 95% CI 1.02-2.94, P-trend=0.2). In pesticide-adjusted NHL sub-type analyses, the ordinal measure of lifetime-days was statistically significant (P=0.03) for small lymphocytic lymphoma (SLL) and associations were elevated, but not statistically significant, for "ever years" or "days/year" of use. The authors also showed

²⁹ Zhang, L., et al., "Exposure to Glyphosate Based Herbicides and Risk for Non-Hodgkin Lymphoma: A Meta-Analysis and Supporting Evidence," July-September 2019, Mutation Research/Reviews in Mutation Research, Volume 781, pp. 186-206. <https://doi.org/10.1016/j.mrrev.2019.02.001>.

³⁰ Pahwa, M. et al., "Glyphosate use and associations with non-Hodgkin lymphoma major histological sub-types: findings from the North American Pooled Project," 2019 Jun 27, Scand J Work Environ Health. pii: 3830. doi:10.5271/sjweh.3830

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that subjects handling glyphosate more than two days per year had an excess of DLBCL (OR 2.14, 95% CI 1.07-4.28).

These findings (as summarized in **Table 5**) are consistent with results reported from prior meta-analyses but show higher risk for NHL due to the focus on the highest exposure groups. The authors caution on the interpretation of the numerical risk estimates because of the heterogeneity between the studies.

Nevertheless, all of the evidence from these studies of glyphosate-exposed mice support this association in humans and mechanistic studies of glyphosate-induced immunosuppression/inflammation, endocrine disruption, genetic alterations and oxidative stress suggest clinically-plausible links between GBH exposure and NHL development. The authors conclude “*The overall evidence from human, animal and mechanistic studies presented here supports a compelling link between exposures to GBHs³¹ and increased risk for NHL.*”

³¹ Glyphosate-based herbicides.

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Summary of Epidemiological Studies

Table 5 shows the various exposure parameters and assessment metrics for the six (6) epidemiological studies noted herein.

Table 5
Exposure Parameters for Six Referenced Epidemiological Studies³²

Study	Type of study	Exposure Parameters	
		Metrics (dose intervals)	Cut-off between Cases and Controls
McDuffie, H. et al., 2001	Case-control study of men in six Canadian provinces.	Unexposed >0 days and ≤2 days >2 days/year	Cases were diagnosed with STS, HD, NHL or MM between 9/1/1991 and 12/31/1994. Controls did not have NHL diagnoses.
Eriksson, M., et al., 2008	Case-control study of men and women in Sweden	≥1 day ≤ 10 days >10 days	Cases were newly diagnosed NHL patients aged 18-74 years. Controls were randomly selected from the population registry.
Andreotti, G., et al., 2018	Prospective cohort study of pesticide applicators	Never use Quartiles ranging from 1 day to ≥ 108.5 days Tertiles ranging from 1 day to ≥ 62.0 days	Cases reported ever use of glyphosate. Reference subjects may have used any other pesticides.
Leon, et al, 2019	Pooled analysis of three agricultural worker cohorts	Ever use	Cases reported ever use of glyphosate. Reference subjects may have used any other pesticides.
Zhang, et al., 2019	Meta-analysis	Ever use	6 studies included in primary analysis: one cohort and five case-control.
Pahwa, M. et al., 2019	Case-control study	2 days/year	Subjects handling glyphosate more than two days/year had an excess of DLBCL (OR 2.14, 95% CI 1.07-4.28).

³² All studies in the table revealed statistically significant increased rates of some type of NHL except Andreotti, et al., 2018. Leon, et al., reported a borderline statistic of 1.36, CI: 1.00–1.85.

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Comparisons of Exposure Days to Human Epidemiological Studies

The results of the “exposure-day” calculations (based on validated, reported exposure intervals in the above tables) indicate that Ms. Peterson’s cumulative exposures of 4.5 exposure days were above most of the exposure threshold metric cut-offs. That is, he exceeded the “*ever use*” threshold, the “*>0 and ≤ 2 days*” threshold, the “*>2 days per year*” threshold and the “*≥1 day ≤ 10 days*” total threshold, but he did not exceed the “*>10 days*” total exposure limit.

(Note that no statistically-significant finding of NHL was reported in the Agricultural Health Study). Mr. Peterson was within the range of exposure metrics for applicators as cited within the human epidemiological studies that revealed *statistically significant increased NHL cases among glyphosate applicators*.

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Summary of Objective Toxicological Factors

The generally-accepted, peer-reviewed toxicological literature is not based on unsubstantiated, subjective opinions, but rather statistically significant data at the 95% level of confidence. The various 8 prongs of the well-established Bradford Hill criteria have been evaluated in my assessment by considering the strength of various associations within genotoxicity and other mechanistic studies, the specificity of the adverse effect(s) as well as their consistencies among different studies.

Additionally, dose-responsiveness has been evaluated among the various genotoxicity and other mechanistic studies as referenced within this report (in some cases using human equivalent dosing (HED methodology)). Also, coherence of studies among different study designs has been considered along with latency (temporality) and experimental studies in which animal dose equivalency comparisons to human dosage were assessed.

Expert opinions must always be based on objective, reliable evidence without deviation from the generally accepted methodology. Using the weight-of-evidence methodology of significant findings within the human epidemiological studies that employ dose-metrics, coupled with a scientific understanding of the genotoxic mechanisms, bone distribution/ADME and the mechanisms in which the Roundup mixtures are absorbed, distributed to bone marrow and other locations, retention time in such tissues prior to metabolism and excretion, reliable toxicological opinions are provided.

The evidence of glyphosate potency when applied as a chemical mixture has also been evaluated from both mechanistic findings and dose-response evidence. Mr. Peterson's exposure histories have been compared to the dose-metrics in human epidemiological studies with respect to determining whether 8-hour time-weighted exposure day thresholds were exceeded.

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Evidential Considerations

The following evidential factors are useful in formulating an objective toxicological assessment of Mr. Peterson with regard to his Roundup® exposures and subsequent NHL diagnosis:

- **Diagnosis:** Mr. Peterson's pathology report provides a clinical diagnosis of diffuse large B-cell lymphoma. DLBCL is an aggressive, fast-growing form of NHL (non-Hodgkin's lymphoma). The disease affects B-lymphocytes, a white blood cell that manufactures antibodies to fight infections (an important part of the lymphatic system). DLBCL is the most prevalent form of NHL and is also the *most common form of NHL associated with Roundup® exposures*.
- **Prolonged Acute Exposure and Absorption:** Mr. Peterson reported in interview that his hands or ankles regularly came into contact with liquid Roundup when mixing and while applying diluted Roundup concentrate. He did not immediately wash after such direct exposures. Thus, there were multiple instances of prolonged dermal exposures of indeterminate durations.
- **Chronic Glyphosate Exposure:** Beginning in 2013, Mr. Peterson sprayed every 1-2 months depending on weather, resulting in 4-5 Roundup applications per year. In total, he estimated that he spent 8 to 10 hours per year mixing and spraying Roundup. He continued to use Roundup through the fall of 2016. Other than long pants and (occasionally) blue nitrile gloves while mixing, Mr. Peterson did not wear any personal protective equipment.
- **Dermal Absorption Rates Higher than Presented by Monsanto:** As previously discussed in great detail, the correct dermal absorption rate for glyphosate ranges between 3% and greater (as opposed to the defective values recently issued by Monsanto's contractor, DTL Laboratory). Additionally, numerous other factors are known to increase skin absorption of glyphosate including (but not limited to) elevated temperatures, continuing to wear herbicide-soaked clothing and gloves, sweating (which contributes to increased skin absorption) and cracked skin as well as the various surfactants formulated in the actual Roundup products (as most of the dermal absorption studies were performed on pure glyphosate without the additives).
- **Lack of Personal Protective Equipment (PPE):** Mr. Peterson was not instructed via the product label to wear personal protective equipment such as impermeable pants, boots, mask, long sleeve shirt, face shield, etc. He believed Roundup® was "safe" to use for many reasons and proceeded accordingly. Notably, Monsanto employees (in

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the previously referenced study) were protected with PPE on all exposed body areas during their own dermal exposure testing procedures, but consumers are not protected because the product label provides no such instructions.³³⁶ (Even though the Monsanto research study and report recommended multiple warnings with respect to PPE).

- **Mechanism of Carcinogenicity:** Mr. Peterson's exposures are to Roundup® product, not to glyphosate alone. Roundup® and glyphosate have been demonstrated in several studies to repeatedly cause DNA damage with promotion by Roundup® being more damaging than glyphosate alone. Genotoxicity is the first stage in cancer formation. Wozniak, et al.,³³⁷ and other studies as referenced in this report further demonstrated that Roundup®, at a higher dose, was even able to impede the natural repair of damaged DNA.

The George, et al., study³³⁸ documented cancer promotion at relatively low dermal exposure doses in mice. The dose levels, when converted to human doses, are reasonably similar to that sustained by applicators (when applying the HED factor and dermal absorption rate of 3%). More importantly, the test model employed DMBA (as found in cigarette smoke/tar). This primary carcinogen was dermally applied at low doses on the shaved skin of mice with no tumors produced unless glyphosate was also applied to the skin in which case 40% of the animals developed tumors (2.8 tumors per animal). The mechanism of glyphosate carcinogenesis is important with respect to tumor promotion among smokers prior to the onset of NHL. The George study reveals substantial promotion (40% of the mice with tumors) with realistic concentrations of glyphosate as compared to that of applicators using HED methodology.

- **Latency of non-Hodgkin's Lymphoma:** The compilation of peer-reviewed latency estimates presented herein (see **Table 20**) demonstrates latency intervals within a typical range of 2 to 25 years. Based upon the study findings, the weight of available evidence indicates that a minimum latency interval of 2 to 25 years is required and is scientifically reliable. Mr. Peterson's clinical diagnosis and latency of 4 years meets the minimal latency requirement within the generally-accepted NHL latency range.

³³⁶ Some later labels included recommendation of gloves during mixing.

³³⁷ Wozniak, E., et al., "The mechanism of DNA damage induced by Roundup 360 PLUS, glyphosate and AMPA in human peripheral blood mononuclear cells – genotoxic risk assessment," 2018, Food and Chemical Toxicology, doi: 10.1016/j.fct.2018.07.035

³³⁸ George, J., et al., "Studies on glyphosate-induced carcinogenicity in mouse skin: A proteomic approach," 2010, Journal of Proteomics, Vol. 73, pp. 951 – 964.

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- **Scope of Exposure in Comparison to Epidemiological Studies:** Mr. Peterson's exposure doses in units of duration and frequency were compared to the reference doses in six epidemiological studies. The studies included Eriksson, et al.³³⁹, McDuffie, et al.³⁴⁰, Leon, et al., 2019,³⁴¹ (study combining data from >300,000 farmers or agricultural workers from France, Norway and the USA), the Agricultural Health Study (AHS), Pahwa, M. et al., 2019³⁴² and Zhang, L., et al., (2019).³⁴³

The Zhang, et al., study is a meta-analysis design that included the most recent update of the Agricultural Health Study cohort published in 2018 along with five case-control studies. Mr. Peterson's calculated exposure dose of **4.5 exposure-days** over a 4 year period exceeded most (but not all) of the threshold exposure dose criteria reported within all of the studies revealing statistically significant increased rates of NHL.³⁴⁴ However, he was within range of most of the statistically significant studies including the meta-analysis studies. His episodic acute and chronic Roundup exposures served to measurably increase his NHL risk level.

³³⁹ Eriksson, M., et al., "Pesticide exposure as risk factor for non-Hodgkin lymphoma including histopathological subgroup analysis," 2008, International Journal Cancer, Vol.123, pp. 1657 – 1663.

³⁴⁰ McDuffie H., et al., "Non-Hodgkin's Lymphoma and Specific Pesticide Exposures in Men: Cross-Canada Study of Pesticides and Health," 2001, Cancer Epidemiology, Biomarkers & Prevention, Vol.10, pp. 1155 – 1163.

³⁴¹ Leon, Maria, et al., "Pesticide use and risk of non-Hodgkin lymphoid malignancies in agricultural cohorts from France, Norway and the USA," 2019, International Journal of Epidemiology, pp. 1–17.

³⁴² Pahwa, M. et al., "Glyphosate use and associations with non-Hodgkin lymphoma major histological sub-types: findings from the North American Pooled Project, 2019 Jun 27. Scand J Work Environ Health. pii: 3830. doi:10.5271/sjweh.3830

³⁴³ Zhang et al., "Exposure to Glyphosate-Based Herbicides and Risk for Non-Hodgkin Lymphoma: A Meta- Analysis and Supporting Evidence," 2019, Mutation Research-Reviews in Mutation Research <https://doi.org/10.1016/j.mrrev.2019.02.001>

³⁴⁴ The Leon study was of borderline statistical significance (@ 95% confidence interval, but not exceeding it).

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Summary and Conclusions

My toxicological assessment of the current matter includes assessment of the human epidemiological studies discussed above, the dose/response (biological gradient), strength of association, consistency and coherence of the six primary studies and the studies of various chemical formulants and additives found in the Roundup product as well as experimental evidence including absorption, distribution (*i.e.*, measurement in bone marrow), metabolism and excretion (ADME) and the various mechanisms of carcinogenesis (including genotoxicity, impairment of DNA repair mechanisms and promotion). Additionally, I have focused on dermal absorption, the manner and degree to which Roundup penetrates the skin, the lack of adequate PPE and additive toxicological effects of POEA and POEA derivatives used in the product. I have carefully examined Mr. Peterson's history for potential confounding toxicological factors and have found none other than 1st generation family history positive (mother smoked cigarettes for 43 years and died of lung cancer).

On the basis of findings of multiple applicable studies (as cited herein) and on the basis of Mr. Peterson's episodic exposures, doses and durations to the Monsanto Roundup® product, it is my opinion, to reasonable toxicological certainty, that these exposures were a significant factor contributing to a substantially-increased risk of development of diffuse large B-cell lymphoma.



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