Solar Array Soil Test Results

After community concerns of heavy metal contamination in solar sites, the Noble County Planning Department requested soil tests from a solar site for heavy metal contamination. A privately-owned northern Indiana site was contacted due to its longevity of operation and proximity to Noble County. The owners of the company gave permission for testing the soil.

Site & Testing Description

The solar field has been in place since 2016 and contains over 3000 solar panels. The field to the east of standing corn was used for the comparison sample.

Solar field samples were taken at the drip line of the solar array. Cornfield samples were taken in a random pattern in row and between corn rows. Both samples were a composite of greater than 15 individual soil cores. Both composite samples were taken on the afternoon of October 16, 2023 and submitted to A&L Labs (Fort Wayne, Indiana) for analysis of lead and cadmium plus a basic plant nutrient report. Soil test results are attached.

Figure 1. USDA's Web Soil Survey shows an aerial view of the solar array site.

Lead (Pb)

The United States Geological Survey shows average soils in Indiana have between 8.2 and 83.9 mg/kg of lead, with an average of 23.7 mg/kg. Rural sites tend to be lower than urban areas.

The Environmental Protection Agency (EPA) considers soil on the property of a child-occupied facility that contains total lead at 1200 parts per million (ppm) a soil lead hazard. This value lowers to 400 ppm in a children's play area (Lead in Soil, 2020). Kansas State University suggests soil with lead levels of greater than 400 mg/kg should be used to grow leafy and fruiting vegetables instead of root vegetables (Gardening, 2017).

Metal	Average level in soil around NH[1]	Average level in soil around NY State[3]	Natural level in soils around U.S.[2]	US EPA Soil Screening Level[4]
	(ppm)			
Arsenic (As)	11	5.0	5.2	0.39
Cadmium (Cd)	2	0.5	0.2	70
Chromium (Cr)	33	13.5	37	230
Copper (Cu)	31	14.2	17	
Iron (Fe)			18000	
Lead (Pb)	51	18.7	16	400
Mercury	0.31		0.06	1
Molybdenum	3.5		0.6	39
Nickel (Ni)	23	17.1	13	1600
Selenium	5			39
Zinc (Zn)	98	65.2	180	23,000

Figure 2. Background Heavy Metal Concentrations in Soils (Saunders, et al 2021)

The lead values from the tested site were 9.27 ppm (corn field) and 9.88 ppm (solar field). Both values fall well below levels of concern.

Cadmium (Cd)

Average soil test values of Cadmium in Indiana are difficult to find. Values reported from 15 Indiana sites by Pietz et al (1978) ranged from <0.05 in Lafayette to 0.60 at a Gary site where contamination was expected. Cadmium levels in soil are between 0.01 to 1 mg/kg with a worldwide mean of 0.36 mg/kg" (Kubier 2019).

The US EPA screening level is 70 ppm. The cadmium values at the site were 0.271 ppm (corn field) and 0.298 ppm (solar field). Both values fall well below levels of concern.

Figure 2. Background Heavy Metal Concentrations in Soils (Saunders, et al 2021)

Plant Nutrients and Soil Characteristics

The soil organic matter (OM) content of the sites was 2.6% (cornfield) and 1.9% (solar). When sampling, the cornfield, the higher OM content was noticeable. This is likely a result of a well-managed crop using good soil health principles. The pH of the soil at both sites was very high for growing most agronomic plants (7.7 in cornfield and 7.8 in solar array), but similar to each other.

The field showed phosphorus values at 33 ppm (high value) and the solar site tested at 62 ppm (very high value), which indicates both sites had sufficient quantities of phosphorus. Potassium values were at medium levels (108 ppm in the corn and 109 ppm in the solar array). Magnesium (Mg) and calcium (Ca) values were both sufficient in high levels at 290 ppm Mg and 2500 ppm Ca (corn) and 310 ppm Mg and 2900 ppm Ca (solar). Phosphorus, potassium, magnesium, and calcium are all macronutrients essential for plant growth. The values are typical of northeast Indiana soils.

Attachments (Note: 1 ppm = 1 mg/kg)

Cadmium and Lead Soil Test Results: 64501_F23293_0631.PDF

Plant Nutrient Soil Test Results: 64501_F23293_0166.PDF

Resources

Gardening on Lead-Contaminated Soils. MF3166. Kansas State University. (2017, June). https://bookstore.ksre.ksu.edu/pubs/MF3166.pdf

Kubier A, Wilkin RT, Pichler T. Cadmium in soils and groundwater: A review. Appl Geochem. 2019 Sep 1;108:1-16. doi: 10.1016/j.apgeochem.2019.104388. PMID: 32280158; PMCID: PMC7147761.

Lead In Soil. U.S. Environmental Protection Agency. (2020, August). https://www.epa.gov/sites/default/files/2020-10/documents/lead-in-soil-aug2020.pdf

Pietz, R.I., R.J. Vetter, D. Masarik, and W.W. McFee. 1978 Zinc and Cadmium Contents of Agricultural Soils and Corn in Northwestern Indiana. J. Environ. Quality.

Saunders, O. and T. Buob. Soil testing for environmental contaminants - interpreting your heavy metals test results. University of New Hampshire Extension. (2021, July). https://extension.unh.edu/resource/soil-testing-environmental-contaminants-interpreting-your-heavy-metals-test-results-fact.

Report Number
F23293-0631
Account Number
64501

a&lgreatlakes LABORATORIES
Scientists who don't mind getting dirty.™

3505 Conestoga Dr.
Fort Wayne, IN 46808
260.483.4759
algreatlakes.com

To: NOBLE COUNTY - PURDUE EXTENSIO
109 N YORK ST
ALBION, IN 46701-1038

Attn: ANN KLINE

REPORT OF ANALYSIS

Date Received: 10/20/2023
Date Reported: 10/31/2023

Lab Number	Sample ID	Analysis	Result	Unit	Method
52249	W-CORN	Cadmium	0.271	mg/kg	US EPA SW846-6020
		Lead	9.27	mg/kg	US EPA SW846-6020
52250	W-SOLAR	Cadmium	0.298	mg/kg	US EPA SW846-6020
		Lead	9.88	mg/kg	US EPA SW846-6020

Report reviewed and approved by our professional agronomy staff.

Report Number
F23293-0166
Account Number
64501

a&lgreatlakes LABORATORIES
Scientists who don't mind getting dirty.™

3505 Conestoga Dr.
Fort Wayne, IN 46808
260.483.4759
algreatlakes.com

To: NOBLE COUNTY - PURDUE EXTENSIO
109 N YORK ST
ALBION, IN 46701-1038

Attn: ANN KLINE

SOIL TEST REPORT

Date Received: 10/20/2023
Date Reported: 10/23/2023 Page: 1 of 1

Sample ID	Lab Number	Organic Matter %	Phosphorus		Potassium K ppm	Magnesium Mg ppm	Calcium Ca ppm	Sodium Na ppm	Soil pH	Buffer pH	CEC meq/100g	Percent Cation Saturation				
			Bray-1 Equiv ppm-P	Bray P2 ppm-P								% K	% Mg	% Ca	% H	% Na
W-CORN	44327	2.6	33 *H*		108 *M*	290 *H*	2500 *H*		7.7		15.2	1.8	15.9	82.3		
W-SOLAR	44328	1.9	62 *VH*		109 *M*	310 *M*	2900 *H*		7.8		17.4	1.6	14.9	83.5		

VL = Very Low *L* = Low *M* = Medium *H* = High *VH* = Very High

Sample ID	Sulfur S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Soluble Salts (1:2) mmhos/cm	Nitrate NO_3-N ppm	Ammonium NH_4-N ppm	Bicarb-P P ppm				Comments

Report reviewed and approved by our professional agronomy staff.

A&L-R