

## Arsenic Impacts at Florida Golf Courses

### HSA's Role in Development of Arsenic SCTL

HSA staff sit on the Florida Department of Environmental Protection (FDEP) Methodology Focus Group (MFG) of the Contaminated Soils Forum (CSF), which provides the FDEP a scientific review of evolving policy and application issues associated with contaminated site cleanup, using risk-based management principles. Through our participation in the MFG, HSA has been actively involved in the development of Chapter 62-780 of the Florida Administrative Code (FAC) known as Global Risk-Based Corrective Action (RBCA), which is the regulatory framework used at many arsenic-impacted sites. In addition, HSA provided expert review in the update of the Arsenic Soil Clean-up Target Level (SCTL) per Chapter 62-777 FAC.

**Our active involvement in this group has led us to a comprehensive understanding of the FDEP's rules and regulations on arsenic use and remediation in Florida soils.**

### Contact Us

[rlewis@croworld.com](mailto:rlewis@croworld.com)

1520 Royal Palm Square Blvd.  
Suite 260

Fort Myers, Florida 33919

Phone: (239) 936-0789

Fax: (239) 936-0819

### WHAT IS MSMA?

Monosodium Methanearsonate (MSMA) is an organic arsenical herbicide used for grass weed control in bermudagrass and zoysiagrass turf, as well as in some cool season turfgrasses. In bermudagrass turf, it is used for post-emergence control of grass weeds, including goosegrass, crabgrasses, dallisgrass, and tropical signalgrass. There are 90 brand-name herbicides that contain MSMA, according to EPA estimates. The active ingredient in MSMA is organic arsenic. MSMA has been the herbicide of choice among cotton growers, turf growers, and golf course managers since its introduction in the 1960s. EPA estimates that each year farms and golf courses throughout the U.S. spray about 3-million pounds of MSMA or the similar DSMA for the purpose of controlling grass weeds.



### ARSENIC

Inorganic Arsenic is a naturally occurring mineral that has been classified by the EPA and by the International Agency for Research on Cancer (IARC) as a carcinogen, a substance known to produce cancer in humans. Organic Arsenic, such as MSMA, is not considered a carcinogen, but may convert to inorganic forms over time. Arsenic can be present at golf courses or on agricultural land due to a variety of sources, including the presence of burn piles and CCA-treated wood or mulch, cattle dip vats, fertilizer application (HSA has tested numerous iron-containing fertilizers from major retail and wholesale stores), chicken manure (i.e., Roxarsone), and historical use of other arsenic-containing pesticides and herbicides (e.g., MSMA, lead arsenate, etc.).

### PROSPECTIVE GROUNDWATER STUDY

The re-registration of MSMA is under scrutiny by the EPA. The MAA Task Force, under the auspices of the Florida Department of Agriculture and Consumer Services (FDACS), has contracted HSA to conduct a prospective groundwater study to aid in understanding the fate of applied MSMA in Florida. HSA has completed site selection and the site is currently being equipped. HSA has also participated on a national level in regards to arsenic regulation and remediation by presenting information to EPA's Environmental Fate and Effects Division (EFED) concerning retrospective surface water studies conducted at golf courses in Florida.

## EXAMPLES: DEVELOPMENT OF FORMER GOLF COURSES

### Sarasota Golf Course

- Primary Concerns: conversion of site to residential land use, but arsenic and dieldrin exceeded SCTLs in soil
- Developed Site Assessment Report and Remedial Action Plan (SAR/RAP)
- Performed bench-scale testing for blending options and groundwater treatment
- Goal: obtain "No Further Action without Controls" designation under Chapter 62-780 Florida Administrative Code



### Jacksonville Golf Course

- Primary Concern: conversion of site to residential land use but soil & groundwater exceeded regulatory levels
- Bench-scale testing for lime amendment and mechanical blending
- Field blending pilot test proved successful using innovative mixing technique
- Goal: blend soil to meet direct exposure and leaching SCTLs in soil. Obtain institutional control closure for groundwater.



## GOLF COURSE & AGRICULTURAL LAND REMEDIATION

### BENCH-SCALE TESTING

HSA has conducted extensive bench-scale testing for arsenic remediation. Specifically, HSA has tested a variety of techniques, including soil blending and soil amendment, in the laboratory to ensure that the remedial strategy can meet the direct-exposure and leaching SCTLs prior to full-scale implementation. HSA has found that some arsenic-impacted soils leach arsenic even at low levels near the SCTL. Using blending soils from the site with elevated cation content, HSA has found that soil leaching can be reduced to acceptable levels. Such high cation soil is available in soil types such as spodosols, common in Florida. HSA has also conducted extensive testing of arsenic-impacted groundwater as part of the feasibility study process. Bench-scale groundwater testing has included chemical precipitation using alum and iron, shift to aerobic environment in high iron-containing groundwater followed by precipitation, and the use of various adsorptive media. Other characterizations that HSA can complete in-house include:

• Soil Characterization	• Leaching Analysis
• bulk density	• Soil Amendment Analysis
• porosity	• Soil Blending Analysis
• water content	• Groundwater Testing
• particle size distribution	• Remedial Design Testing
• classify soils for sand/silt/clay content	

### PILOT-SCALE TESTING

HSA has conducted pilot-scale testing on various arsenic-impacted sites, such as blending experiments at golf courses and sites impacted with mulch containing CCA-treated wood. HSA's numerous blending tests were performed to ensure SCTLs are met prior to full-scale implementation. HSA designed experiments that provided a statistical basis for full-scale design (i.e., a statistically significant number of samples were collected on a small portion of the site to ensure sufficient blending so that many fewer samples were required after full-scale implementation). In addition, HSA devised a statistical basis for screening soil to segregate "impacted" from "clean" soil. HSA has developed techniques that have been reviewed and approved by the FDEP to address sites with broadly impacted soils, including soil blending, use of institutional controls, and use of engineering controls. HSA has received no further action designations on numerous sites impacted with metals and pesticides.

## STATISTICAL CLOSURES

HSA has facilitated the statistical closure of numerous sites including:

### Car Manufacturer in Tampa

- Primary Concern: arsenic
- Excavation and sampling activities in three areas
- 544 tons of soil were excavated for off-site disposal
- 95% UCL was calculated for a broad low-level impacted area remaining after excavation
- Excavated area was reduced by a factor of three
- This site received a "No Further Action" (NFA) determination

### Former Boatyard Converted to Condos

- Primary Concern: arsenic
- Determined site-specific cleanup target levels based on the 95% UCL
- Excavated arsenic-impacted soil
- 95% UCL utilized to reduce excavation volume by a factor of four
- The site received a "No Further Action" (NFA) determination

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