DEPARTMENT OF AGRICULTURE

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Remedial Investigation Work Plan

Guidance Document 9

Persons storing or who have stored, distributed, or used agricultural chemicals may have had releases of these chemicals into the environment. To determine if such sites are contaminated and the level of concern, the Minnesota Department of Agriculture (MDA) requires a Remedial Investigation (RI). Corrective actions may also be required, if appropriate.

The objectives of an RI are to identify the:

1) Likely sources of contamination;
2) Extent and magnitude of contamination in soil, groundwater, and/or other media;
3) Actual and potential impacts relating to the contamination; and
4) Information needed to design corrective actions.

A remedial investigation work plan (RI Work Plan) describing how the RI will be conducted must be submitted to the MDA for approval prior to implementation. MDA approval of the RI Work Plan is necessary for the Agricultural Chemical Response and Reimbursement Account Board to approve reimbursement of costs associated with the investigation and any subsequent cleanup (ACRRA.001 Reimbursement of Costs for Agricultural Chemical Incident Cleanups: ACRRA).

Once the RI Work Plan is approved, investigation activities can proceed. Remedial investigation results must be documented in an RI Report and Corrective Action Plan (CAP). A CAP may be required to address or mitigate agricultural chemical contamination impacts (GD10 Agricultural Chemical Incident Remedial Investigation Report and Corrective Action Plan).

APPROACH TO REMEDIAL INVESTIGATIONS

The following general procedures apply to agricultural chemical incident investigations. The MDA staff can modify any of these procedures based on site specific considerations. Environmental consultants and responsible/voluntary parties are encouraged to propose modifications that will achieve effective results while reducing project costs.

Investigations at agricultural chemical facilities should be conducted in a flexible, phased approach whereby the results of preceding steps are used as rationale and justification for subsequent steps. With MDA staff approval, steps may be modified, combined or conducted concurrently at different locations on one facility to best suit the needs of a particular site. All work must be conducted in a safe manner and in accordance with all appropriate local, state, and federal rules and regulations.

STEP l. RI Work Plan Development

The main objectives of the RI Work Plan are to identify and document:

- Potential source areas and chemicals of concern;
- Proposed methods and procedures that will be employed to investigate potential source areas and chemicals of concern; and
- How potential receptors and migration pathways will be identified and investigated.

An outline for an RI Work Plan is included in Attachment 1.

Prior to the submission of the RI Work Plan, the Agricultural Chemical Environmental Site Assessment (AgESA) must be completed in accordance with Guidance Document 14 (GD14 The Agricultural Environmental Site Assessment).

After the AgESA has been received and deemed sufficient by MDA staff, the consultant and MDA staff shall visit the Site to identify sampling areas and site-specific concerns or restrictions.

The RI Work Plan must document the results of the site history investigation discussed above. The site history results shall be used to provide the rationale and justification for selecting potential source areas and chemicals of concern that will be investigated through further sampling and analysis.

The RI Work Plan shall discuss how the information necessary to complete the Contamination Impacts Survey (CIS; see Attachment 2) will be obtained and evaluated. The methods and procedures that are to be utilized to collect remedial investigation data must be identified and discussed in detail. The MDA staff will not approve a RI Work Plan that only references MDA technical guidance documents when discussing methods and procedures. Any deviations from MDA technical guidance documents should be identified along with the consultant's rationale and justification for the proposed deviations. In addition, the consultant's Standard Operating Procedures for collecting and handling samples must be included as appendices in the RI Work Plan.

STEP ll. Investigation of the Potentially Contaminated Areas

Once the historical and current use of the property have been evaluated and potential areas of concern have been identified (STEP l), those areas shall be proposed for investigation by the collection and analysis of soil, groundwater, surface water and/or other samples. Several phases of field work may be required to address the objectives of the RI as noted above. The MDA staff should be notified at least one week prior to the implementation of field work and may choose to observe the field work and split samples without prior notice.

A) Soil Sampling:

FOCUS: Investigation activities should focus on high risk areas for agricultural chemical contamination identified in STEP l. These areas include:

- Any place where small packaged, minibulk, or bulk quantities of agricultural chemicals were delivered, stored, mixed or loaded;
- The interior of any earthen dike;
- Fertilizer impregnation tower area;
- Load-in and load-out areas;
- Anhydrous ammonia loading areas and piping;
- Equipment parking areas;
- Stained areas;
- Obvious dead, damaged or barren vegetation spots;
- Areas associated with previous spills;
- Pesticide container storage locations;
- Scale pits;
- Locations where pesticide containers have been burned;
- Areas where runoff occurs;
- Water fill sites;
- Seed treatment areas;
- Equipment repair areas and/or shops;
- Fertilizer production areas (e.g. mobile phosphate reactors);
- Beneath the floor of dry fertilizer buildings if the floor is or was cracked, and
- Sumps and drains.

SOIL SAMPLING APPROACH: Sampling consists of at least one surface composite sample, one subsurface composite sample and one subsurface discrete sample from each high-risk area and other potential contaminant source areas on the site.

Composite samples in each high-risk area should consist of 3 to 6 evenly spaced sub-samples from an area roughly 15 feet in diameter. Surface composite samples should be collected from 0 to 6 inches below any surficial gravel. Subsurface composites should be collected at a depth of 2 to 2.5 feet below ground surface (bgs).

One discrete "grab" sample from a depth of 4.5 to 5 feet bgs should be collected near the center or close to the probable source in each surface composite area.

For more information see MDA guidance document GD11 Soil Sampling Guidance.

SOIL SAMPLE COLLECTION: Samples may be collected by any suitable sampling method such as push probes, hand auger, solid stem auger, hollow stem auger or test trenching. The RI Work Plan shall specify exact sampling procedure to ensure the sample is representative of the specified depth interval and not contaminated by soil falling in from above. Sampling at depths within areas previously sampled or excavated shall be noted in the RI Work Plan.

DEEP SOIL SAMPLING: A deeper soil boring to a depth of 25 feet or the water table, whichever is less, generally will be required to evaluate the threat of contamination reaching the groundwater, the vertical extent of contamination, and/or to evaluate subsurface stratigraphic formations. Deeper borings may be required at some sites. Scale pit areas require deeper soil sampling immediately. Soil samples should be collected from six (6)-inch intervals every two (2) feet, at changes in lithology, and at the water table. Classify soil samples in accordance with ASTM methods D 2487 or D 2488. Any soil samples submitted for laboratory analyses should be held under proper chain of custody and analyzed according to MDA staff preapproval.

Soil borings should not be a conduit for the vertical migration of contamination. Borings should not penetrate through confining layers below saturated zones or connect aquifers and shall be immediately grouted in accordance with the Minnesota Department of Health (MDH) water well construction code (MN Rules Chapter 4725).

SOIL SAMPLE ANALYSIS: Composite samples from the 2-2.5-foot interval are usually analyzed immediately, unless otherwise requested by MDA staff. The 2-2.5-foot interval is analyzed first, in high risk areas, because past experiences suggests that the surface sample in high risk areas is very likely to be contaminated. The surface composite and 4.5 to 5-foot discrete samples are to be held frozen under proper chain of custody for long-term storage.

Analytical reports for the 2-2.5 foot samples, a summary table presenting the analytical results, the Laboratory Data Review Checklist (GD29), boring logs, a map showing sampling locations and a proposal for next steps, including the additional analyses of frozen samples, as applicable, should be forwarded to the MDA project staff by email within five (5) days upon receiving analytical results from the laboratory. MDA staff will then contact the consultant and responsible/voluntary party to discuss the analyses of frozen samples. If the 2-2.5-foot sample is found to be contaminated, the deep discrete sample (4.5-5-foot depth) is usually analyzed to determine the vertical extent of contamination. MDA staff will accept analytical data from frozen samples properly stored for a period of up to six months.

If the 2-2.5-foot sample interval collected from a high-risk area is not contaminated, then the surface composite (i.e., 0-0.5-foot interval) is usually analyzed to determine if there is surface soil contamination. Proposals to analyze the deep discrete or the surface composite sample immediately along with the 2-2.5-foot interval will be considered on a case-by-case basis.

SOIL ANALYTICAL PARAMETERS: The MDA has standard analytical lists for use in pesticide incident investigations. In general, most soil samples are analyzed for MDA List 1 pesticides (neutral extractables). See MDA guidance document GD26 Analytical Lists for Pesticide Incident Investigations. Analysis of site-specific pesticides, based on the agricultural chemical inventory obtained during the AgESA for the Site, may also be required. Nitrate-nitrogen and Total Kjeldahl Nitrogen (TKN) analyses will be required in areas where fertilizer contamination is suspected. If practicable, analytical costs may be reduced by targeting previously identified contaminants of concern. However, confirmation sampling for the full MDA List 1 pesticide analytical suite will be required.

B) Groundwater Sampling:

FOCUS: Groundwater investigations are often required at agricultural chemical facilities depending on the extent of soil contamination, site specific hydrogeology and the risk to potential receptors. Typically, temporary and/or permanent monitoring wells are installed at the water table to define the horizontal or lateral extent of the contamination; permanent monitoring wells are then sampled on a regular basis to determine trends in the concentrations of contaminants and flow direction over time.

Downward vertical migration of contaminants in the water column can potentially impact deeper wells and formations. In order to protect human health and the environment, the vertical extent of contamination from agricultural chemical incidents must be determined as well as the horizontal extent. Temporary wells can be used to guide the locations and depths of deeper monitoring wells. Similar to determining the horizontal extent of contamination, multiple deeper wells and sampling events will likely be needed to delineate the vertical extent of the contamination, the direction of flow in the deeper groundwater, and the potential impacts on deeper formations and water supply wells.

MONITORING WELLS: A minimum of three wells are necessary to define the groundwater flow direction. At most facilities, four or more monitoring wells will be required to adequately evaluate groundwater beneath the facility. Monitoring well locations, well design, well drilling methods, well development methods and well sampling methods must be reviewed and pre-approved by MDA staff. It may be necessary to install wells off-site to determine both the horizontal and vertical extent of contamination in the groundwater.

Monitoring wells should be constructed with polyvinyl chloride (PVC), stainless steel or low carbon steel materials dependent on the contaminant(s) of concern being assessed. Monitoring wells intended to intercept the groundwater table or perched water should be constructed to allow for seasonal fluctuations in water levels. For wells finished at the water table, in general the screen length should be 10 feet. Monitoring wells must comply with the MDH water well construction code (MN Rules Chapter 4725).

The vertical extent of contamination in groundwater will require the installation of wells finished at different depths, or the use of multi-level well systems. Vertical distance between different sample depths should be on the order of 5-10 foot intervals initially. The screen length should be five feet or less for either temporary or permanent monitoring wells. Groundwater flow maps should be constructed using wells screened at approximately the same elevation. Therefore, the ground surface elevation at each proposed well location should be determined and wells should be designed so that groups of wells are finished at similar elevations. This will allow the determination of groundwater flow directions and contaminant concentrations for discrete depths within the water column.

To avoid cross-contamination of deeper groundwater, do not install deeper wells in the contaminant source area, immediately downgradient of the source area or in areas of highly contaminated groundwater. In addition, it may be necessary to install double-cased wells when completing wells in deeper formations to avoid the migration of contamination from shallower soil and/or groundwater to deeper groundwater.

Each sample location should be mapped using equipment capable of achieving submeter or better horizontal accuracy and 0.01 foot or better vertical accuracy. The X and Y coordinates should be reported in meters using the Universal Transverse Mercator (UTM) projection, Zone 15 extended, NAD83 Datum. Reference elevations in feet to the National Geodetic Vertical Datum (NGVD) or to a local benchmark. In the well summary data table in reports (see Attachment 3), provide a description, elevation, and coordinates of the datum or local benchmark. List the well name or number, Minnesota unique well number, location coordinates, dates installed, elevations of the ground surface, top of riser and bottom of well, depths to top of screen and bottom of screen, screen slot size, and well stickup height.

Slug or plug tests that estimate the horizontal hydraulic conductivity of the screened formations should be performed once on select new monitoring wells. In order to obtain accurate results, slug or plug tests should be

conducted on undisturbed wells before water samples are collected. The slug or plug tests should be conducted in accordance with the procedures outlined in the RI Work Plan.

POTABLE WELLS: Potable wells on and near the site should be sampled as soon as it appears that there is a reasonable likelihood that groundwater may be contaminated, based on the site hydrogeology, past practices and analytical data. This could be as early as the start of Step ll. Contact MDA staff if there is any concern about potable wells and prior to sampling off-site wells.

For more information on groundwater sampling see MDA guidance document GD12 Groundwater Sampling Guidance.

C) Handling and Transport of Samples:

All samples must be collected, transported and stored in accordance with applicable Environmental Protection Agency (EPA), Department of Transportation (DOT) and MDA approved procedures, including chain of custody. Quality Assurance/Quality Control (QA/QC) plans and analytical methods from commercial laboratories analyzing standard Lists 1 and 2 compounds must be approved by the MDA. Lists of commercial laboratories with approved QA/QC plans are provided in MDA guidance document GD23 Pre-approved Commercial Laboratories: Fixed Base and Mobile.

STEP III. Remedial Investigation Report

After field work is completed, an Agricultural Chemical Incident Remedial Investigation Report must be submitted to the MDA (GD10 Agricultural Chemical Incident Remedial Investigation Report and Corrective Action Plan). If the RI activities completed do not accomplish the objectives of the RI Work Plan, additional field activities and reports may be necessary. The CIS (Attachment 2) should be completed, submitted, and discussed in the RI Report.

The RI Report should be a comprehensive document. All data used, including geological logs, well construction logs, and laboratory data, should be reproduced in the appropriate tables and appendices, without referring to previous reports.

CLOSURE

Once the Site is investigated and remediated (if necessary) to MDA staff satisfaction, the project file will be closed.

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Attachment 1
FORM AND CONTENT OF THE REMEDIAL INVESTIGATION WORK PLAN

The following is a general outline for an RI Work Plan. Additional site-specific information should be included where appropriate. The work plan should be referenced where appropriate and be thorough, but concise.

INTRODUCTION

- the purpose for the investigation
- when and by whom the work was authorized

SCOPE OF WORK

- description of services to be performed at the site

SITE DESCRIPTION

- soil type(s)
- estimated depth to groundwater
- anticipated regional groundwater flow direction
- anticipated hydrogeology
- topography
- list of references

SAMPLE COLLECTION

- sample locations and rationale (locate on a large-scale site map)
- soil sample plan (types and depths)
- number of borings to be completed
- number of samples to be collected
- groundwater sample plan
- number of wells and locations (locate on site map)
- sample analysis parameters
- field screening methods, supporting documentation and how they are to be used
- sample analysis plan describing which samples will be analyzed and which will be held frozen
- borehole abandonment methods

SAMPLE COLLECTION PROCEDURES (consult guidance documents for details)

- General:
  - sampling equipment
  - equipment decontamination methods
  - sample storage, containers, transport, preservation, handling and chain of custody
- Soil:
  - drilling method and borehole diameter
  - sample intervals (analytical and lithologic)
  - how samples will be collected
  - lithologic classification methods
  - sample type (composites, discretes)
  - how and when samples will be split

- Groundwater:
  - water level measurement
  - well stabilization
  - how samples will be collected
  - decontamination and QA/QC procedures
  - sample preservation
- Surface Water:
  - sample location and depth
  - how samples will be collected and characterized

FIELD SCREENING METHODS

- how and when they will be used
- procedures for use
- detection limits
- percent fixed laboratory confirmation

ANALYTICAL LABORATORY

- name of laboratory performing analysis (must have QA/QC and analytical methods approved and on file with MDA)
- sample holding time
- approximate sample turnaround time

WELL DRILLING and INSTALLATION METHODS

- well locations and explanation of location selection
- sampling interval
- construction methods temporary and permanent (drilling method, well diameter, screen length and placement, well protection)
- construction materials (screen and riser materials, filter pack and interval, seal materials)
- compliance with MDH Water Well Code
- collection and disposal of cuttings and purge water when sampling highly contaminated soil in public areas
- well development
- equipment decontamination
- well abandonment procedures

MAPS

- topographic map with site location indicated (adapted from U.S Geological Survey quads)
- soil map and legend, if available
- large-scale site map showing all permanent structures (labeled), high risk areas and proposed sampling or well locations
- boundaries of investigation areas, approximate boring locations and well locations

CONTAMINATION IMPACTS SURVEY (see Attachment 2)

- how and when it will be conducted

WORK SCHEDULE

- proposed timetable for work to be performed

Attachment 2
CONTAMINATION IMPACTS SURVEY

A Contamination Impacts Survey (CIS) should be conducted for each incident site as part of the Remedial Investigation (RI). The four exposure pathways are:

- human health
- surface water
- groundwater
- other potential receptors

The human exposure to contaminated soil pathway is evaluated for each site. The other three pathways should be evaluated if the conditions described at the beginning of each pathway section are applicable to the site. For instance, if it is known or strongly suspected that groundwater is contaminated, then complete the groundwater section of the CIS. The results of the CIS should be included and discussed in the RI Report.

I. HUMAN EXPOSURE TO CONTAMINATED SOIL

Identify the relative risk to humans, and particularly to children, who may come into direct and sustained contact with contaminated soil.

a. Does anyone live on the contaminated property?

b. Are there any residences, schools, daycare centers, parks or recreational areas on property adjacent to the site, or within 1,000 feet of the site? If so, estimate the number of each and how many people may be affected.

c. How accessible is the site? Is there a competent fence surrounding the property with a gate which is locked at night? Is the site isolated or guarded?

II. GROUNDWATER

Complete the following activities if groundwater analytical data indicate that groundwater has been affected, or if contamination in the soil and a hydrogeologic assessment indicate that groundwater likely has been affected:

a. Determine whether a municipal water supply is in the site vicinity. Identify any present or potential municipal water supply wells within a one-mile radius.

b. Obtain copies of all well logs within a one-mile radius of the site. If more than 25 well logs are present, select the logs for any public water supply wells, from unusually deep wells, and for wells that are nearest to the site. If the affected water source is a regional aquifer, obtain all well logs from wells constructed in the affected and connected aquifers within a two-mile radius of the site.

c. Contact appropriate state and local authorities, county water planning officials and local well drillers to determine whether any unregistered or abandoned wells are located within a one-mile radius of the site. Report the location, construction, depth and use of any identified wells if the information is available.

d. Contact the site owner and owners of all properties that adjoin the site to determine whether existing or abandoned wells are located on their properties. Report the location, construction, depth and use of any identified wells, if that information is available.

e. Summarize the data on all identified wells in a table, including the following information: Minnesota unique well number or other identifier; the ground surface elevation; the well base elevation; the casing base elevation; water level elevation; and aquifer use. Elevations should be referenced to the National Geodetic Vertical Datum, if

possible. Produce a map showing the location of all wells with the map labels corresponding to the information on the tables.

f. Contact appropriate local authorities and property owners to determine whether any groundwater development is scheduled up to one-mile down-gradient of the site.

III. SURFACE WATER

A surface water body includes wetlands, ponds, lakes, rivers and streams. Complete the following activities if any surface water body is: a) within 200 feet of the site and receiving or likely will receive discharge of contaminated groundwater from the site; or, b) known or suspected of being contaminated by surface water runoff from the site.

a. Identify the water use and classification of each affected or potentially affected surface water body as classified in MN Rules Ch. 7050.0400 through 7050.0470.

b. For groundwater discharges, calculate the potential mass loading from groundwater to the surface water body per the following calculation sheet:

MASS LOADING TO SURFACE WATER BODY

A. Characteristics of groundwater contaminant plume

Plume width, W, (ft): _____

Plume thickness, H, (ft): _____

Hydraulic conductivity, K, (ft/day): _____

Hydraulic gradient, I, (ft/ft): _____

Discharge (Q) of groundwater plume to surface water body.

Q = W * H * K * I, (ft^3/day): _____

Conversion to liter/day, Q * 28.32 liter/ft^3, (liter/day): _____

B. Calculation of contaminant mass in plume entering surface water body

Maximum observed concentration of a single pesticide in groundwater as measured in the monitoring well closest to the down gradient surface water body, C_1, (ug/liter):

_____

_____

Contaminant mass entering river, M = C_1 * Q, (ug/day): _____

_____

IV. OTHER POTENTIAL RECEPTORS

Consider any impacts from the site that are not previously accounted for. These include areas contaminated by surface water runoff or erosion and areas with unusual wildlife mortality, stressed vegetation or visible erosion features.

a. Are terrestrial sensitive or unique environments, areas of heavy wildlife use or hunting activity, endangered species, or animal feedlots adjacent to or potentially contaminated from the site?

b. Are there any other potential impacts not previously accounted for?

c. Identify all other receptors potentially impacted by the agricultural chemical incident (e.g., tile lines, utilities, storm and sewer drainage system, air quality).

Attachment 3 – Monitoring well completion and location information[1]

Well number	MDH unique well number	Well location[2]		Date installed	Surface elevation (ft amsl)[4]	Top of riser elevation (ft amsl)[4]	Bottom of well elevation (ft amsl)[4]	Depth to top of screen from surface (ft)	Depth to bottom of screen from surface (ft)	Screen slot size (inches)	Well stickup (ft)[5]
		X Coordinate[3]	Y Coordinate[3]								
Ex 1	*123456*	*123456*	*1234567*	*1/1/17*	*1023.6*	*1025.6*	*1003.6*	*10*	*20*	*0.01*	*2*

[1] Include well construction diagrams and Minnesota Department of Health well logs in the Remedial Investigation Report/Corrective Action Plan.

[2] Well locations should preferably be provided in Universal Transverse Mercator (UTM) coordinates (meters) to the nearest meter, but geographic coordinates (Lat-Long) are acceptable using decimal degrees with precision to six decimal places.

[3] X Coordinate is the easting coordinate and the Y Coordinate is the northing coordinate. The method of obtaining the coordinates must be indicated in the table footnotes; for example: classical surveying, GPS, map interpolation, photo interpolation, or other interpolation.

[4] The method of obtaining the elevation must be indicated in the table footnotes; for example: classical surveying, GPS (indicate equipment type). AMSL stands for above mean sea level.

[5] If the top of riser is below grade (at-grade well), indicate the well stickup as a negative value.

Notes: (location and elevation of benchmark, coordinate collection method, elevation collection method)