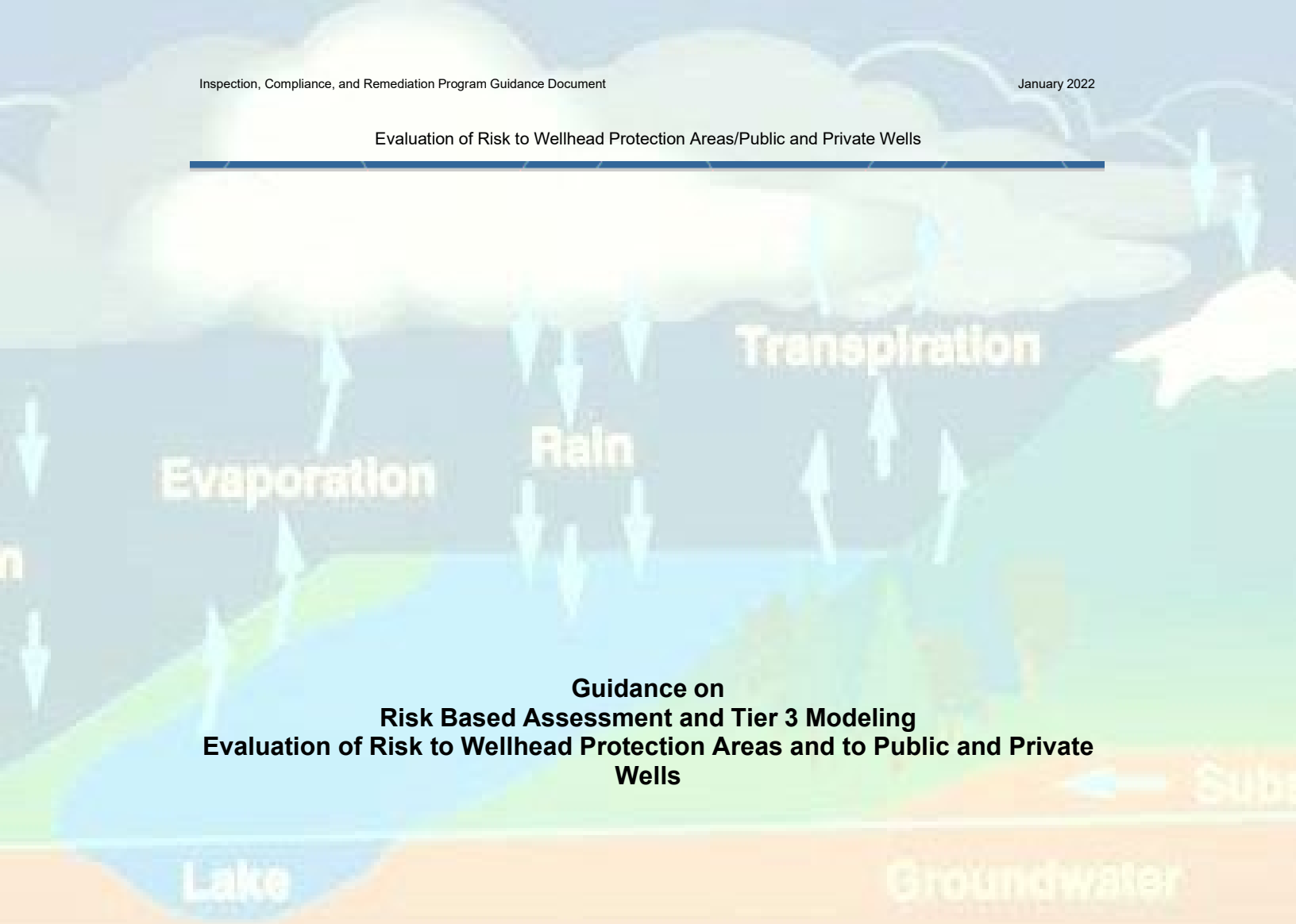

Guidance on
Risk Based Assessment and Tier 3 Modeling
Evaluation of Risk to Wellhead Protection Areas and to Public and Private Wells

South Dakota Department of Agriculture and Natural Resources
Inspection, Compliance, and Remediation Program
Pierre, SD 57501

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Risk Based Assessment and Tier 3 Modeling

The South Dakota Department of Agriculture and Natural Resources has recently developed guidance on how to evaluate the risk to public and private wells and also to clarify the Tier 2 risk-based assessment and the Tier 3 modeling requirements at aquifer sites including wellhead protection areas.

Tier 3 modeling can be done at release sites where Tier 2 risk-based assessment has been done and identified presence of public or private wells.

The initial consideration for evaluating potential risk to the public and private wells in the area of a release site is the vulnerability of the underlying aquifers. For purposes of this guidance, the following criteria will be used to define confined and unconfined aquifers:

- A confined aquifer is an aquifer more than 50-feet below the land surface with more than15-feet of low permeability material (confining layer).

- An unconfined aquifer is an aquifer within 50-feet or less below the land surface with 15-feet or less of low permeability material (confining layer).

Risk to Public and Private Wells in a Confined Aquifer:

- As part of the Tier 2 risk based assessment, DANR will require that a search be conducted for public and private drinking water wells within a 500-feet radius of the spill site. In most cases the well search will involve requesting well records from city officials and DANR Water Rights program. However, in some cases it may be necessary to solicit information from individuals in the area of the release site to determine if there are unregistered private water wells.

- If no public or private well is found within the 500-feet radius, the site may qualify for No Further Action (NFA) consideration (see additional criteria for NFA).

- If a public or private well is found within the 500-feet radius, further assessment must be done to gather information regarding the conditions of the well casing and the sealing. In most cases the well construction information will be obtained from city officials and DANR Water Rights program. If the well is constructed according to the Water Rights well construction standards, the contaminants may not be able to penetrate the well through the sealing and casing. In this case, an analytical modeling may be used to determine the vertical movement of the contaminants to demonstrate the contaminants will or will not reach the confined aquifer.

- Site may qualify for No Further Action consideration if modeling shows there is no risk to the confined aquifer/well (see additional criteria for NFA).

Risk to Public and Private Wells in an Unconfined Aquifer:

- As part of the Tier 2 risk based assessment, DANR will require that a search be conducted for public wells within one mile radius around the spill site, criteria for Wellhead Protection Areas (WHPA) Zone A.

- If no public well is found within one mile radius around the spill site or the site is not within the delineated WHPA Zone A, the site may qualify for No Further Action consideration provided there is no private well located within the 500-feet radius of the site (see additional criteria for NFA).

- If a private well is located within the 500-feet radius, an analytical model may be used as part of the Tier 3 modeling to show the contaminants will or will not impact the private well.

- If a public water well is found within the one mile radius around the spill site or the site is within the delineated WHPA zone A, the radius of influence or cone of depression of the public water well must be determined as part of the Tier 3 modeling. (In some cases depending on the boundary conditions, it may not be necessary to determine the radius of influence/cone of depression of the public water well. For example presence of a major river between the release site and the public well.)

- The radius of influence/cone of depression of the public drinking water well must be determined by using the Visual MODFLOW software or other departmental approved numerical model. In some cases it may not be necessary to use Visual MODFLOW, if the department determines an analytical solution can be used.

- If the site is not within the determined radius of influence/cone of depression of the public water well, the site can qualify for Tier 3 fate and transport modeling.

- With department approval, it can be acceptable to use an analytical model for Tier 3 fate and transport modeling. If the analytical model with assumed conservative aquifer characteristics shows contaminant can impact the well, the responsible party (RP) can either do the clean up or use more sophisticated numerical model (Visual MODFLOW) with the site specific aquifer characteristics.

- If DANR is concerned about the immediacy of impact, the consultant will calculate the time of travel (TOT) for the pollutants to reach the well as if there was no active remediation occurring.

- Corrective action must be adequate to reduce or eliminate the risk to the wells.

Additional Criteria That Must Be Met To Qualify For No Further Action (NFA):

- The sources of contamination (leaky tanks, lines, dispensing islands and associated product saturated soil, and contaminated backfill) must have been removed if possible (DANR is aware that in some cases it may not be possible to remove them).

- No on going release is occurring and free phase product has been removed to the extent practicable.

- The site must have been in validation monitoring phase for at least 2 years.

- The ground water contamination plume is shrinking or stabilized.

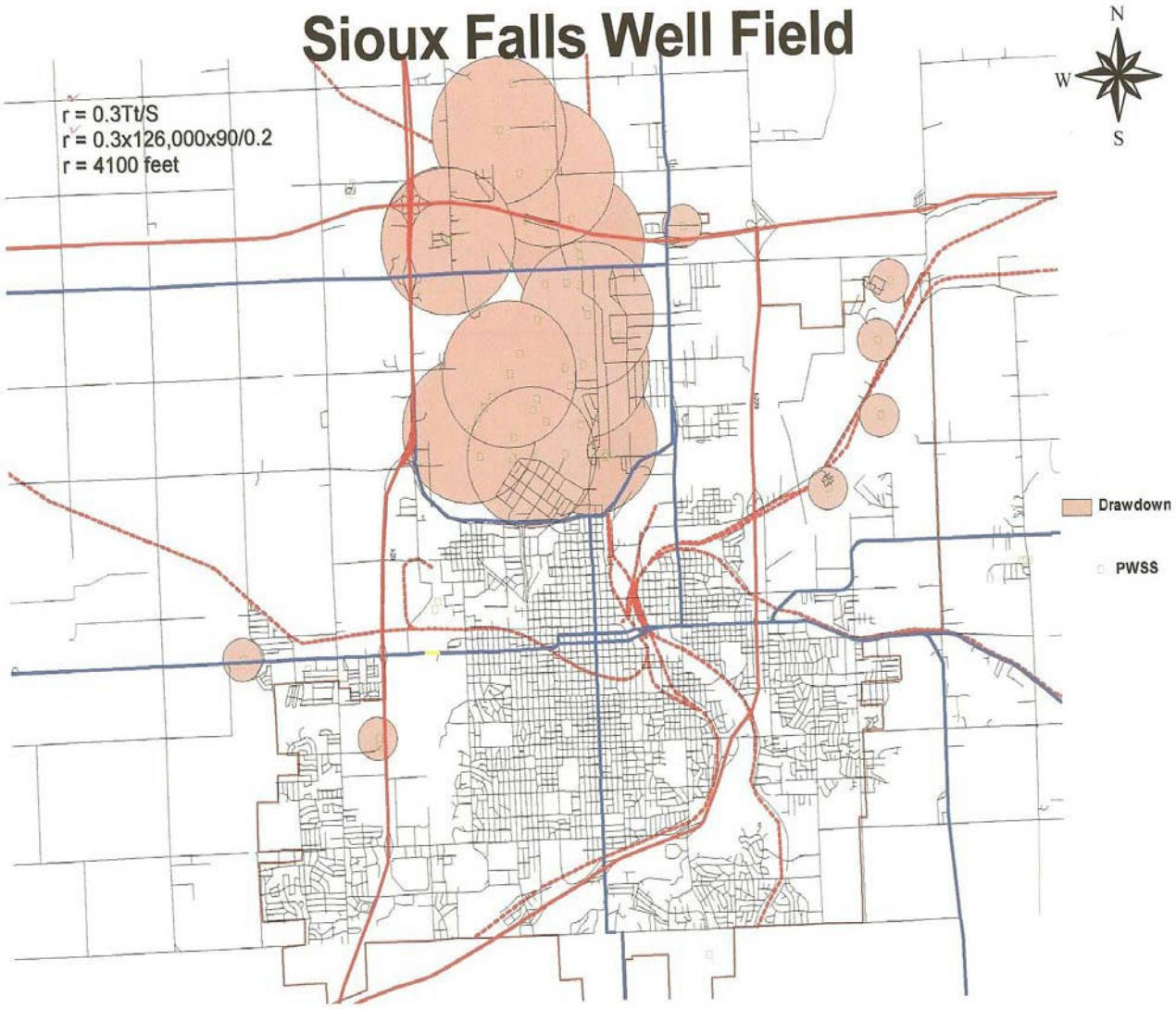
- There is no risk to structures or underground utilities as determined by the Tier 2 site assessment and agreed to by DANR.

- Tier 3 modeling must be approved by DANR.

- In the event a well other than a well used for drinking purposes has the potential to be impacted by the petroleum contaminants, the department may direct the responsible party (RP) to conduct an analysis of the contaminants, the use of the well, and the contaminant's potential impacts on human health and environment. The department will determine if further cleanup or monitoring is needed or if the case can receive no further action status.

Special Circumstances:

- Sites located within the karst topographic areas (western South Dakota) or within the quartzite (eastern South Dakota) or the surface water intake areas will be looked at on a case by case basis.



- The Sioux Falls Water Source Protection Overlay Zones are different from any other wellhead protection areas. The majority of the city wells are located to the north of Russell Street and the future well field expansion will be in the Skunk Creek aquifer to the north of the city. Therefore, sites located south of Russell Street can receive a standard “No Further Action” status without performing a complete Tier 3 assessment.

Glossary:

Validation monitoring;

If the ground water is a pathway and a receptor is close by then validation monitoring of ground water is required for at least two years. First year will be quarterly monitoring and the second year monitoring will be semi-annual.

Analytical Models;

Analytical models are an exact solution of simplified fate and transport equation. This simplification results in reducing the groundwater flow to one dimension and the solute transport equation to one or two dimensions.

Because of the simplifications inherent with the analytical models, it is not possible to account for field conditions that change with time or space. This includes variations in groundwater flow rate or direction, variations in hydraulic properties, changing hydraulic stresses, or complex hydrogeologic boundary conditions.

RBCA Tier 2 computer model is an example of an analytical one-dimensional fate and transport model.

Numerical Models;

Numerical models are capable of solving the more complex equations that describe groundwater flow and solute transport. These equations generally describe multi-dimensional groundwater flow, solute transport and chemical reactions. Numerical models use approximations (e.g. finite differences, or finite elements) to solve the differential equations describing groundwater flow or solute transport.

Unlike analytical models, numerical models have the capability to account for field conditions that change with time or space. This includes variations in groundwater flow rate or direction, variations in hydraulic properties, changing hydraulic stresses, or complex hydrogeologic boundary conditions.

Visual MODFLOW model is an example of a numerical model.