HYDROGEOLOGIC ASSESSMENT AT SAUKVILLE, WISCONSIN

Prepared for:

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INTRODUCTION

The Wisconsin Department of Natural Resources has expressed concern with the possible presence of organic contaminants in the ground water near the Saukville, Wisconsin municipal wells, and has requested that Freeman Chemical Corporation (and other companies) propose, implement and fund a monitoring program. In response, Freeman Chemical asked that Olver Incorporated prepare this hydrogeological assessment and remedial action program. Historical records indicate that a shallow aquifer underlies the study area. Olver Incorporated assumes that the industrial activities occurring at Freeman Chemical's site would first have to contaminate this shallow aquifer underlying the plant site. We have no present evidence that the shallow aquifer is connected to the deep aquifer that serves as Saukville's drinking water supply. Therefore, the basic component of this program will be a series of dewatering wells that will control the hydraulic gradient in the shallow aquifer underlying the study site (see Figure 1). When operating, the program will protect the Saukville municipal wells from potentially contaminated shallow ground water.

To correctly locate and operate the shallow wells, a detailed hydrogeologic study of the site will be performed. The following sections of this proposal contain the details of the proposed project. It should be noted that the emphasis of the project is on the correct location and operation of dewatering wells. Additionally, the hydrogeologic study is designed to identify the ground water flow regime, and the interaction between shallow and deep aquifers.

Since the proposed program is based on hydrogeological studies and control of shallow ground water, detailed chemical analyses of soil and water are limited. Olver Incorporated has learned from several years' experience with soil and ground water contamination studies that a detailed analytical program

is expensive and most often delays the actual cleanup. In particular, we have, for almost two years, been trying to identify the organic components causing high chemical oxygen demand in the shallow aquifer underlying Freeman's Chatham, Virginia plant. To date, we can account for less than one percent of the COD. Therefore, we propose, for this project, a set of carefully selected indicator parameters: pH, odor, field conductivity, Total Organic Carbon (TOC), phenols, and specific volatile organic compounds (trichloroethylene, benzene, ethylbenzene, toluene, styrene and total xylenes). Only ground water will be analyzed since any contaminants leaching into the shallow ground water will be collected by the proposed ground water removal system which will cover the entire study area.

METHOD OF APPROACH

The proposed ground water protection program will be accomplished in three phases, and will take approximately two years to implement and evaluate. Phase I will be literature/existing information collection and borehole logging of existing deep wells. This phase will provide the necessary preliminary information for Phase II which will be comprised of geotechnical drilling, piezometer and shallow well installation, and hydrogeological studies of shallow wells and existing deep wells. Following the completion of Phase II (approximately one year), a report of the hydrogeological studies and proposed dewatering program will be made to the DNR.

Phase III will be the operation of and data collection from the shallow ground water protection system. The report that is issued on Phase III results (approximately one year after initiation of Phase III) will address the possible need to expand the shallow ground water program to deep aquifers. While this need is not anticipated at this time, we have included a proposed methodology for deep aquifer studies (Phase IV).

Phase I - Preliminary Hydrogeologic Assessment

Activities in this phase will be directed at identification of the ground water flow regime from existing sources of information. These activities will include a detailed literature search, fracture trace analysis, borehole geophysical surveys, and ground water level monitoring, as delineated below:

1) Literature Search - Review of published and unpublished reports on geology, soils, ground water and surface water resources will be undertaken to help identify the characteristics of the ground water flow regime. Additionally, water well completion reports, pump tests and aquifer evaluations will be sought out from both state and local agencies in an effort to provide as much background data as possible. Such activities will include on-site visits with appropriate local and state agencies, citizens, and water well contractors, in an effort to collect this information. Village and DNR assistance will be essential to locate as many local wells as possible. Specifically, a questionnaire will be sent with the October 10, 1983 water bills requesting information as to the ownership of the wells and specific details pertaining to construction.

2) Fracture Trace Analysis - Interpretation of aerial stereographic photographs, topographic maps and other imagery (e.g. LANDSAT, Skylab, etc.) will be utilized, as appropriate, to determine the presence and orientations of fracture traces and/or lineaments present in the vicinity of the study area. From a cursory literature search, it is known that the plant site is underlain by glacial outwash deposits which are, in turn, underlain by a dolomitic bedrock. The predominance of ground water storage flow in the bedrock will be in fractures, joints, and solution cavities developed in that formation. Consequently, the fracture trace analysis may provide a means of identifying areas where ground water flow/storage occurs.

3) Borehole Geophysical Surveys - Existing water wells in the bedrock formation provide access points for the collection of hydrogeological information concerning the ground water resources in the vicinity of the study area. Borehole geophysical surveys can provide valuable information concerning borehole configuration, geology, and water quality. Historically, these surveys have been predominantly utilized in exploration for oil, natural gas and coal; however, in the past decade, their use in the water well industry has increased dramatically. Caliper, Spontaneous Potential (SP), Double Point Resistivity, natural Gamma and Temperature surveys will be conducted. Through the use of these surveys it should be possible to identify fracture zones in the boreholes, water-bearing strata, shale layers or other strata which may act as aquicludes, and provide an assessment of water quality occurring in different water-bearing zones. It is anticipated that borehole geophysical surveys will be conducted in the Laubenstein well, the cemetery well and other selected wells identified within the immediate vicinity of the study area. Selection of additional wells will be based on analysis of data collected during the literature search and fracture trace analysis stages delineated above.

4) Ground Water Levels Monitoring - In order to delineate ground water gradients in the study area, monitoring of the ground water table elevations in existing wells will provide valuable information. It is anticipated that continuous water level monitoring devices will be installed in the Laubenstein and cemetery wells, and any other wells identified that could provide additional information. Further, a drawdown test is proposed for Municipal Well #2. During this test, water table elevations will be recorded in the pumping well, the Laubenstein and cemetery wells, and any other wells (as previously identified). This information will permit preliminary calculation of aquifer characteristics, such as transmissivity and storage coefficient. Further, this information

will permit identification of the nature of the dolomite aquifer (i.e. confined vs. unconfined).

Phase II - Ground Water Flow Regime Evaluation

Activities during this phase of the study are directed at identification of shallow and deep ground water flow systems in the study area as delineated in Figure 1, and the interrelationships between those systems. Specific activities are delineated below:

1) Site Topographic Survey - An existing topographic map of the study area will be updated in order to provide basic elevation information to be utilized later in this phase. All piezometers and shallow wells will be surveyed and accurately located on the site topographic maps, after those installations have been completed. In this manner, accurate ground water table contour elevations and flow directions can be determined.

2) Exploratory Drilling/Piezometer Installation - Exploratory soil boreholes will be installed within the study area to collect information on soil depth, bedrock geology and ground water elevations. Specific areas at the plant sites where spillages were known to have occurred will be investigated in the exploratory drilling program. During all drilling activities/piezometer installations, auger cuttings and samples will be checked for odor in order to provide a qualitative soil quality determination. Since some of the borings and piezometers will be off the plant sites, DNR or Village assistance will be needed to obtain access to private property.

Based on information collected during the exploratory drilling program, specific locations will be selected for installation of piezometers. Depth of drilling and piezometer installation will be limited to the depth of over-

burden, since the intent of this stage is to identify shallow ground water resources. However, a minimum of three piezometer nests will be installed at selected locations to determine the vertical component of ground water flow. Through this means, it will be possible to identify if the area in question is located in a ground water recharge, or ground water discharge zone. When piezometer nests are installed, the deeper piezometer will be completed a minimum of five feet into the dolomitic bedrock, while the shallower piezometer will be developed as a water table observation monitoring point. At this time, it is estimated that out of 40 to 50 borings, a minimum of ten piezometers will be installed in the study area. All borings, piezometers, and shallow wells will be properly grouted to minimize the opportunity for ground water contamination.

3) Ground Water Levels Monitoring - Monitoring of ground water table elevations will occur to identify any periodic fluctuations in water levels which may be caused by weather conditions and/or pumping actvities. Additionally, this information will be utilized to determine locations of shallow dewatering wells, and to test the effectiveness of those wells.

4) Shallow Dewatering Wells - Several wells will be installed to bedrock. These wells will be six or eight inches in diameter, cased with PVC casing, and gravel-packed with 0.010-inch screens installed in the saturated portion of the unconsolidated deposits. Eventually, these wells will be utilized to control the direction of ground water flow. During this phase, they will be used in pump tests to show the efficiency of their location.

5) Laubenstein Well Pump Test - A drawdown test will be conducted in the Laubenstein well in order to identify the interrelationship between shallow ground water resources and the Laubenstein well. During the pump test, ground water elevations will be monitored in the piezometers and shallow dewatering

wells constructed in the study area. This pump test will utilize packers both above and below the water-bearing zones identified during the borehole geophysical survey of this well. Each zone will be pumped individually to determine its yield, and any effects it may have on the shallow ground water resources of the study area. During the pump tests, indicator water quality analyses will be conducted.

6) Indicator Water Quality Testing - Since ground water contamination may have occurred from numerous raw materials and waste products from the local industries, it is financially impractical to determine all individual contaminants. Consequently, the emphasis of this program is to develop a viable means of determining the presence or absence of contamination and quantification of select toxic compounds. Therefore, indicator water quality parameters consisting of pH, odor, field conductivity, Total Organic Carbon (TOC), phenols, and selected volatile organics (trichloroethylene, benzene, ethylbenzene, toluene, styrene and total xylenes) will be determined. Volatile organic analyses will be conducted in accordance with EPA methods 601, modified to utilize a column that will separate all of the above mentioned organic compounds. The detection limits of 0.12 µg/l for trichloroethylene, 0.2 µg/l for benzene and ethylbenzene, and 1.0 µg/l for toluene, styrene and total xylenes will be used for the Saukville water system analysis. All routine monitoring of piezometers will be analyzed at the 1.0 µg/l detection level. Analysis for total phenols will be in accordance with Method #510 (Standard Methods for the Examination of Water and Wastewater, 14th Edition), with a detection limit of 1.0 µg/l. All EPA protocols for sample holding times, preservation methods and analytical procedures will be strictly followed. No analysis for heavy metals is proposed because none of the known spills are suspected to have contained heavy metals. These analyses will be conducted on samples collected during the packer pump tests in the Laubenstein well, from initial water quality samples

collected from piezometers and shallow wells in the study area and from other selected wells (e.g., municipal wells).

Ground water quality testing will be conducted at selected intervals during Phases II and III of the study. Specifically, the following minimum testing frequencies will be employed:

a) Two consecutive monthly samples will be analyzed from piezometers within three months after installation and continued on a quarterly frequency thereafter.

b) Analysis of samples collected from the Laubenstein packer pump test, the Municipal Well #2 pumping test and any other pump tests conducted on other suitable wells in the study area. For each pump test, samples will be collected at three times during the test.

c) Samples will be collected and analyzed during the pump tests for the shallow dewatering wells (see Phase III). Further, samples will be collected on a quarterly basis throughout the life of the project once those wells have been put into service.

d) Municipal Wells #1, #2 and #4 will be sampled quarterly, while Municipal Well #3 will be sampled semi-annually, throughout the life of the project.

All water quality sample collection from piezometers will be collected using a teflon bladder pump or PVC Bailer to ensure the integrity of the samples collected. Each piezometer will have a minimum of three times the borehole storage volume removed prior to sample collection. Additionally, the teflon bladder pump and other sampling equipment will be adequately cleaned between sample collection activities in order to avoid cross-contamination of the samples. Analytical results will be forwarded to the Wisconsin DNR and the Village of Saukville, within 15 days after completion of the analyses.

7) Interim Report - An interim report will be prepared which details the results of the study to this point. The report will include geologic crosssections in the study area, approximate bedrock surface elevation and depth of overburden maps, and will include maps/cross-sections which delineate the results of field soil quality determinations (i.e. odor). Recommendations will be prepared as to the operation of the shallow wells to achieve the goals of shallow ground water control. Also, the report will address monitoring activities, water disposal and other pertinent aspects of the testing of the shallow ground water protection system.

Phase III - Testing of Shallow Ground Water Protection System

Control of on-site ground water contamination will be accomplished through the use of shallow dewatering wells. This program will involve pumping the shallow wells and possibly the Laubenstein well, with treatment and disposal in a manner that is acceptable to the Department of Natural Resources. Such treatment may encompass carbon adsorption, other physical/chemical treatment processes, or discharge to the Saukville Village wastewater treatment plant. If discharge to the treatment plant is the preferred method, it is anticipated that only a nominal fee would be assessed by the Village. The specific treatment mechanism will be determined at a later date.

The ground water level of all piezometers and other non-production wells will be monitored monthly. These data will be analyzed to determine if a cone of depression has been developed. Dependent upon the results of those studies, additional wells and piezometers may be required for further delineation of the plume(s). Additionally, the water quality indicators described in Phase II will be monitored on the dewatering wells. Based on the information collected during the study, a performance report and plan of operation for the

wells will be developed to address the problem of contaminant migration. This report will delineate the various alternatives available. The recommended operational plan will be submitted for approval to the Department of Natural Resources and, upon approval, the plan will be implemented.

Phase IV - Deep Ground Water Resources Evaluation

Based on the information collected during the shallow ground water resources evaluation stage, it may be necessary to expand the scope of the project by inclusion of an evaluation of the deep ground water resources in the vicinity of the study area. This evaluation would consist of the following steps:

1) Install Wells - Two water wells could be installed in the dolomite bedrock aquifer with collection of ground water quality samples for indicator water analyses. Installation of these wells would be accomplished in a stepwise fashion in that the first well would be installed, have borehole geophysical surveys conducted, and indicator water quality analyses performed, before the second well would be drilled. Individual step drawdown tests will be conducted to obtain information on aquifer characteristics.

2) Aquifer Characteristics Determination - If deep wells have been installed, individual pump tests, with ground water levels monitoring activities, will be performed in order to determine aquifer characteristics of transmissivity and storage coefficient.

3) Operation - If deep wells are installed, they will be pumped at a flow rate and depth determined by the aquifer characteristics, after approval by the Department of Natural Resources.

4) Final Report - A final report will be prepared which delineates the ground water flow regime within the vicinity fo the study area. Specifically,

the report will delineate the results of the study to date and make recommendations as to measures to be implemented to assure protection of Saukville's municipal wells.