

May 9, 2005

Ms. Heather Hopkins
Environmental Quality Analyst
Michigan Department of Environmental Quality
Remediation and Redevelopment Division
Grand Rapids District Office
245 Colrain, SW
Grand Rapids, Michigan 49545-1013

SITE/CO
FILE NAME RI/FS
TITLE R/W
DOCUMENT Horizon Env

**RE: SAPPI FINE PAPER NORTH AMERICA/S.D. WARREN COMPANY,
MUSKEGON, MICHIGAN: BUILDING #31 AREA GROUNDWATER
INVESTIGATION RESULTS**

Dear Ms. Hopkins:

The purpose of this letter is to present the results of an investigation completed in August of 2004 by Horizon Environmental Corporation ("Horizon") in the area of Building 31 at the Sappi Fine Paper North America/S.D. Warren Company ("Sappi") facility at 2400 Lakeshore Drive in Muskegon, Michigan. The investigative activities reported here were conducted to provide the additional information as outlined in Horizon's November 14, 2002 letter report of investigation results in this area of the Sappi site, as well as to address the requests presented in your February 4, 2003 letter to Evert Vanderberg of Sappi.

The scope of work for this additional investigation included the following major elements:

- Vertical profiling of the water table aquifer at four locations (designated TW-43, TW-44, TW-45 and TW-46) north of former monitoring wells TW-19 and TW-22 to assess groundwater pH, as well as sodium, sulfate, and metals concentrations as a function of depth,
- Construction of two monitoring wells (designated TW-44 and TW-45) at the locations and screened at the depth intervals where greatest impact (lowest pH) was observed during field screening of groundwater samples from vertical profiling;
- Vertical profiling of the aquifer at two locations adjacent to TW-40 (designated TW-41 and TW-42) to better define the nature and extent of sodium impacts to groundwater in this area;
- Construction of one additional monitoring well adjacent to TW-40 (designated TW-42) where greatest impact (highest conductivity) was observed during field screening of groundwater samples from vertical profiling; and

- Analysis of each groundwater sample from the vertical profile intervals and newly constructed monitoring wells for sodium, sulfate, and "Michigan 10" metals¹ using both filtered and unfiltered samples to assess dissolved and total metals, respectively.

A partial site plan depicting the Building 31 area and the locations of vertical profiling and monitoring wells is presented as Figure 1. As you are aware, the investigation activities were completed to better define the nature and extent of impacted groundwater in the area north of Building 31. Groundwater impact in this area of the site appears to be sourced from a release of acidic wastewater from a process sewer flowing north out of Building 31. This release was discovered in October of 1999.

INVESTIGATION METHODS

Vertical profile sampling outlined above was conducted to further define the extent of impacted groundwater in this area of the site, in response to observations of elevated sodium concentrations in groundwater at TW-40 and the pH, sodium, sulfate concentrations near TW-19 and TW-22. Additionally, the vertical profile sampling was intended to assess the potential for acidic groundwater to mobilize metals from anthropogenic fill materials in this area of the property, in response to a comment from the Michigan Department of Environmental Quality, Remediation and Redevelopment Division ("MDEQ", "RRD"). To address this concern all groundwater samples collected during this investigation were sampled and analyzed for the "Michigan 10" metals on a total and dissolved basis (unfiltered and filtered samples, respectively). Samples were also analyzed for sodium and sulfate.

The vertical profile sampling involved collecting groundwater samples at ten-foot intervals throughout the aquifer and field screening each sample for pH, conductivity, and total dissolved solids ("TDS"). Vertical profiling and field screening of groundwater samples were conducted downward until the base of the aquifer was reached. Samples were collected from each vertical profile sampling interval using Geoprobe[®] sampling methods including mill-slot samplers and SP-16 screen point samplers. The mill-slot sampler consists of a steel pipe with vertical machine cut slots that is driven directly into the subsurface soils. The SP-16 screen point sampler consists of the continuous wire wrap stainless steel well screen that fits inside a closed and sealed drive casing. To collect a sample with the SP-16 sampler the unit was driven to depth and then pulled back a distance of four feet to expose the screened inlet. Each groundwater sample was collected using a peristaltic pump and polyethylene tubing placed to the base of the sampler.

RESULTS OF VERTICAL PROFILE FIELD SCREENING

Vertical profile groundwater sampling was conducted at two locations west of TW-40 (designated TW-41 and TW-42) and at four locations down-gradient of TW-19 and TW-22 (TW-43, TW-44, TW-45, and TW-46). The vertical profile sampling locations are illustrated on Figure 1. At each location, the aquifer sediments consisted of fine-grained sand to a depth of

¹ The "Michigan 10" metals consist of arsenic, barium, cadmium, chromium (trivalent and hexavalent), copper, lead, mercury, selenium, silver, and zinc.

approximately 44 feet. Below 44 feet the aquifer sediments consisted of clay and silt. Well/boring logs for each vertical profile boring location and newly constructed monitoring well are presented as Attachment I to this letter report.

The results of the pH, conductivity, and TDS field screening at the three vertical profile sampling locations are summarized on Table 1. Groundwater pH values ranged from 5.9 (TW-45, 7 to 12 foot depth interval) to 8.57 (TW-41, 10 to 14 foot depth interval). The zone of low pH groundwater in the areas that were investigated appears to be centered on the locations monitoring wells TW-44 and TW-45. Slightly higher pH values were identified in the peripheral vertical profile sampling locations TW-43 and TW-46 (see Table 1 and Figure 1). This observation is consistent with both the pH values and groundwater flow patterns (i.e., flow to the north, towards Muskegon Lake) identified during previous investigations in this area of the site.

The pH distribution observed in the vertical profile sampling appears to be generally consistent with the pH distribution observed in prior investigations of this area. However, data from the TW-43, TW-44 and TW-45 locations does not exhibit the acidic conditions that were previously identified in this area of the site. With the exception of a single sample from TW-45 at a depth interval from 7 to 12 feet below grade, all pH values exceeded 6.0 and many exceeded 6.5. A comprehensive evaluation of groundwater pH in all monitoring wells in this area of the site was not completed as part of this investigation.

The greatest groundwater conductivity, 2.43 mS/cm, was observed in a vertical profile sample from TW-45 at a depth of 7 to 12 feet below the ground surface. The groundwater conductivity measured in TW-42 was comparable, at 2.28 mS/cm in the vertical profile sample from the 10 to 14 foot depth interval, and at 2.52 mS/cm in TW-42, which was screened in the interval from 4.5 to 9.5 feet below ground. Based on conductivity values, estimated concentrations of TDS in the groundwater samples were calculated. These calculated values are also presented in Table 1. The majority of the calculated TDS concentrations appear to exceed the generic groundwater/surface water interface ("GSI") TDS criterion of 500 mg/L. However, the distribution of TDS as a function of sampling depth does not suggest density-driven flow of water containing elevated concentrations of TDS within the aquifer.

RESULTS OF LABORATORY ANALYSES OF GROUNDWATER SAMPLES FROM VERTICAL PROFILE SAMPLING

Groundwater samples were collected for laboratory analysis from each of the vertical profile sampling locations. At each depth interval, groundwater samples were collected for sodium, sulfate, dissolved Michigan 10 metals (filtered), and total Michigan 10 metals (unfiltered). Groundwater analyses were completed by Trace Analytical Laboratories of Muskegon, Michigan. Laboratory analytical reports and relevant chain-of-custody documentation for the groundwater samples are presented as Attachment II to this letter. The results of the laboratory analyses are summarized in Table 2. Table 2 also presents a comparison to potentially applicable groundwater criteria established pursuant to Part 201 of 1994 Michigan P.A. 451, as amended ("Part 201").

SODIUM AND SULFATE RESULTS

Several groundwater samples collected from the vertical profile sampling contained sodium and sulfate at concentrations that exceed residential and/or industrial & commercial criteria based on consumptive use of groundwater. Additionally, the numeric total of the sodium and sulfate analyses represents a portion of the total dissolved solids ("TDS") concentration of the groundwater sample. Groundwater samples with a combined sodium and sulfate concentration exceeding 500 mg/L would also exceed the generic Part 201 GSI criterion for TDS. Nine of the 24 vertical profile groundwater samples had a combined sodium and sulfate concentration that exceeded the generic GSI criterion for TDS. This observation appears consistent with the calculated TDS concentrations observed during field screening of groundwater samples from vertical profiling.

MICHIGAN 10 METALS RESULTS (UNFILTERED SAMPLES)

Groundwater samples collected from several locations and depth intervals contained chromium and lead at concentrations that exceed residential and/or industrial criteria based on consumptive use of groundwater. In addition, unfiltered groundwater samples from various locations and depth intervals contained barium, chromium, copper, lead, mercury, selenium, silver and zinc at concentrations that exceed generic GSI criteria. Hardness-dependent GSI criteria were evaluated based on a hardness of 160 mg/L for Muskegon Lake.²

As noted on Table 2, criteria for chromium were established for hexavalent chromium, while analyses indicate the total concentration of trivalent and hexavalent chromium. As a result, more rigorous analysis of chromium to speciate between the valance states would be expected to reduce or eliminate the number of criteria exceedances for chromium.

Potentially more significantly, field observations suggest that the turbidity of the groundwater samples collected from vertical profile sampling may contribute to the present of metals in unfiltered samples. As noted above, groundwater samples were collected from vertical profile sampling locations using either a mill-slot or SP-16 screen point sampler. Both sampling methods do not employ well filter packs, nor do they involve significant "well" development prior to sampling. Field observations suggest that the groundwater samples collected from these locations were relatively turbid. Field measurements of turbidity were not collected as part of this scope of investigation. Nonetheless, the samples' turbidity appears to have contributed to the elevated metals concentrations present in unfiltered samples submitted for laboratory analyses. Moreover, the turbidity of the samples appears to be non-representative of the turbidity of groundwater flowing in the aquifer. This assertion is corroborated by the absence of exceedances of generic GSI criteria in unfiltered groundwater samples collected from monitoring wells TW-42, TW-44 and TW-45 (see additional discussion below).

² A hardness value of 160 mg/L was used based on the average of hardness results from April 1999 through April 2002 from samples of the Muskegon River collected by the MDEQ, as presented on the U.S. EPA's STORET data repository (<http://www.epa.gov/storet/>).

MICHIGAN 10 METALS RESULTS (FILTERED SAMPLES)

In contrast to the unfiltered metals analyses described above, no groundwater samples that were field filtered prior to laboratory analyses exceeded criteria established pursuant to Part 201 based on consumptive use of groundwater. Four groundwater samples contained chromium at concentrations in excess of its generic GSI criterion, one sample contained copper at a concentration in excess of its generic GSI criterion, and one sample contained selenium at a concentration in excess of its generic GSI criterion.

As noted above, criteria for chromium were established for hexavalent chromium, while analyses indicate the total concentration of trivalent and hexavalent chromium. As a result, more rigorous analysis of chromium to speciate between the valance states would be expected to reduce or eliminate the number of criteria exceedances for chromium.

RESULTS OF LABORATORY ANALYSES OF GROUNDWATER SAMPLES FROM MONITORING WELLS

Groundwater samples were collected from three monitoring wells. Monitoring well TW-42 was constructed west of TW-40, with a screened depth from 4.5-9.5 feet, coincident with the depth interval where the highest conductivity was observed in field screening. Monitoring wells TW-44 and TW-45 were constructed north of TW-19 and TW-22 in the area directly down gradient of the former acid release. Both TW-44 and TW-45 were screened in the depth interval from 7 to 12 feet below ground surface, where the greatest conductivity was observed in field screening. The analytical results for groundwater samples collected from these monitoring well are also presented in Table 2. As with the groundwater samples from vertical profiling of the aquifer, each groundwater sample from the monitoring wells was analyzed for sodium, sulfate, and the Michigan 10 metals, on both a total and dissolved basis.

Groundwater samples from TW-42, TW-44 and TW-45 contained sodium and sulfate at concentrations in excess of residential and/or commercial/industrial criteria for consumptive use of groundwater. In addition, the combined concentration of sodium and sulfate in samples collected from TW-42 and TW-45 exceeds the generic GSI criterion for TDS. Field screening results also suggest that concentrations of TDS in samples collected from TW-42, TW-44 and TW-45 exceed 500 mg/L.

The unfiltered groundwater sample collected from monitoring well TW-42 also contained lead at a concentration in excess of its residential and commercial/industrial criteria for consumptive use. This sample also contained chromium at a concentration in excess of its generic GSI criterion. However, the groundwater samples collected from monitoring wells TW-44 and TW-45 did not contain metals at concentrations in excess of any Part 201 criterion for either the filtered or unfiltered metals.

As evident from review of the well construction logs presented as Attachment I to this letter, the monitoring wells were constructed with filter pack material placed adjacent to the monitoring well screen and were developed to remove sediment prior to sampling. While monitoring wells

TW-44 and TW-45 were positioned in the intervals found to have the lowest groundwater pH, the analytical results of samples from these wells indicate that these most acidic intervals also have the lowest total metals concentrations. This phenomenon may be attributable to low concentrations of suspended sediments in these intervals. Alternatively, and more likely, the use of a filter pack and development of the monitoring wells may have produced groundwater samples with a lesser turbidity, resulting in lower overall concentrations of metals in unfiltered samples.

INTERPRETATION/ADDITIONAL ACTIVITIES

The results of this investigation suggest that significant migration of low pH groundwater from the Building 31 source area has not occurred from November of 2002 to date. The results also suggest that density-driven flow of low pH groundwater is not occurring in the areas where vertical profile sampling has been completed.

The results also indicate that sulfate, sodium, chromium and lead are present in groundwater at concentrations in excess of criteria based on consumptive use of groundwater at the site. Consumptive use of groundwater does not occur on the property, nor is such use contemplated in the future. As a result, the exceedances of Part 201 criteria established based on consumptive use of groundwater do not appear to pose a risk to human health or the environment. Emplacement of an institutional control, likely in the form of a restrictive covenant placed on the deed for the property or a City of Muskegon ordinance restricting construction of potable water wells on the property, will be necessary to eliminate this potential exposure pathway. Emplacement of such an institutional control would be completed as part of a Remedial Action Plan ("RAP") or a plan for an Interim Response Designed to meet Criteria ("IRDC") for the property.

The results further suggest that certain constituents are present in groundwater in this area of the site at concentrations in excess of generic GSI criteria. These constituents include a number of the Michigan 10 metals and TDS. The exceedances of GSI criteria for total metals identified through this investigation appear to be attributable to the presence of turbidity in groundwater samples collected from vertical profile sampling locations. Moreover, exceedances of chromium criteria may likely be resolved through additional analyses to differentiate hexavalent chromium from trivalent chromium. However, other exceedances of generic GSI criteria, especially those observed for dissolved metals and for TDS, appear to warrant additional investigation and assessment.

Our observations suggest that the presence of metals and TDS in groundwater is likely attributable to historical manufacturing and filling activities on the property. Contemporaneous investigation of groundwater conditions in the area of the green liquor clarifier area, located approximately 350 feet southwest of Building 31, indicates the presence of elevated concentrations of TDS in groundwater.³ Based on these results, Sappi proposes to prepare and implement a work plan for additional investigation activities to assess the potential for the

³ The results of contemporaneous investigation in the green liquor clarifier area were presented to MDEQ, RRD under separate cover.

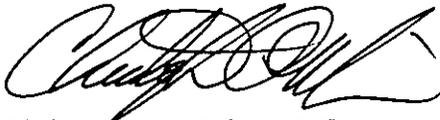
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identified exceedances of GSI criteria to truly impact the GSI. This investigation will take into account the groundwater investigation results from both the Building 31 area and the green liquor clarifier area. A work plan for further investigation will be issued to the MDEQ, RRD for review and consideration within three months of the date of this letter. The investigation will focus on assessment of the potential for groundwater more proximate to the GSI to contain elevated concentrations of constituents of concern.

If you have questions or require additional information about anything presented in this letter report, please contact me at 616.554.3210 or Evert Vanderberg of Sappi at 231.759.5324.

Sincerely,

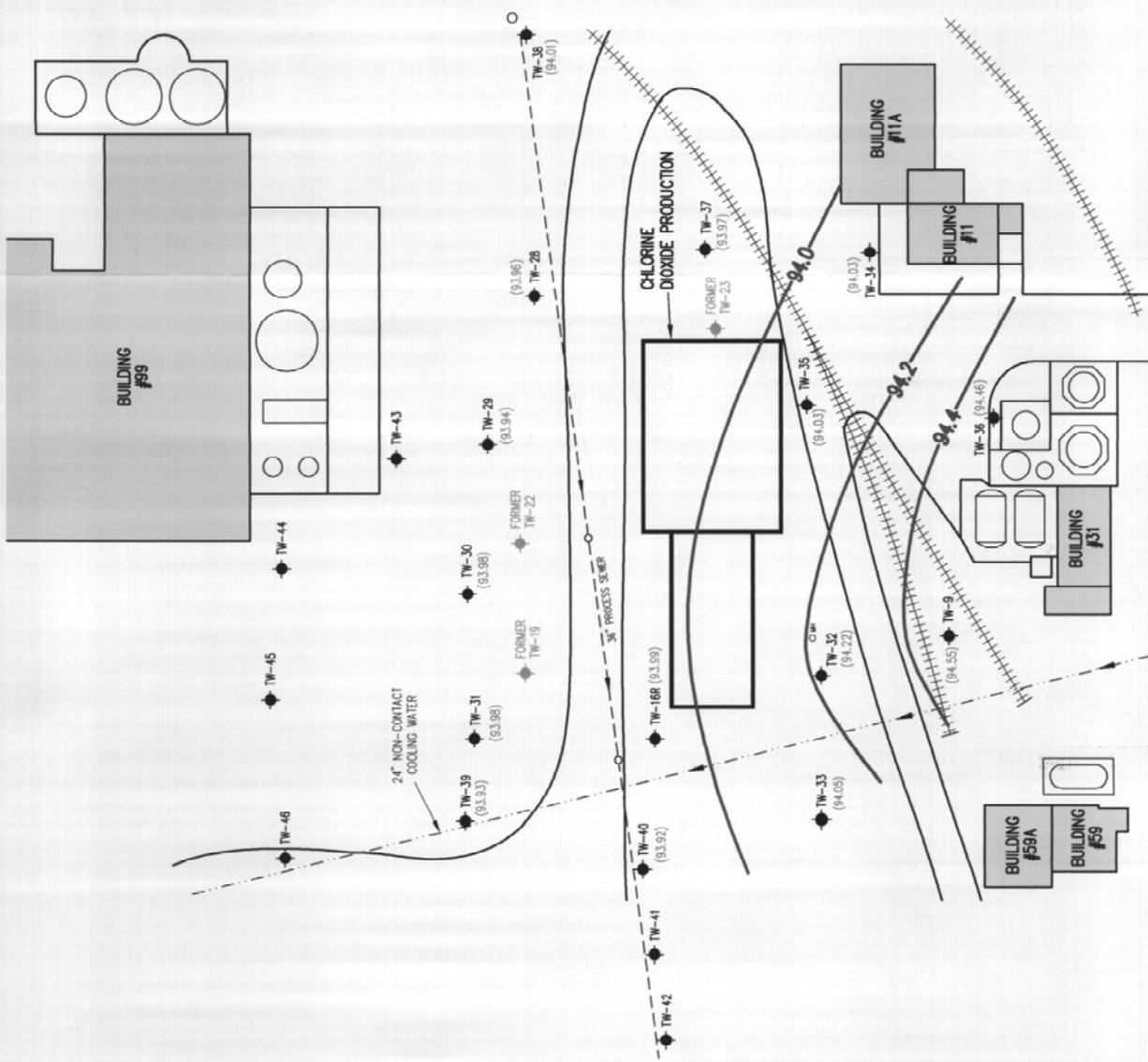
HORIZON ENVIRONMENTAL



Christopher A. Miron, P.E.
Senior Project Engineer

cc: E. Vanderberg, Sappi

enclosures



LEGEND

- TW-31 ◆ BORING/MONITORING WELL LOCATION
- 94.20- (94.05) - GROUND WATER ELEVATION CONTOUR
- GROUND WATER ELEVATION



HORIZON ENVIRONMENTAL
 SAPP/ S.D. Warren
 Muskegon, Michigan

PROJECT NUMBER: SDW-0104
 FIGURE: 1
 MAY 2005

**SITE MAP WITH VERTICAL PROFILE/
 MONITORING WELL LOCATIONS**

Table 1
Summary of Field Screening Results for Groundwater Samples
Sappi Fine Paper North America/S.D. Warren
Muskegon, Michigan Facility
Building 31 Area Hydrogeologic Investigation

Monitoring Well/ Sampling Depth	pH (std.units)	Conductivity (mS/cm)	Calculated Total Dissolved Solids ("TDS") (mg/L)	Notes
TW-41 10-14 ft.	8.57	1.58	1,000	
TW-41 20-24 ft.	8.04	0.60	380	
TW-41 30-34 ft.	7.76	1.13	700	
TW-41 43-45 ft.	7.86	1.06	700	
TW-42 4.5-9.5 ft.	7.51	2.52	1,600	(1)
TW-42 10-14 ft.	7.41	2.28	1,500	
TW-42 20-24 ft.	7.82	1.04	700	
TW-42 30-34 ft.	7.89	1.82	1,200	
TW-42 43-45 ft.	7.84	1.36	900	
TW-43 7-12 ft.	6.42	1.69	1,100	
TW-43 20-25 ft.	8.27	1.72	1,100	
TW-43 30-35 ft.	7.75	0.94	600	
TW-43 40-45 ft.	7.03	2.16	1,400	
TW-44 7-12 ft	6.44	1.72	1,100	(1)
TW-44 7-12	6.37	2.03	1,300	
TW-44 20-25 ft.	6.38	2.03	1,300	
TW-44 30-35 ft.	6.56	3.23	2,100	
TW-44 40-45 ft.	7.09	1.57	1,000	
TW-45 7-12 ft	6.16	2.21	1,400	(1)
TW-45 7-12	5.90	2.43	1,600	
TW-45 20-25 ft.	6.05	1.75	1,100	
TW-45 30-35 ft.	6.51	2.66	1,700	
TW-45 40-45 ft.	6.87	1.95	1,200	
TW-46 7-12	6.40	1.84	1,200	
TW-46 20-25 ft.	6.37	1.90	1,200	
TW-46 30-35 ft.	6.91	1.60	1,000	
TW-46 40-45 ft.	7.14	1.10	700	

(1) Samples collected from monitoring well constructed with a screened interval as noted.

Table 2
Summary of Analytical Results for Groundwater Samples
SAPPI Fine Paper North America / S.D. Warren
Muskegon, MI Facility
Building #31 Groundwater Investigation

Sample Location Sample Identification Sampled By Analyzed By Sample Date Sample Depth (ft)	Residential & Commercial I Drinking Water Criteria	Industrial & Commercial II, III & IV Drinking Water Criteria	Groundwater Surface Water Interface Criteria	Groundwater Contact Criteria	TW-41 EH059-01 Horizon Trace 8/2/2004 43-45'		TW-41 EH059-02 Horizon Trace 8/2/2004 30-34'		TW-41 EH059-03 Horizon Trace 8/2/2004 20-24'		TW-41 EH059-04 Horizon Trace 8/2/2004 10-14'		TW-42 EH059-05 Horizon Trace 8/2/2004 43-45'		TW-42 EH059-06 Horizon Trace 8/2/2004 30-34'		TW-42 EH059-07 Horizon Trace 8/2/2004 20-24'	
					Units	mg/L	mg/L	mg/L	mg/L	mg/L								
Sulfate (as SO4)	250 {E}	250 {E}	NA	ID	150	290	46	30	240	170	200	340	180	290	290	170	200	76
Sodium	120	350	NA	1000000 {D}	140	130	78	340	180	290	76	340	180	290	290	170	200	76
Inorganics, Total																		
Arsenic, total	0.05 {A}	0.05 {A}	0.15 {X}	4.3	<0.020	<0.020	<0.020	<0.020	0.047	0.046	<0.020	<0.020	0.047	0.046	0.046	<0.020	<0.020	<0.020
Barium, total {B}	2 {A}	2 {A}	0.721 {G,X}	14000	0.78	0.49	0.54	0.68	0.64	0.73	0.38	0.68	0.64	0.73	0.73	0.38	0.38	0.38
Cadmium, total {B}	0.005 {A}	0.005 {A}	0.0032 {G,X}	190	0.00087	0.00054	<0.00050	0.00089	0.0021	0.0021	<0.00050	0.00089	0.0021	0.0021	0.0021	<0.00050	<0.00050	<0.00050
Chromium, total 1	0.1 {A}	0.1 {A}	0.011	460	0.44	0.26	0.23	0.34	0.50	0.54	0.15	0.34	0.50	0.54	0.54	0.15	0.15	0.15
Copper, total	1 {E}	1 {E}	0.013 {G}	7400	0.19	0.10	0.093	0.15	0.43	0.39	0.10	0.15	0.43	0.39	0.39	0.10	0.10	0.10
Lead, total {B}	0.004 {L}	0.004 {L}	0.017 {G,X}	ID	0.25	0.16	0.15	0.28	0.77	0.72	0.17	0.28	0.77	0.72	0.72	0.17	0.17	0.17
Mercury (total) {B,Z}	0.002 {A}	0.002 {A}	0.0000013 {Z}	0.056 {S}	0.00079	0.00055	0.00049	0.00061	0.00023	0.00022	<0.00020	0.00061	0.00023	0.00022	0.00022	<0.00020	<0.00020	<0.00020
Selenium, total {B}	0.05 {A}	0.05 {A}	0.005	970	<0.0050	<0.0050	<0.0050	<0.0050	0.0064	0.0064	<0.0050	<0.0050	0.0064	0.0064	0.0064	<0.0050	<0.0050	<0.0050
Silver, total {B}	0.034	0.098	0.0002 {M}	1500	<0.00050	0.00060	0.0041	0.0037	0.0033	0.0027	0.0015	0.0037	0.0033	0.0027	0.0027	0.0015	0.0015	0.0015
Zinc, total {B}	2.4	5 {E}	0.176 {G}	110000	0.25	0.17	0.17	0.27	0.87	0.83	0.22	0.27	0.87	0.83	0.83	0.22	0.22	0.22
Inorganics, Dissolved																		
Arsenic, dissolved	0.05 {A}	0.05 {A}	0.15 {X}	4.3	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Barium, dissolved {B}	2 {A}	2 {A}	0.721 {G,X}	14000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium, dissolved {B}	0.005 {A}	0.005 {A}	0.0032 {G,X}	190	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium, dissolved	0.1 {A}	0.1 {A}	0.011	460	<0.005	<0.005	<0.005	0.014	<0.005	0.0062	<0.005	0.014	<0.005	0.0062	0.0062	<0.005	<0.005	<0.005
Copper, dissolved	1 {E}	1 {E}	0.013 {G}	7400	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Lead, dissolved {B}	0.004 {L}	0.004 {L}	0.017 {G,X}	ID	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Mercury (dissolved) {B,Z}	0.002 {A}	0.002 {A}	0.0000013 {Z}	0.056 {S}	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Selenium, dissolved {B}	0.05 {A}	0.05 {A}	0.005	970	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver, dissolved {B}	0.034	0.098	0.0002 {M}	1500	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Zinc, dissolved {B}	2.4	5 {E}	0.176 {G}	110000	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Table 2
Summary of Analytical Results for Groundwater Samples
SAPPI Fine Paper North America / S.D. Warren
Muskegon, MI Facility
Building #31 Groundwater Investigation

Sample Location	Residential & Commercial I Drinking Water Criteria	Industrial & Commercial II, III & IV Drinking Water Criteria	Groundwater Surface Water Interface Criteria	Groundwater Contact Criteria	TW-42 EH059-08 Horizon Trace 8/2/2004 10-14'	TW-43 EH059-09 Horizon Trace 8/2/2004 40-45'	TW-43 EH059-10 Horizon Trace 8/2/2004 30-35'	TW-43 EH059-11 Horizon Trace 8/3/2004 20-25'	TW-43 EH059-12 Horizon Trace 8/3/2004 7-12'	TW-44 EH059-13 Horizon Trace 8/3/2004 40-45'	TW-44 EH059-14 Horizon Trace 8/3/2004 30-35'
Constituent	Units										
Sulfate (as SO4)	250 {E}	250 {E}	NA	ID	44	8.4	65	590	230	63	720
Sodium	120	350	NA	1000000 {D}	470	76	130	290	200	83	340
Inorganics, Total											
Arsenic, total	0.05 {A}	0.05 {A}	0.15 {X}	4.3	<0.020	0.031	<0.020	<0.020	0.025	0.044	0.025
Barium, total {B}	2 {A}	2 {A}	0.721 {G,X}	14000	0.11	0.81	0.29	0.40	0.54	0.90	0.32
Cadmium, total {B}	0.005 {A}	0.005 {A}	0.0032 {G,X}	190	<0.00050	0.00064	<0.00050	<0.00050	0.00070	0.00062	<0.00050
Chromium, total 1	0.1 {A}	0.1 {A}	0.011	460	0.097	0.35	0.13	0.21	0.31	0.39	0.15
Copper, total	1 {E}	1 {E}	0.013 {G}	7400	0.053	0.16	0.074	0.11	0.14	0.21	0.093
Lead, total {B}	0.004 {L}	0.004 {L}	0.017 {G,X}	ID	0.078	0.042	0.023	0.036	0.041	0.045	0.020
Mercury (total) {B,Z}	0.002 {A}	0.002 {A}	0.0000013 {Z}	0.056 {S}	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Selenium, total {B}	0.05 {A}	0.05 {A}	0.005	970	<0.0050	<0.0050	<0.0050	<0.0050	0.0054	0.0086	0.0086
Silver, total {B}	0.034	0.098	0.0002 {M}	1500	0.0013	0.0012	0.00092	0.00074	0.00082	0.0011	0.0013
Zinc, total {B}	2.4	5 {E}	0.176 {G}	110000	0.12	0.15	0.053	0.091	0.13	0.15	0.054
Inorganics, Dissolved											
Arsenic, dissolved	0.05 {A}	0.05 {A}	0.15 {X}	4.3	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Barium, dissolved {B}	2 {A}	2 {A}	0.721 {G,X}	14000	<0.1	0.18	<0.1	<0.1	0.12	0.12	<0.1
Cadmium, dissolved {B}	0.005 {A}	0.005 {A}	0.0032 {G,X}	190	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium, dissolved	0.1 {A}	0.1 {A}	0.011	460	0.018	0.0075	0.0060	<0.005	<0.005	<0.005	0.011
Copper, dissolved	1 {E}	1 {E}	0.013 {G}	7400	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Lead, dissolved {B}	0.004 {L}	0.004 {L}	0.017 {G,X}	ID	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Mercury (dissolved) {B,Z}	0.002 {A}	0.002 {A}	0.0000013 {Z}	0.056 {S}	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Selenium, dissolved {B}	0.05 {A}	0.05 {A}	0.005	970	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0057
Silver, dissolved {B}	0.034	0.098	0.0002 {M}	1500	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Zinc, dissolved {B}	2.4	5 {E}	0.176 {G}	110000	<0.01	<0.01	<0.01	<0.01	0.011	<0.01	<0.01

Table 2
Summary of Analytical Results for Groundwater Samples
SAPPI Fine Paper North America / S.D. Warren
Muskegon, MI Facility
Building #31 Groundwater Investigation

Sample Location Sample Identification Sampled By Analyzed By Sample Date Sample Depth (ft)	Residential & Commercial I Drinking Water Criteria	Industrial & Commercial II, III & IV Drinking Water Criteria	Groundwater Surface Water Interface Criteria	Groundwater Contact Criteria	TW-44		TW-45		TW-45		TW-45		TW-45		TW-46	
					EH059-15 Horizon Trace 8/3/2004 20-25'	EH059-16 Horizon Trace 8/3/2004 7-12'	EH059-17 Horizon Trace 8/4/2004 40-45'	EH059-18 Horizon Trace 8/4/2004 30-35'	EH059-19 Horizon Trace 8/4/2004 20-25'	EH059-20 Horizon Trace 8/4/2004 7-12'	EH059-21 Horizon Trace 8/4/2004 40-45'					
Constituent				ID	330	270	200	660	360	440	13					
Sulfate (as SO4)	250 {E}	350	NA	1000000 {D}	340	280	140	190	180	320	130					
Sodium	0.05 {A}	0.05 {A}	0.15 {X}	4.3	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020					
Inorganics, Total																
Arsenic, total	2 {A}	2 {A}	0.721 {G,X}	14000	0.23	0.22	0.34	0.11	0.13	0.12	0.37					
Barium, total {B}	0.005 {A}	0.005 {A}	0.0032 {G,X}	190	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050					
Cadmium, total {B}	0.1 {A}	0.1 {A}	0.011	460	0.11	0.079	0.11	0.024	0.10	0.065	0.27					
Chromium, total 1	1 {E}	1 {E}	0.013 {G}	7400	0.060	0.056	0.043	<0.025	0.036	0.033	0.072					
Copper, total	0.004 {L}	0.004 {L}	0.017 {G,X}	ID	0.012	0.012	0.036	0.0055	1.3	0.015	0.016					
Lead, total {B}	0.002 {A}	0.002 {A}	0.0000013 {Z}	0.056 {S}	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020					
Mercury (total) {B,Z}	0.05 {A}	0.05 {A}	0.005	970	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0054	<0.0050					
Selenium, total {B}	0.034	0.098	0.0002 {M}	1500	0.00058	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050					
Silver, total {B}	2.4	5 {E}	0.176 {G}	110000	0.057	0.041	0.029	0.011	0.11	0.033	0.088					
Inorganics, Dissolved																
Arsenic, dissolved	0.05 {A}	0.05 {A}	0.15 {X}	4.3	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02					
Barium, dissolved {B}	2 {A}	2 {A}	0.721 {G,X}	14000	<0.1	<0.1	0.18	<0.1	<0.1	<0.1	0.16					
Cadmium, dissolved {B}	0.005 {A}	0.005 {A}	0.0032 {G,X}	190	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0025	<0.0005					
Chromium, dissolved	0.1 {A}	0.1 {A}	0.011	460	0.0085	0.0080	0.0084	0.0080	0.0071	0.0090	0.019					
Copper, dissolved	1 {E}	1 {E}	0.013 {G}	7400	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025					
Lead, dissolved {B}	0.004 {L}	0.004 {L}	0.017 {G,X}	ID	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003					
Mercury (dissolved) {B,Z}	0.002 {A}	0.002 {A}	0.0000013 {Z}	0.056 {S}	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002					
Selenium, dissolved {B}	0.05 {A}	0.05 {A}	0.005	970	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005					
Silver, dissolved {B}	0.034	0.098	0.0002 {M}	1500	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005					
Zinc, dissolved {B}	2.4	5 {E}	0.176 {G}	110000	0.020	<0.01	<0.01	<0.01	0.081	0.017	<0.01					

Table 2
Summary of Analytical Results for Groundwater Samples
SAPPI Fine Paper North America / S.D. Warren
Muskegon, MI Facility
Building #31 Groundwater Investigation

Sample Location	Residential & Commercial I Drinking Water Criteria	Industrial & Commercial II, III & IV Drinking Water Criteria	Groundwater Surface Water Interface Criteria	Groundwater Contact Criteria	TW-46 EHO59-22 Horizon Trace 8/4/2004 30-35'	TW-46 EHO59-23 Horizon Trace 8/4/2004 20-25'	TW-46 EHO59-24 Horizon Trace 8/4/2004 7-12'	TW-42 EHO59-25 Horizon Trace 8/4/2004	TW-44 EHO59-26 Horizon Trace 8/4/2004	TW-45 EHO59-27 Horizon Trace 8/4/2004
Constituent				ID 1000000 {D}	440	280	220	22	200	270
Sulfate (as SO4)	250 {E}	350	NA		110	200	210	490	220	310
Sodium	120		NA							
Inorganics, Total										
Arsenic, total	0.05 {A}	0.05 {A}	0.15 {X}	4.3	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Barium, total {B}	2 {A}	2 {A}	0.721 {G,X}	14000	0.20	0.20	0.16	<0.10	0.11	<0.10
Cadmium, total {B}	0.005 {A}	0.005 {A}	0.0032 {G,X}	190	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chromium, total 1	0.1 {A}	0.1 {A}	0.011	460	0.14	0.089	0.094	0.044	<0.0050	<0.0050
Copper, total	1 {E}	1 {E}	0.013 {G}	7400	0.048	0.028	0.036	<0.025	<0.025	<0.025
Lead, total {B}	0.004 {L}	0.004 {L}	0.017 {G,X}	ID	0.033	0.0062	0.0079	0.0093	<0.0030	0.0035
Mercury (total) {B,Z}	0.002 {A}	0.002 {A}	0.000013 {Z}	0.056 {S}	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Selenium, total {B}	0.05 {A}	0.05 {A}	0.005	970	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Silver, total {B}	0.034	0.098	0.0002 {M}	1500	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Zinc, total {B}	2.4	5 {E}	0.176 {G}	110000	0.052	0.044	0.077	<0.010	<0.010	0.012
Inorganics, Dissolved										
Arsenic, dissolved	0.05 {A}	0.05 {A}	0.15 {X}	4.3	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Barium, dissolved {B}	2 {A}	2 {A}	0.721 {G,X}	14000	<0.1	0.13	<0.1	<0.1	0.10	<0.1
Cadmium, dissolved {B}	0.005 {A}	0.005 {A}	0.0032 {G,X}	190	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium, dissolved	0.1 {A}	0.1 {A}	0.011	460	<0.005	0.0072	0.0058	0.014	0.0060	0.0084
Copper, dissolved	1 {E}	1 {E}	0.013 {G}	7400	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Lead, dissolved {B}	0.004 {L}	0.004 {L}	0.017 {G,X}	ID	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Mercury (dissolved) {B,Z}	0.002 {A}	0.002 {A}	0.000013 {Z}	0.056 {S}	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Selenium, dissolved {B}	0.05 {A}	0.05 {A}	0.005	970	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver, dissolved {B}	0.034	0.098	0.0002 {M}	1500	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Zinc, dissolved {B}	2.4	5 {E}	0.176 {G}	110000	<0.01	0.015	0.034	<0.01	<0.01	0.010

Table 2
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Footnotes:

Criteria from Part 201 Rule 299-5744

Results Qualifiers:

Shaded values exceed Residential Drinking Water Criteria.

Boxes exceed Industrial Drinking Water Criteria.

Underlined values exceed Groundwater Surface Water Interface Criteria.

Criteria Qualifiers:

{ Although criteria are for hexavalent Chromium, results are total of hexavalent and trivalent Chromium.

{A} Criterion is MI Drinking Water Standard.

{B} Background, may be substituted if higher than cleanup criterion.

{D} Calculated criterion exceeds 100% hence is reduced to 100% or 1.0E+9 ppb.

{E} Criterion is the aesthetic DW value, as required by section 20120a(5) of the act.

A notice of aesthetic impact may be employed as an institutional control mechanism if groundwater concentrations exceed the aesthetic drinking water criterion, but do not exceed the applicable health-based drinking water values for the Aluminum, tertiary Amyl methyl ether, Copper, Diethyl ether, Ethylbenzene, Iron, Manganese, MTBE, Toluene, 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene and Xylenes.

{G} Criterion is dependant upon pH and/or hardness value of the receiving source water. A hardness of 160 mg/L is applied.

{L} Criteria for Lead are derived using a biologically based model.

{M} Calculated criterion is below the analytical Target Detection Limit (TDL), therefore, the criterion defaults to the TDL.

{X} GSI shown is not protective for surface water that is used as a drinking water source.

{Z} A TDL of 5.0E-4 using U.S. EPA Method 1631 is required.

NA = Criterion or value is not available, or not applicable.