

LEGEND

M	Matched Chemicals/Industries
MY	Multi-year Matched Chemicals/Industries
A	All Chemicals/Industries

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■ Key Findings

- The pulp and paper industry is the third largest contributor of releases and transfers in both Canada and the United States. However, the types of pulp and paper facilities reporting, and the distribution of releases and transfers from the facilities, differ significantly in the two countries.
- The Canadian pulp and paper industry is dominated by pulp mills, which report large discharges to surface waters. However, these discharges are decreasing, due in part to new federal and provincial regulations that place stricter limits on such discharges. Because many Canadian mills made changes late in 1995 and virtually all mills had secondary treatment plants in operation by 31 December 1995, the impact of these changes may be further reflected in decreases in releases in 1996 NPRI data.
- The US pulp and paper industry has a wider variety of types of paper-making facilities and, for the most part, transfers its wastewaters to sewage treatment rather than discharging them to surface waters.
- Canadian pulp and paper industry facilities report almost exclusively on-site releases (93 percent of their total releases and transfers) with very few transfers, while TRI paper industry facilities report 79 percent of their total as releases and 21 percent as transfers.
- The Canadian pulp and paper industry has reported reductions in surface water discharges of 15 percent from 1994 to 1995, despite an increase in the number of reporting facilities of 14 percent. TRI pulp and paper industry releases and transfers remain about the same from 1994 to 1995. The Canadian pulp and paper industry is projecting a 38 percent decrease in releases and transfers from 1995 to 1997, compared to 3 percent for US pulp and paper facilities.
- Pulp and paper industry facilities in both countries are moving to install new processes that will drastically reduce or even eliminate some of their releases and transfers in the future. In Canada, regulations governing releases of pollutants are changing as well.

8.1 Introduction

As noted in **Chapter 4**, in 1995 the pulp and paper industry in Canada had average releases and transfers per reporting form that were one-and-one-half times those reported to TRI. This chapter investigates the differences in paper-industry reporting to NPRI and TRI in more detail. The paper industry was chosen for special analysis because:

- In 1994 and 1995, the pulp and paper industry was one of the top three industries in North America for releases and transfers.
- In Canada, this industrial sector has made major investments to reduce pollutants, driven, in part, by changing regulatory requirements.
- The pulp and paper industry contributes a greater proportion of total releases and transfers than would be expected based on the number of forms submitted. In 1995, pulp and paper facilities filed 3 percent of the total number of forms, but reported 11 percent of total releases and transfers in North America.
- In 1995, the pulp and paper industry also averaged the highest releases and transfers per form in North America: 65,515 kg compared to 20,434 kg for all industries.
- Of the top 50 facilities for total releases and transfers in North America, four were from pulp and paper facilities: Simpson Pasadena Paper Co. of Pasadena, Texas; Consolidated Papers Inc. of Wisconsin Rapids, Wisconsin; Boise Cascade Corporation of Saint Helens, Oregon, and Irving Pulp and Paper of Saint John, New Brunswick (**Table 3–8** in **Chapter 3**).

- Methanol is the chemical with the largest total releases in North America (**Table 3–10**), and the paper industry contributes the majority of this chemical—releasing almost 54 percent of the North American total or 76 million kg of methanol each year.

Analyses in this chapter address the matched set of chemicals common to both NPRI and TRI, as in **Chapters 3 and 4**. Where pulp and paper industry reporting is analyzed for 1994 to 1995, the multi-year matched data set of **Chapter 5** is used. Thus, differences found here do not arise from the difference in the NPRI and TRI chemical lists.

8.2 Major Trends in the Pulp and Paper Industry

The pulp and paper industry is diverse: many different types of materials and processes are used to produce numerous products. Pulp mills, traditionally large operations, separate the wood fibers using chemical or mechanical methods or a combination of both. The cellulose molecules in wood fibers are held together by lignin (an almost tar-like substance in cell walls with a complex chemical structure), which must be chemically degraded or mechanically broken down in the pulping process. Often mills are integrated—wood pulp is produced and made into paper or paper products at the same location. In other mills, wood pulp can be dried, baled and then shipped. The type of cellulosic raw material or mix of timber species entering the pulp mill, the type of process, and the nature of the treatment systems installed all affect the amounts and types of pollutants released.

In paper mills, wood pulp is mixed into a slurry with water and put on a screen. The water is then removed by gravity, vacuum, pressure, or heat, forcing the fibers in the pulp to bond

together. The properties of the paper, including its strength, thickness, moisture content, and finish, are closely controlled. Each of the numerous kinds of paper made have a specific purpose, ranging from fine writing paper to newsprint to sanitary papers.

The pulp and paper industry has typically experienced great swings in market supply and demand, and often these economic cycles have been matched by large technological changes. During the period covered in this report, 1994–1995, the industry continued to experience economic, technological and regulatory change, briefly described in the following sections.

8.2.1 Changing Economic Environment

The world demand for paper has doubled in the last 20 years and is projected to double again by the year 2010. The industry has been stimulated by the lowering of tariffs, including the phasing out of European Union tariffs on non-newsprint grades by 2000 and newsprint by 2002.

The US paper and paperboard industry is the largest in the world, producing over 24 percent of the world's capacity in 1993. In 1995 the industry employed 486,000 in manufacturing jobs. This amounts to four percent of all US manufacturing employees. In 1995, over five percent of all shipments involved paper products—an increase of 30 percent since 1992—while employment has increased four percent (source: American Forestry & Paper Association <www.afandpa.org> and US Census of Manufacturers).

Canada, however, was the world's largest producer and exporter of newsprint (supplying 26 percent of world demand) and the second largest supplier of wood pulp (producing 29 percent of all wood pulp) in 1996. The forest

industry directly employs approximately 250,000 people across Canada. In 1996, the pulp and paper industry had net exports reaching C\$17 billion (US\$12 billion). Since 1990, pulp and paper production in Canada has increased approximately 20 percent.

The US pulp and paper industry has made major investments to lessen the environmental impact of its production processes. From 1984 to 1993, the industry spent \$290 US billion (C\$375 billion) on environmental research and, since 1970, the costs related directly to addressing environmental concerns, per ton of paper produced, have doubled. Over the past two decades, paper companies have also reduced the usage of non-renewable fossil fuels by 38 percent (source: American Forestry & Paper Association <www.afandpa.org>).

In a Statistics Canada survey of environmental protection spending in 1995, the pulp and paper industry reported investing C\$952 million (US\$694 million) on capital projects for environmental protection, the largest such amounts of any Canadian industry. This was a 55 percent increase from 1994 for the pulp and paper industry, and represents nearly one-half of all Canadian industry spending on capital projects for environmental protection. Capital spending centered on pollution abatement and control projects, “in large part to comply with the new environmental regulations that [came] into effect at the end of 1994” (source: *Environment Industry, 1995, Preliminary Data*, Statistics Canada, June 1997, Catalogue Number 16F0007XPE).

8.2.2 Changing Technology

Technological changes in the pulp and paper sector have been profound. Driven by changing regulatory requirements, the need to stay globally competitive and the demands of the

marketplace, most pulp and paper mills have made major investments in reducing pollutants. Some have switched from the traditional chlorine-based bleaching process to one utilizing chlorine dioxide or oxygen. Others have upgraded secondary treatment systems or even installed such systems for the first time. These investments have yielded direct environmental effects: providing documented reductions in total suspended solids, biological oxygen demand, dioxin and furan emissions and acute lethal toxicity.

In the late 1980s and early 1990s, public concern over the potential health and environmental impacts of chlorine came to a head. At the time, most pulp and paper mills used chlorine as a chemical agent to degrade (or “bleach”) the lignin in the wood pulp, a process that releases dioxins and furans as by-products of the reaction. Like other harmful compounds with complex ring structures, such as DDT and PCBs, dioxins and furans persist in the environment for decades. They are found in all environmental media—air, water, and soil—where they tend to accumulate in sediments. From there they make their way into the food web and hence into human and animal tissues (source: *Priority Substances List Assessment*, CEPA, 1990).

Industry has responded by employing improved defoamers to reduce the potential for dioxin and furan formation, and switching from chlorine-based bleaching to an elemental-chlorine-free bleaching process (ECF) or to a totally chlorine-free process (TCF). In ECF, chlorine dioxide replaces elemental chlorine in the bleaching process, resulting in significantly fewer chlorine atoms that can react to form dioxins and furans. In a mill using TCF, by contrast, no chlorine dioxide is permitted; instead, a variety of agents such as hydrogen peroxide and ozone are used to bleach the pulp.

The switch to ECF bleaching has been rapid in the United States and Canada—accounting for approximately 25 percent of US production in 1995 (source: D. Reeve, ECF bleaching and TCF bleaching versus chlorine bleaching, *Canadian Market Pulp*, September 1995). Between 1988 and 1995, the use of elemental chlorine bleaching has decreased 87 percent in Canada. Other countries, such as Sweden and Finland, have moved toward TCF. One study of nearly 50 plants in six countries that had invested in ECF and TCF bleaching found that these facilities showed improved financial performance even when national differences in organochlorine legislation were taken into account—another example of “pollution prevention pays” (source: Chad Nehrt, Process changes pay off for mills investing in pollution control, *Pulp and Paper Magazine*, 1 September 1995).

Some pulp and paper mills are using “closed loop” systems where no effluent is released. Using a variety of technologies, waste is recycled for use within the plant. Although adoption of closed loop systems may increase transfers off-site, interest in these new systems is high, with a major C\$88 million (US\$63 million) research effort underway. One example is the installation of a pilot project at Avenor Inc.’s mill in Thunder Bay, Ontario.

Installation or upgrading of secondary treatment systems also contributes to substantial reductions in releases. These systems use bacteria to break down organic pollutants and reduce their concentrations, including such NPRI and TRI substances as methanol and phosphoric acid.

Not only are mills changing their processes and pollution systems, but the nature of their raw material has also changed. Many mills now use recycled paper as a source of fiber and so have added de-inking technology to their

process. In 1989 only one newsprint mill in Canada used recycled fiber; now a total of 62 mills use recycled paper as a fiber source—approximately 23 do so for the production of newsprint. From 1990 to 1995 consumption of recycled paper grew at an average of 17 percent per year. Canadian mills used 4.5 million tonnes of recycled fiber in 1996 and had to import nearly one-half of this amount to meet demand (source: CPPA, 1996).

In 1993, the US paper industry set its goal to recover—for recycling and reuse—50 percent of all paper used in the United States in the year 2000. By 1996, the US paper recovery rate was an estimated 45 percent. Exports of recovered paper fell from 1994 to 1996, but domestic use of recovered paper largely offset this decline. Had exports not declined, the US paper recovery rate would have exceeded 48 percent. About 400 of the 550 facilities in the United States that make paper, paperboard and building products use recovered paper as a raw material, and more than 200 rely on it entirely (source: American Forestry and Paper Association <www.afandpa.org>).

8.2.3 Changing Regulatory Environment

The pulp and paper sector is subject to numerous environmental programs, both mandatory and voluntary, in Canada and the United States.

Canadian Regulations

In Canada, three new federal regulations set limits on pollutants released from the pulp and paper industry. In 1992 the new Pulp and Paper Mill Chlorinated Dioxins and Furans Regulation required mills that use chlorine bleaching to implement process changes to prevent the formation of dioxin and furans, and to monitor dioxin and furan concentrations. The regulation prohibits

the discharge of measurable concentrations of 2,3,7,8-tetrachlorodibenzodioxin (TCDD) and 2,3,7,8-tetrachlorodibenzofuran (TCDF). The measurable concentration for 2,3,7,8-TCDD is 15±5 parts per quadrillion (ppq) and for 2,3,7,8-TCDF is 50 ppq. Of the 46 mills using chlorine bleaching, the regulation required one group of mills to comply immediately in 1992; the second group of 25 mills were allowed a phase-in period until 1 January 1994.

Another new federal regulation limits the quantities of total suspended solids and biological oxygen demand that can be released into lakes and rivers, and prohibits the discharge of any acutely lethal effluent. The quantity of pollutant that can be released depends on the mill’s production rate over the past three years. This regulation applies to all 157 pulp and paper mills in Canada, but allowed 79 mills an extended phase-in period to achieve compliance. Full compliance was required by 31 December 1995. While industry was free to choose any technology or system that could meet these limits, many mills reported installing secondary treatment. Because many mills made changes late in 1995, the 1996 NPRI reporting year will be the first year to reflect their full effects.

A third federal regulation, which became effective 20 May 1992, places restrictions on defoamers and the use of polychlorinated phenol-treated wood chips to prevent the formation of dioxins and furans. In addition to these three new federal regulations, many provinces have also set standards limiting pollutants in pulp and paper mill discharges.

These new regulations are significantly more stringent than the previous Canadian federal pulp and paper regulation which did not state explicitly whether the standards applied only to new or expanded sections of a mill, and

did not provide standards that reflected current technology. Furthermore, the old regulation did not apply to mills that began operation before 1971 (an estimated 90 percent of Canadian mills).

In addition to these regulations limiting pollutants, the reporting criteria for NPRI changed in 1995, requiring substances at concentrations lower than 1 percent to be included in the calculation. This important reporting change has been noted by many mills to be a reason for increased quantities of pollutants reported in 1995.

US Regulations

In the United States, the pulp and paper sector is influenced by numerous pieces of legislation, including Executive Order 127873 and EPA’s newly promulgated “Cluster Rules.” The Executive Order on the purchase of environmentally preferable products by the federal government, issued in October 1993, required a minimum recycled fiber content of 50 percent in uncoated printing and writing papers for federal purchases. As of March 1996, this was reduced to a 20 percent requirement for some papers. This Order might be expected to have had a noticeable effect on the market for paper because the federal government is a major consumer of paper products, not only directly, but also through its contractors.

Quantifying its exact contribution, and that of other factors, in stimulating strong growth in the recycled paper market is difficult, though. It has recently been reported, for instance, that available de-inking capacity has outstripped the demand for recycled paper (perhaps reflecting an influx of low-cost pulp in international markets). To the extent that recycled fibers, and post-consumer fibers in particular, attain an increased market share, the composition of the paper industry will be transformed, in terms of the relative prevalence of operations with very different chemical characteristics.

The new “Cluster Rule” represents the EPA’s attempt at regulatory rationalization by combining regulatory criteria for industry sectors into a coherent system intended to reflect the operating characteristics of each industry. This stands in marked contrast to the historical pattern, dictated by EPA’s multiple independent legislative mandates, of separately specifying regulations for each environmental medium (air, water, soil, etc.).

The Cluster Rule for the pulp and paper industry, originally proposed in December 1993, was made final on 14 November 1997. Since its initial proposal, the rule has been the impetus for significant debate and considerable research.

Procedurally, the “Cluster Rule” is primarily concerned with setting National Emission Standards for Hazardous Air Pollutants under the Clean Air Act and Effluent Guideline Limitations under the Clean Water Act. A key concept introduced with the 1990 amendments to the Clean Air Act was the determination of “Maximum Available Control Technology,” designed to encourage the use of advanced technology.

Substantively, a key focus of the Cluster Rule has been the generation of highly toxic and frequently bioaccumulative chlorinated organic compounds, including 2,3,7,8-TCDD as well as other chlorinated dioxins and dibenzofurans, trihalomethanes such as chloroform, and other compounds.

Among the innovations of the Cluster Rule are the addition of several new classes of chemicals to the list of those regulated for this industry. In addition to dioxin, 12 chlorinated phenolics, and tetrachlorodibenzofuran, the regulation addresses a composite parameter, “AOX,” representing adsorbable organic halides. Regulation of pollutants, including biological oxygen

demand, chemical oxygen demand, and total suspended solids in water, would also be made more stringent.

Over the four-year development of the Cluster Rule, much debate centered on whether EPA would accept the substitution of chlorine dioxide for chlorine—the ECF process—as “Best Available Technology.” There was industry concern that EPA would require the use of totally chlorine-free technologies, or require oxygen delignification (oxygen-based removal of lignin) in addition to substitution of chlorine dioxide. Industry sources argued that this approach offers no environmental improvement and would pose substantial cost. In the final rule, EPA accepted ECF for the bleached paper-grade kraft and soda subcategory, as well as for ammonium-based and specialty paper-grade sulfite mills. TCF bleaching was specified for calcium-, magnesium-, and sodium-based paper-grade sulfite mills.

The potential of these rules to affect TRI reporting in future years appears significant. Whether, during the years they have been undergoing debate as a proposed measure, the rules have already encouraged the ongoing switch to chlorine dioxide is uncertain, given the influence of both market factors and existing regulations.

8.2.4 Voluntary Reduction Efforts

In addition to new mandatory effluent limits, approximately one-half of the production of Canada’s pulp and paper mills is also subject to voluntary reductions of specific pollutants under the Accelerated Reduction/Elimination of Toxics (ARET) program. The participating pulp and paper companies achieved a 5 percent, or 473 tonne, net decrease in releases from 1993 to 1995 and have committed themselves to an 80 percent overall reduction of releases

by the year 2000. While the pulp and paper sector remains the largest contributor to total 1995 ARET releases, releases of chlorinated dioxins and furans have been reduced by 95 percent. Almost half of the ARET substances are also on the NPRI list, including pollutants commonly released from the pulp and paper sector, such as chlorine dioxide and chloroform, for which the short-term goal is a 50 percent reduction by 2000 (source: ARET Leaders Report, January 1997).

US EPA’s 33/50 Program was established in 1991 to elicit voluntary commitments from TRI facilities for reductions of 17 targeted chemicals. The program sought to achieve a reduction in total releases and transfers of 33 percent from 1988 to 1992 and 50 percent from 1988 to 1995. More than 1,290 companies pledged reduction goals, including 60 that own paper facilities. TRI paper products facilities, whose companies made a commitment to the program, achieved a 66 percent reduction in total releases and transfers of the 33/50 Program chemicals from 1988 through 1995. TRI paper industry facilities as a whole achieved reductions of 60 percent, and the total for all TRI facilities was 56 percent.

8.3 Overview of Paper Industry Reporting

As noted in **Chapter 4** of this report, in 1995 paper industry facilities reporting to NPRI and those reporting to TRI showed significant differences. While total releases and transfers were much larger in TRI than NPRI, there were also four times as many TRI paper facilities as NPRI facilities (see **Table 8-1**).

Most pollutants were released rather than transferred from paper facilities in both Canada and the United States. However, the pattern was more exaggerated in Canada, where releases accounted for 93 percent of total

releases and transfers, than in the United States, where releases were 79 percent of the total.

NPRI and TRI also showed significant differences in the medium to which listed chemical substances was released. In NPRI, releases from the paper industry were split between air and water, with somewhat more released into the air (56 percent) than to water (43 percent). However, almost 90 percent of TRI releases were to the air, with almost 9 percent to water and the remainder to land.

One of the most striking differences between the industry’s reporting to NPRI and to TRI came in the area of transfers. Not only did the Canadian paper industry transfer significantly less as a percentage than such facilities in the United States; what was transferred went to very different places. In Canada, the paper industry transferred less than 0.1 percent of total releases and transfers to sewage treatment plants, whereas in the United States, the paper industry reported large quantities sent to sewage treatment plants, almost 17 percent of total releases and transfers.

Another difference was in the number of substances for which reporting forms were submitted. NPRI paper facilities submitted an average of 2.7 forms, while TRI paper facilities averaged 4.2 (see **Table 8-1**). This meant that TRI paper facilities reported on one to two more substances, on average, than did NPRI paper facilities. These are counted from the same matched list of substances and do not include any chemicals on the larger TRI list that are not also on the NPRI list.

The effect of this can be seen by comparing average releases and transfers per form and per facility between NPRI and TRI. Average total releases and transfers per facility were about the same in both countries (255,064 kg for NPRI and 253,306 kg for TRI).

Table 8-1		Releases and Transfers for Paper Industry (US SIC Code 26)									
M	1995	NPRI					TRI				
		Number	Average per Facility Number			Number	Average per Facility Number				
Facilities		115				447					
Forms		312	2.7			1,864	4.2				
Total Releases and Transfers											
		kg	% of Medium	% of Total	kg/facility	kg/form	kg	% of Medium	% of Total	kg/facility	kg/form
Total Air Emissions		15,330,306	56.0	52.3	133,307	49,136	79,932,135	89.7	70.6	178,819	42,882
Surface Water Discharges		11,879,113	43.4	40.5	103,297	38,074	7,622,282	8.6	6.7	17,052	4,089
Underground Injection		0	0.0	0.0	0	0	100	0.0	0.0	0	0
On-Site Land Releases		140,139	0.5	0.5	1,219	449	1,535,058	1.7	1.4	3,434	824
Matched Releases		27,352,922	100.0	93.3	237,851	87,670	89,089,575	100.0	78.7	199,306	47,795
Treatment/Destruction		1,558,207	78.7	5.3	13,550	4,994	4,017,155	16.6	3.5	8,987	2,155
Sewage/POTWs		21,133	1.1	0.1	184	68	18,890,688	78.3	16.7	42,261	10,134
Disposal/Containment		400,082	20.2	1.4	3,479	1,282	1,230,268	5.1	1.1	2,752	660
Matched Transfers		1,979,422	100.0	6.7	17,212	6,344	24,138,112	100.0	21.3	54,000	12,950
Matched Releases and Transfers		29,332,344		100.0	255,064	94,014	113,227,686		100.0	253,306	60,744

However, average total releases and transfers per form, that is, per chemical substance reported, were 55 percent higher for NPRI than for TRI (94,014 kg versus 60,744 kg).

Also striking were the differences in the distribution of releases compared to transfers seen as averages per form from NPRI and TRI paper facilities. Releases per form for NPRI were 83 percent greater than for TRI (87,670 kg/form in NPRI versus 47,795 kg/form in TRI). Average transfers per form for NPRI were 49 percent lower than for TRI (6,344 kg/form in NPRI versus 12,950 kg/form in TRI).

NPRI and TRI facilities averaged about the same amount of air emissions per form (49,136 kg versus 42,882 kg); the significant differences were in surface water discharges from NPRI paper facilities and transfers to sewage treatment from facilities in the US. NPRI facilities reported an average of 38,074 kg per form discharged to surface waters, while for TRI forms this was 4,089 kg on average. TRI facilities reported an average of 10,134 kg per form of transfers to sewage treatment, while NPRI forms averaged just 68 kg.

Pulp and paper mills in Canada projected a 38 percent decrease in releases and transfers from 1995–1997,

compared to a three percent projected reduction for TRI releases and transfers (refer back to **Tables 4–20** and **4–21**).

Table 8-2		Changes in NPRI and TRI Releases and Transfers for Paper Industry (US SIC Code 26)							
M Y	94-95	NPRI				TRI			
		1994 Number	1995 Number	Change 1994-1995 Number %		1994 Number	1995 Number	Change 1994-1995 Number %	
Facilities		94	107	13	13.8	450	425	-25	-5.6
Forms		216	258	42	19.4	1,621	1,604	-17	-1.0
		kg	kg	kg	%	kg	kg	kg	%
Total Air Emissions		16,092,936	15,221,226	-871,710	-5.4	75,347,549	74,900,879	-446,670	-0.6
Surface Water Discharges		12,245,868	10,381,420	-1,864,448	-15.2	3,906,082	3,128,034	-778,048	-19.9
Underground Injection		0	0	0	—	0	100	100	—
On-Site Land Releases		132,249	140,139	7,890	6.0	2,090,102	1,520,522	-569,580	-27.3
Matched Releases		28,472,996	25,745,222	-2,727,774	-9.6	81,343,733	79,549,534	-1,794,199	-2.2
Treatment/Destruction		3,028,911	1,558,207	-1,470,704	-48.6	3,930,777	4,013,526	82,749	2.1
Sewage/POTWs		77,475	21,133	-56,342	-72.7	18,343,323	18,566,102	222,779	1.2
Disposal/Containment		180,150	400,076	219,926	122.1	1,226,601	1,212,565	-14,036	-1.1
Matched Transfers		3,286,536	1,979,416	-1,307,120	-39.8	23,500,702	23,792,193	291,492	1.2
Matched Releases and Transfers		31,759,532	27,724,638	-4,034,894	-12.7	104,844,435	103,341,727	-1,502,707	-1.4

► Does not include ammonia, ammonium nitrate, ammonium sulfate, hydrochloric acid, nitric acid, nitrate compounds, sulfuric acid, and chemicals not reported to both NPRI and TRI.

8.4 Changes in Reporting 1994-1995

Between 1994 and 1995, pulp and paper industry reporting to NPRI showed significant changes while that to TRI changed very little. In 1995 paper industry reporting to NPRI increased substantially (14 percent increase in facilities and 19 percent increase in forms). On the other hand, releases from NPRI paper facilities were reduced by almost 10 percent and transfers by 40 percent from 1994 to 1995. These reductions in releases and transfers are all the more significant given that they occurred at the same time as the number of facilities was increasing (see

Table 8-2). Many mills continued to make changes to reduce pollutants in 1996, which will be reflected in the 1996 NPRI data.

In contrast, paper facilities reporting to TRI in 1995 showed little change from 1994. Total releases were reduced two percent and total transfers increased by one percent from 1994 to 1995. The largest reductions were in surface water discharges (a decrease of 20 percent).

Discussion of changes from 1994 to 1995, however, is based on a different set of chemicals because the reporting definition for some of the listed chemicals changed between 1994 and 1995.

This is the multi-year matched data set analyzed in **Chapter 5**.

8.4.1 NPRI Facilities with Significant Changes, 1994-1995

For many NPRI facilities in the paper industry, 1995 was a year of change. Facilities faced new regulations requiring compliance by December 1995 and new NPRI reporting criteria for by-products. Both of these factors can have a major effect on 1995 NPRI reporting. As was seen in **Table 5-10**, 12 of the 50 NPRI facilities with the greatest reductions in total releases and transfers were in the paper industry. On the other

hand, 10 of the 50 NPRI facilities with the greatest increases (**Table 5-8**) were paper facilities. For TRI, where overall changes were slight, five of the 50 TRI facilities reporting the largest decreases (**Table 5-14**) and four of the TRI facilities reporting the largest increases (**Table 5-12**) were from the paper industry.

Explanations of the facilities' changes in the amounts they reported from 1994 to 1995, as detailed in the following sections, were obtained in personal communications with facility representatives.

NPRI Facilities with Large Decreases

The data indicated that six NPRI facilities had apparent decreases of over 450,000 kg (1 million lbs) in releases and transfers from 1994 to 1995. These were contacted to determine possible reasons for such significant reductions (see **Table 5-10**). The facilities are Kimberly-Clark in New Glasgow, Nova Scotia; Western Pulp in Port Alice, British Columbia; Cartons St-Laurent in La Tuque, Quebec; Stora Forest Industries in Port Hawkesbury, Nova Scotia; Rexham Metallizing, Camvac Division, in Brantford, Ontario; and St. Anne-Nackawic Pulp Company in Nackawic, New Brunswick.

Because methanol is degraded in secondary treatment systems, the reported reductions in methanol releases could reflect the new Canadian federal effluent regulation, which required final compliance by 31 December 1995. The new Canadian dioxin and furan regulations, effective 1 January 1994, may have triggered reductions in the use of chlorine, resulting in continuously reduced releases of chlorine.

Of the six facilities whose data showed significant reductions, three had installed or improved secondary treatment plants which could account for the reductions (Kimberly-Clark, Cartons St-Laurent, and Stora Forest Industries), and one facility had made process and treatment changes. In addition, one facility reported an error and one did not report at all in 1995. All facilities that had made equipment or process changes identified the new federal or provincial regulations as a significant factor in their decisions either to initiate the changes or to increase the speed at which they were made. Companies reporting reductions in chlorine releases also cited increased demand for ECF paper as a reason for reductions.

The pulp mill with the largest reductions from 1994 to 1995 was Kimberly-Clark in New Glasgow, Nova Scotia, which reported reductions of nearly 3 million kg. Kimberly-Clark reported transferring 2 million kg of methanol to an off-site treatment plant in 1994, but none in 1995. This large reduction was due to the treatment plant being leased in 1995, which changed the transfer to a release, and improvements in aeration made at the treatment plant reduced the release of the methanol. Process changes in the plant also reduced chlorine use.

Cartons St-Laurent in La Tuque, Quebec, attributed its 1-million kg reduction in released methanol to the installation of a new secondary treatment plant. The company was predicting additional reductions in 1996, when the system would have been operating for a whole year. The reductions in pollutants could be seen in physical changes in the bay surrounding the plant. Stora Forest Industries in Port Hawkesbury, Nova Scotia, also gave credit for the significant 1995 reductions in methanol released to water to the installation of a new secondary treatment plant.

St. Anne-Nackawic Pulp Company, Ltd., in Nackawic, New Brunswick, has installed a bleach plant scrubber, which resulted in significant reductions in chlorine and chlorine dioxide from 1994 to 1995. The mill can use a variety of chemicals to bleach pulp, thereby ensuring ECF grades of wood pulp for European markets. The facility has also installed a secondary treatment plant and is conducting air emission testing to confirm its estimates of emission factors.

Western Pulp, in Port Alice, British Columbia, which reported a reduction in methanol releases of nearly 2 million kg in 1995, indicated that the 1994 estimate had been in error and the

accurate value was zero for 1994. Thus, this may be a "paper" reduction, that is, a change in reporting that does not reflect a change in actual releases. Western Pulp has also changed its bleaching process and installed secondary treatment.

Rexham Metallizing, Camvac Division, in Brantford, Ontario, did not submit any forms in 1995.

Therefore, the new federal regulations requiring reductions of biological oxygen demand and total suspended solids, which prompted many mills to install or upgrade secondary treatment or make process changes, could account for some of the large reductions seen in methanol releases to water. The combination of market demand for ECF paper and the federal and provincial regulations limiting dioxins and furans could account for some of the reductions in chlorine releases. Environment Canada is producing a report in 1998 on the results of the chemical monitoring required under these regulations.

NPRI Facilities with Large Increases

The three facilities reporting increases in releases and transfers of over 450,000 kg from 1994 to 1995 (**Table 5-8**) were contacted to determine possible reasons for these increases. The three facilities are Domtar Packaging in Red Rock, Ontario; Fraser Inc./Noranda Forest in Edmunston, New Brunswick; and Peace River Pulp Division in Peace River, Alberta. All three facilities reported increased releases or transfers of methanol in 1995.

The paper facility reporting the greatest increase in 1995 was Domtar Packaging in Red Rock, Ontario. In 1994, the facility did not report any releases of methanol, but this increased to nearly 2 million kg in 1995. An important change in 1995, which

accounts for this increase, is that by-products are included in the calculation of the threshold, regardless of their concentration. At Domtar's mill, methanol is produced as a by-product in low concentrations, and so the revised threshold requirement brought this release within the scope of NPRI reporting for 1995. The mill installed secondary treatment in the fall of 1995, which will substantially reduce methanol releases to water in 1996.

Fraser Inc./Noranda Forest in Edmunston, New Brunswick, noted that an error accounted for the reported increase of more than 1 million kg of methanol transferred in 1995. The company stated that in 1994 it transferred more than 1 million kg of methanol instead of the recorded value of zero, so the amount of methanol transferred had not increased from 1994 to 1995, but rather remained consistently above 1 million kg.

The Peace River Pulp Division in Peace River, Alberta, reported increases of 600,000 kg of methanol to air from 1994 to 1995. In 1995, the mill switched from relying on engineering calculations to actual monitoring data for methanol releases. This change in estimation methods accounted for the increase in methanol releases reported to NPRI.

TRI Facilities with Significant Changes

A few facilities did have notable changes in reporting to TRI from 1994 to 1995. They had little influence on overall reporting because so few reported large changes. Six facilities that had changes in releases and transfers of greater than 1 million pounds (454,000 kg) were contacted to determine the reasons for these changes. Of this set of six facilities, three registered decreases and three, increases. No consistent pattern or explanatory factor was seen in either group.

TRI Facilities with Large Decreases

TRI facilities with large decreases in total releases and transfers (see **Table 5-14**) included a Louisiana-Pacific Corp. pulp mill in Samoa, California, which reported a decrease of more than 1 million kg from 1994 to 1995, primarily reflecting decreased discharges to surface water of methanol. The Simpson-Pasadena pulp and paper facility in Pasadena, Texas, reported a decrease of more than 500,000 kg, largely in transfers to sewage and point source air emissions of methanol. The 3M Tape Manufacturing Division in Bedford Park, Illinois, reported a decrease of nearly 500,000 kg. This was due to decreases in point source air emissions of several solvents, notably mixed xylenes and cyclohexane.

The explanations for these changes are as diverse as the facilities that reported them and the chemicals and media for which changes were reported. Changes at the Louisiana-Pacific pulp mill in California reflected the installation of a steam stripper, so that condensates that had been sewered in previous years were now being incinerated. This capital investment in pollution control technology was made pursuant to a consent decree with the US EPA.

Simpson Pasadena's combined pulp and paper mill in Texas noted that market factors were primarily responsible for its decreased release estimates. This older facility operated at only two-thirds capacity in 1995. A representative indicated that variability in feedstock (for example, the age and species' characteristics of the trees being pulped) and operating conditions would also cause non-systematic changes in reporting, as were reflected in the results of twelve 24-hour-long sampling events conducted over the course of a year.

The 3M tape manufacturing facility in Illinois indicated that changes in its solvent emissions did not reflect changes in its own operations or reporting methods, but rather in the composition of solvent mixtures that it purchased from suppliers. In general, the amounts of TRI chemicals in these solvents had been decreasing since 1990, but were variable. Ethylbenzene content, for example, increased from 1993 to 1994, decreased from 1994 to 1995, and increased from 1995 to 1996.

TRI Facilities with Large Increases

TRI facilities with large increases (see **Table 5-12**) included a Stone Container Corp. pulp and paper facility in Panama City, Florida, reporting more than 1 million kg more releases and transfers in 1995 than in 1994. These were primarily transfers to sewage of methanol, but also air emissions, primarily point source, of methanol. Weyerhaeuser's paperboard mill in Valliant, Oklahoma, reported nearly 1 million additional kg of releases and transfers, almost entirely due to point source air emissions of methanol. International Paper's pulp and paperboard mill in Gardiner, Oregon, reported more than 600,000 kg of additional releases and transfers, in which a large increase in point source air emissions of methanol was not offset by decreases in other releases or transfers.

As was the case for facilities reporting large decreases, a wide range of factors was responsible for the reporting changes by these facilities. Market factors explain the changes at Stone Container Corporation's Florida mill, with changes in releases and transfers closely tracking an increase in production volume from 1994 (noted as a bad year for paper sales) and 1995.

For Weyerhaeuser's paperboard mill in Oklahoma, the fourfold change

in reported air emissions reflected the use of new estimation factors. Actual operations at the plant had not changed, and production volume was reported as fairly constant from 1994 to 1995.

The increases at International Paper's pulp and paperboard mill in Oregon were due to a change in waste management process under regulatory constraints. For more than three decades, the plant had been collecting, concentrating, and burning methanol produced by its operations. The Oregon Department of Environmental Quality insisted that these operations were not appropriately permitted. Because a satisfactory resolution could not be reached between the company and the state, the company ceased collection and concentration of methanol, allowing it to escape throughout the process. While eliminating the problem of permit compliance, this increased reportable air emissions of methanol by nearly an order of magnitude.

8.5 Differences in Guidelines for Calculating Estimates

Each country has its own guidelines for pulp and paper industry reporting to PRTRs. In the United States, the National Council of the Paper Industry for Air and Stream Improvement (NCASI), provides a handbook of chemical-specific guidance on estimation for TRI reporting (*NCASI Handbook of Chemical Specific Information for SARA 313 Form R Reporting*). In Canada, the Canadian Pulp and Paper Association has published a guideline for mills reporting to NPRI, which is based on the NCASI handbook. Canadian mills tend to use both the CPPA and NCASI guidelines.

Over the years, as a series of research efforts have provided additional information on the generation and release of TRI chemicals from pulp and

paper-making operations, guidance from NCASI has undergone significant revision. These revisions can have a profound effect on the reporting of releases and transfers, independent of any actual change in activity within this industry.

The emission factors contained in the 1994 Handbook, for example, reflected data obtained in sampling programs that indicated that methanol and acetaldehyde air emissions from certain processes at Kraft, sulfite, and semi-chemical pulp mills were considerably greater than had previously been believed. Reported air releases of methanol accordingly increased by 38 percent for pulp and paper mills, by 41 percent for chemical wood pulp mills, and by 17 percent for TRI pulp and paper facilities. Air emissions of cresol from this industry went from zero to more than 50 percent of the TRI total, and those of acetaldehyde increased nearly eightfold, from 13 percent of the TRI total to 39 percent. Specific case studies of Kraft mills conducted by NCASI have shown that use of these emission factors for different classes of mills would lead to major changes in methanol point source air emissions estimates for the reporting years 1991, 1992 and/or 1994, depending upon the particular mill's characteristics.

Similar changes can be seen for other chemicals subject to TRI reporting. For methyl ethyl ketone, reporting would begin in 1991, with subsequent decreases in 1992 and further decreases in 1994 for some plant types. An initial reporting of acetaldehyde air emissions for two types of mills in 1993 would be followed by much greater reporting of this chemical by all three types of mills studied in 1994 and subsequent years.

Paper facilities in the two countries may use guidance to estimate their releases, as do facilities in other

industries. Therefore, because PRTR reporting may be estimated based on different guidance, apparent differences in reporting between NPRI and TRI—whether in trends or at a particular point in time—may or may not reflect actual differences in releases or transfers.

8.6 Investigation of Industrial Mix

The paper industries in the two countries also differ in the types of facilities making up the industrial sector as a whole, which further influences the types and amounts of releases and transfers reported.

8.6.1 Industrial Sub-Sectors

This section analyzes releases and transfers from facilities that reported under US SIC code 26 or the Canadian code SIC 27. The US pulp and paper industry is divided into five subsectors:

SIC 261—Pulp Mills. These mills may engage in the de-inking of newsprint or in the production of pulp from fibrous materials as diverse as wood, rags, wastepaper, linters, straw or bagasse (sugarcane residue).

SIC 262—Paper Mills. These facilities primarily make paper from wood pulp or other pulp, and may or may not also include the manufacture of pulp in their operations. The papers produced may include cotton fiber paper, asbestos paper and asbestos-filled paper, and saturated felts, in addition to an array of specialty papers based on wood pulp.

SIC 263—Paperboard Mills. Again, these mills may produce a broad variety of products, including specialty coated boards, such as are used for food containers, and even paperboard materials for construction.

SIC 265—Paperboard Containers and Boxes. These facilities

primarily manufacture containers from purchased paperboard.

SIC 267—Miscellaneous Converted Paper Products. As might be expected from the name, these facilities produce a wide variety of paper-based products, including coated and laminated paper; plastic, foil and coated paper bags; cardboard; and sanitary paper products.

The Canadian paper industry facilities report under Canadian SIC code 27, and they must also indicate the corresponding US SIC subsector code under US SIC code 26. The two classification systems cover the same types of facilities for the paper industry, although the subsectors at the three-digit level do differ. The Canadian paper industry subsectors are—

1. all mills (pulp, newsprint, paperboard, and other paper mills),
2. folding cartons and set-up boxes,
3. corrugated boxes and paper bags, and
4. converted paper products.

Paper and pulp mills, as distinguished at the three-digit level under the US SIC code system, show marked differences in PRTR reporting. The US SIC code system must be used because only the Canadian facilities report both.

8.6.2 Multiple Codes

Any analysis of NPRI and TRI must take into account both the different subsectors within the paper industry and the different number of facilities within each subsector. The pulp and paper sector consists of a diverse set of industries, and the releases and transfers that pertain to a facility in one of these subsectors can be very different from those found in another.

One considerable barrier to comparison is that a NPRI facility reports

only one (US) SIC code that best represents the facility, while a TRI facility must report all SIC codes that describe its operations. For a US facility reporting multiple codes, it is not possible to break down the reported releases and transfers of a pollutant into individual SIC codes. For example, a US facility that chooses SIC codes 261 and 262 to describe its operations may report 3,000 kg of methanol releases. One cannot determine what proportion of this 3,000 kg total is released from operations within SIC 261 and what proportion from within SIC 262.

Data for US facilities that report multiple codes are thus not easily comparable to those for facilities reporting a single three-digit SIC code. Facilities reporting multiple SIC codes represent 23 percent of TRI paper industry facilities, 40 percent of forms, and 51 percent of total releases and transfers. For the purposes of this section, TRI data are first presented excluding data from facilities reporting multiple codes, and then including the facilities with multiple codes (see **Tables 8-3** and **8-4**).

To investigate the effect of facilities reporting multiple SIC codes, TRI data are presented in two ways within each table. First, only those facilities reporting a single three-digit SIC code are treated, and then secondly, to the single-SIC group are added all facilities that reported the same three-digit SIC code among their multiple codes.

Table 8-3 shows the TRI data with the facilities with multiple operations assigned to the individual subsectors. In this table, for each subsector, all facilities with the corresponding SIC code are added. For example, there are 57 facilities with the codes 261 and 262; nine facilities with codes 261, 262, and 263; nine facilities with 261 and 263; five facilities with 261, 262, and 267;

two facilities with 261, 262, 263, and 267; and one facility each with 261 and 267, and with 261, 262, 263, 265, and 267. These additional 84 facilities are added to the 22 facilities reporting only SIC code 261 (see **Table 8-5** for PRTR facility totals), for a total of 106 facilities. Similarly, all facilities that reported code 262 from among the multiple codes (including, for example, the 57 reporting codes 261 and 262) are added to the 108 paper mills that reported the single code of 262, for a total of 193 paper mill facilities.

Some TRI facilities still report SIC codes 264 (7 facilities) and 266 (1 facility). These SIC codes have not been valid since 1987. For this analysis, forms with these SIC codes have been assigned to the codes that replaced them. The releases and transfers reported under these old codes are less than 0.5 percent of total TRI releases and transfers.

Table 8-3		Releases and Transfers for Paper Industry (US SIC Code 26), by Subsector							
M		1995							
US SIC Code	Industry	Facilities		Forms		Total Releases (kg)	Total Transfers (kg)	Total Releases and Transfers	
		Number	%	Number	%			kg	% of Total
NPRI									
261	Pulp Mills	53	46.1	188	60.3	20,331,495	1,659,818	21,991,313	75.0
262	Paper Mills	26	22.6	62	19.9	3,466,491	130,329	3,596,820	12.3
263	Paperboard Mills	2	1.7	4	1.3	95,770	0	95,770	0.3
265	Paperboard Boxes	5	4.3	7	2.2	139,564	7,239	146,803	0.5
267	Misc. Converted Paper Products	29	25.2	51	16.3	3,319,602	182,036	3,501,638	11.9
Total for NPRI Facilities		115	100.0	312	100.0	27,352,922	1,979,422	29,332,344	100.0
TRI									
TRI Facilities with Single SIC Codes									
261	Pulp Mills	22	4.9	157	8.4	8,207,657	3,325,045	11,532,702	10.2
262	Paper Mills	108	24.2	373	20.0	12,930,980	2,051,461	14,982,441	13.2
263	Paperboard Mills	50	11.2	232	12.4	17,291,148	192,798	17,483,946	15.4
265	Paperboard Boxes	21	4.7	27	1.4	563,009	27,029	590,038	0.5
267	Misc. Converted Paper Products	143	32.0	328	17.6	10,452,562	539,143	10,991,706	9.7
Subtotal for Single SIC Codes		344	77.0	1,117	59.9	49,445,356	6,135,476	55,580,833	49.1
TRI Facilities with Multiple SIC Codes									
261/262		57	12.8	466	25.0	22,354,321	16,103,351	38,457,672	34.0
261/262/263		9	2.0	82	4.4	6,158,293	7,529	6,165,821	5.4
261/262/263/265/267		1	0.2	8	0.4	268,490	0	268,490	0.2
261/262/263/267		2	0.4	21	1.1	1,099,732	0	1,099,732	1.0
261/262/267		5	1.1	29	1.6	1,003,025	0	1,003,025	0.9
261/263		9	2.0	66	3.5	5,632,683	1,887,567	7,520,250	6.6
261/267		1	0.2	3	0.2	21,931	0	21,931	0.0
262/263		3	0.7	21	1.1	1,338,514	0	1,338,514	1.2
262/263/267		2	0.4	9	0.5	756,016	0	756,016	0.7
262/267		6	1.3	21	1.1	69,109	3,299	72,409	0.1
263/265		5	1.1	13	0.7	233,248	888	234,136	0.2
263/267		2	0.4	7	0.4	706,636	0	706,636	0.6
265/267		1	0.2	1	0.1	2,222	0	2,222	0.0
Subtotal for Multiple SIC Codes		103	23.0	747	40.1	39,644,219	18,002,634	57,646,853	50.9
Total for TRI Facilities		447	100.0	1,864	100.0	89,089,575	24,138,111	113,227,686	100.0

► For TRI facilities, SIC 262 includes SIC 266, which was changed in 1987, and SIC 267 includes SIC 264, which was changed in 1987.

8.7 Industrial Subsectors— Detailed PRTR Data

Whether viewed in terms of number of facilities, number of forms submitted, or releases and transfers, the distribution of industrial subsectors within the paper industry as a whole varies markedly between NPRI and TRI. As shown in Tables 8-3 and 8-4, by all three measures, pulp mills (US SIC 261) play a major role in NPRI reporting, but paper mills (US SIC 262) and paperboard mills (US SIC 263) are a more dominant feature of the TRI paper industry reporting. The following sections look into these subsectors in detail.

8.7.1 Pulp Mills (US SIC 261)

Pulp mills represent half of the paper industry facilities in NPRI, but a much smaller fraction in TRI. Fifty-three pulp mills reported to NPRI in 1995, and 22 single-operation pulp mills, with another 84 pulp/paper-making combination mills, reported to TRI (see Table 8-5).

Average releases and transfers per facility were higher in TRI than in NPRI. However, the US facilities submitted reports for twice as many of the listed substances as did the Canadian facilities. [These substances come from the matched list of chemicals that are reportable in both countries.] As a result, the average releases and transfers per chemical form were 47 percent higher for NPRI than for TRI for pulp mills. Also, NPRI pulp mills reported average on-site releases per form twice as high as TRI pulp mills.

Releases and Transfers from Pulp Mills

As Figure 8-1 shows, pulp mills in Canada reported roughly half of their releases as air emissions and half as surface water discharges, while for TRI

Table 8-4		Releases and Transfers for TRI Paper Industry (US SIC Code 26), by Subsector									
M		1995									
US SIC Code	Industry	Facilities		Forms		Total Releases		Total Transfers		Total Releases and Transfers	
		Single SIC Codes Only (Number)	Multiple SIC Code Facilities Included* (Number)	Single SIC Codes Only (Number)	Multiple SIC Code Facilities Included* (Number)	Single SIC Codes Only (kg)	Multiple SIC Code Facilities Included* (kg)	Single SIC Codes Only (kg)	Multiple SIC Code Facilities Included* (kg)	Single SIC Codes Only (kg)	Multiple SIC Code Facilities Included* (kg)
261	Pulp Mills	22	106	157	832	8,207,657	44,746,130	3,325,045	21,323,493	11,532,702	66,069,622
262	Paper Mills	108	193	373	1,029	12,930,980	45,978,441	2,051,461	18,165,527	14,982,441	64,143,968
263	Paperboard Mills	50	83	232	460	17,291,148	33,484,759	192,798	2,088,782	17,483,946	35,573,541
265	Paperboard Boxes	21	28	27	49	563,009	1,066,969	27,029	27,917	590,038	1,094,886
267	Misc. Converted Paper Products	143	163	328	427	10,452,562	14,361,757	539,143	542,399	10,991,706	14,904,156
Total for TRI Facilities		447		1,864		89,089,575		24,138,111		113,227,686	

* Multiple SIC code columns cannot be added because multiple SIC code amounts are added to each subsector where a SIC code was reported.

► For TRI facilities, SIC 262 includes the former SIC 266, and SIC 267 includes SIC 264. Both of these subsector designations were changed in 1987.

pulp mills, over 80 percent of their releases were air emissions. Transfers were almost exclusively to treatment for both NPRI and TRI facilities, except for those with multiple codes. TRI pulp mills with other types of paper-making operations as well reported more than 80 percent of their transfers as transfers to sewage. This was due to six facilities reporting as both pulp and paper mills (SIC codes 261 and 262). These six facilities reported transfers to sewage of more than 1 million kg of methanol. There were five NPRI pulp mills with similarly large amounts of methanol, but the NPRI facilities reported these as discharges to surface water.

Chemicals from Pulp Mills

Methanol. As Table 8-5 shows, releases of methanol reported to NPRI in 1995 totaled over 16 million kg. They accounted for more than half of the total methanol reported to NPRI from all

industrial facilities. Pulp mills reported releases of 6 million kg and transfers of 3 million kg to TRI in 1995, representing 5.5 percent of total releases and transfers of methanol reported to TRI. Pulp mills with other paper operations (TRI facilities reporting multiple SIC codes including 261) reported an additional 31 million kg of methanol releases and 20 million kg of methanol transfers. Together, these facilities accounted for 30 percent of total TRI releases and transfers of methanol in 1995.

Methanol is a volatile organic compound that does not bioaccumulate and biodegrades rapidly. In the pulp and paper industry, methanol is a by-product of the pulping and bleaching processes and can be released from a number of sources within a pulp mill, including the bleach plant, evaporators, and from the manufacturing of chlorine dioxide. Secondary treatment can be 80 to

98 percent effective in reducing methanol releases.

In both NPRI and TRI, the bulk of reported releases from pulp mills consist of methanol (81 percent of NPRI releases from pulp mills and 82 percent of TRI releases from all pulp and combination pulp mills—see Table 8-5). The average quantity of methanol released by NPRI facilities with pulping operations was 18 percent higher than the average released by combination TRI mills (399,361 and 334,871 kg per form, respectively). As noted above, a few TRI combination pulp and paper mills reported large transfers to sewage of methanol. When transfers are also considered, the average total releases and transfers per form are 26 percent higher for TRI than for NPRI.

In Canada, methanol releases and transfers were reduced by 16 percent

from 1994 to 1995, in spite of a 13 percent increase in the number of pulp mills reporting methanol. Most of this reduction represented reduced releases to water, which decreased from almost 12 million kg to just over 8 million kg—a 31 percent reduction. However, methanol released to air increased 20 percent from 1994 to 1995. In the United States, pulp mills and combination pulp mills reported almost no change in methanol releases or transfers. Releases increased by 1 percent and transfers increased by 0.5 percent.

Chlorine Compounds. After methanol, chlorine and chlorine dioxide were the chemicals with the next largest releases from pulp mills reporting to NPRI, each representing approximately 5 percent of total releases. Chlorine can be used to bleach pulp, treat effluent and may be inadvertently formed in the generation of chlorine dioxide. Chlorine dioxide can also be used to bleach pulp

Table 8-5		Releases and Transfers for Pulp Mills (US SIC Code 261)		
M	1995			
		TRI		
	NPRI (Number)	Single SIC Codes (Number)	Multiple SIC Code Facilities Included (Number)	
Facilities	53	22	106	
Forms	188	157	832	
	kg	kg	kg	
Total Air Emissions	10,644,916	6,579,966	37,916,957	
Surface Water Discharges	9,546,873	1,616,941	6,185,960	
Underground Injection	0	0	0	
On-Site Land Releases	138,612	10,750	643,213	
Matched Releases	20,331,495	8,207,694	44,746,130	
Treatment/Destruction Sewage/POTWs	1,410,310	3,308,918	3,407,210	
Disposal/Containment	0	113	17,325,482	
	249,508	16,014	590,800	
Matched Transfers	1,659,818	3,325,045	21,323,493	
Matched Releases and Transfers	21,991,313	11,532,702	66,069,622	
Average Forms/Facility	3.5	7.1	8.0	
Average Releases per Facility	383,613	373,075	422,133	
per Form	108,146	52,278	53,781	
Average Transfers per Facility	31,317	151,138	201,165	
per Form	8,829	21,179	25,629	
Average Releases and Transfers per Facility	414,930	524,214	623,298	
per Form	116,975	73,457	79,411	
Methanol	Number	Number	Number	
Forms	41	16	109	
	kg	kg	kg	
Total Air Emissions	8,329,563	4,691,275	32,862,393	
Surface Water Discharges	8,037,936	1,165,341	3,377,259	
Underground Injection	0	0	0	
On-Site Land Releases	6,312	10,385	261,239	
Matched Releases	16,373,811	5,867,002	36,500,891	
Treatment/Destruction Sewage/POTWs	1,339,100	3,265,306	6,535,057	
Disposal/Containment	0	0	16,777,195	
	134,384	15,646	46,104	
Matched Transfers	1,473,484	3,280,952	23,358,356	
Matched Releases and Transfers	17,847,295	9,147,955	59,859,247	
Average Releases per Form	399,361	366,688	334,871	
Average Transfers per Form	35,939	205,060	214,297	
Average Releases and Transfers per Form	435,300	571,747	549,167	

and to treat raw water and as a slimicide. Almost 1 million kg each of chlorine and chlorine dioxide were released from pulp mills in 1995, a substantial reduction from nearly 1.6 million kg each in 1994. For TRI, chloroform was second to methanol, with 23 percent of total releases from single-operation pulp mills and 7 percent from all TRI facilities with pulp mill operations.

Just as the reductions in methanol could have been prompted by the new federal regulations limiting biological oxygen demand and total suspended solids, one might expect reductions in chlorine releases from mills from 1994 to 1995, as a result of the federal dioxin and furan regulations and the increased

demand for ECF paper. In fact, chlorine releases from pulp mills did decrease 44 percent from 1994 to 1995, and this may reflect process changes within the mills. There was virtually no change in releases and transfers of chloroform from TRI pulp mills and combination pulp mills from 1994 to 1995.

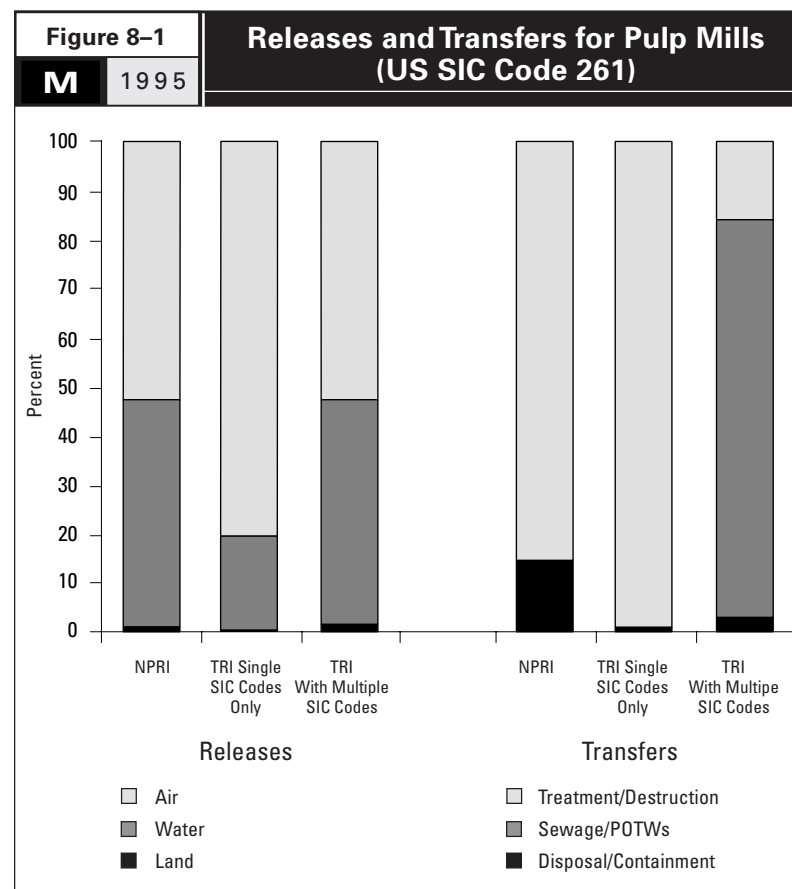


Table 8-6		Releases and Transfers for Paper Mills (US SIC Code 262)		
M	1995			
		TRI		
	NPRI (Number)	Single SIC Codes (Number)	Multiple SIC Code Facilities Included (Number)	
Facilities	26	108	193	
Forms	62	372	1,029	
	kg	kg	kg	
Total Air Emissions	1,191,494	11,680,878	39,563,067	
Surface Water Discharges	2,273,707	1,123,863	5,551,671	
Underground Injection	0	100	100	
On-Site Land Releases	147	126,139	863,604	
Matched Releases	3,466,491	12,930,980	45,978,441	
Treatment/Destruction	81	130,911	232,500	
Sewage/POTWs	0	1,339,855	16,778,687	
Disposal/Containment	130,248	580,695	1,154,341	
Matched Transfers	130,329	2,051,461	18,165,527	
Matched Releases and Transfers	3,596,820	14,982,441	64,143,968	
Average Forms/Facility	2.4	3.4	5.3	
Average Releases				
per Facility	133,327	119,731	238,230	
per Form	55,911	34,761	44,683	
Average Transfers				
per Facility	5,013	18,995	94,122	
per Form	2,102	5,515	17,654	
Average Releases and Transfers				
per Facility	138,339	138,726	332,352	
per Form	58,013	40,275	62,336	
Methanol	Number	Number	Number	
Forms	10	40	112	
	kg	kg	kg	
Total Air Emissions	1,063,661	8,692,388	29,089,190	
Surface Water Discharges	1,861,430	340,541	1,330,226	
Underground Injection	0	0	0	
On-Site Land Releases	107	14,330	415,366	
Matched Releases	2,925,298	9,047,259	30,834,782	
Treatment/Destruction	81	109,218	113,663	
Sewage/POTWs	0	1,215,421	16,178,558	
Disposal/Containment	6	33,101	46,778	
Matched Transfers	87	1,357,740	16,338,999	
Matched Releases and Transfers	2,925,385	10,404,999	47,173,780	
Average Releases per Form	292,530	226,181	275,311	
Average Transfers per Form	9	33,944	145,884	
Average Releases and Transfers per Form	292,539	260,125	421,194	

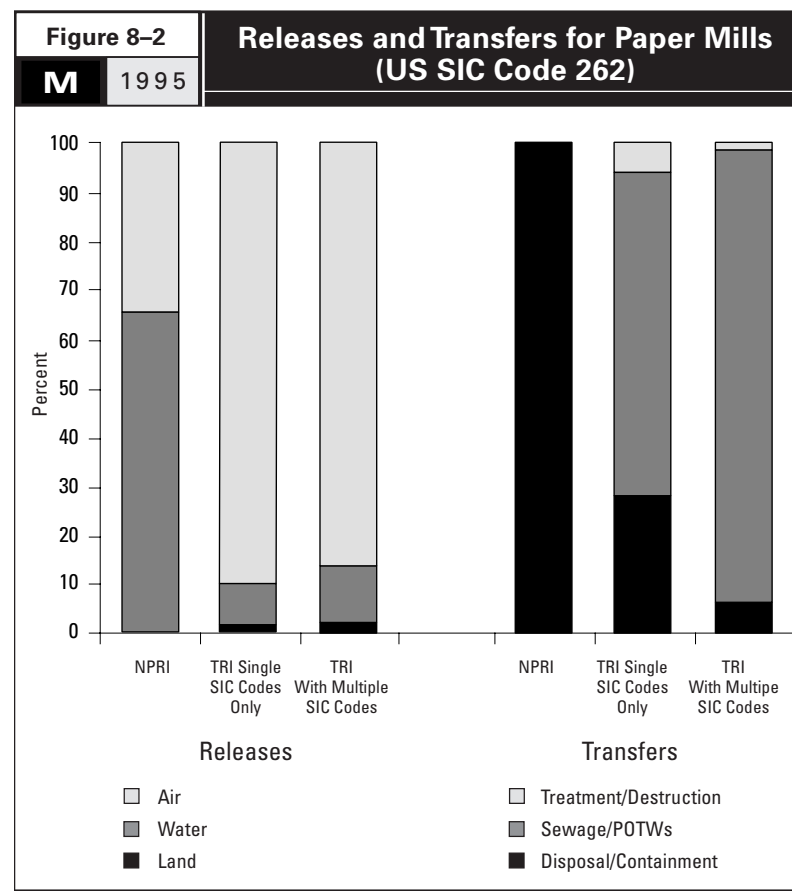
8.7.2 Paper Mills (SIC 262)

Paper mills represent a larger portion of the pulp and paper industry reporting to TRI than to NPRI. Twenty-six paper mills reported to NPRI and 108 to TRI (with an additional 85 combination paper mills and other paper-making operations—see **Table 8-6**). In both NPRI and TRI, paper mills contributed a smaller fraction of total releases and transfers for the paper sector than would be expected based on the number of facilities (23 percent of total facilities and 12 percent of total releases and transfers). However, when TRI paper mills with combinations of other paper-making operations are included, such facilities represent 43 percent of TRI

paper industry facilities and 58 percent of total releases and transfers.

Releases and Transfers from Paper Mills

Figure 8-2 shows the distribution of releases and transfers for paper mills. In this case, NPRI paper mill reporting shows that 66 percent of releases were discharges to surface waters and 34 percent to the air, while TRI paper mills released about 90 percent of their discharges to the air. Again, transfers differ for TRI facilities, depending on whether facilities with multiple SIC codes are included, because the same six facilities with large methanol transfers to sewage are included in this



subsector as well. For NPRI facilities, paper mills reported transfers to disposal while NPRI pulp mills, as seen above, reported transfers to treatment.

Total releases and transfers per form submitted by paper mills were the same for NPRI and TRI paper mills, with TRI combination paper mills reporting just 7 percent higher average releases and transfers. However, on-site releases from NPRI paper mills represented 96 percent of total releases and transfers in NPRI and approximately 70 percent of releases and transfers reported to TRI. Releases were higher on average in NPRI than in TRI, whether or not the combination paper mills are included (55,911 versus 34,761 kg/form for paper mills and 44,683 kg/form for combination paper mills).

Similar to the trend observed for pulp mills, paper mills in Canada reported fewer chemicals, on average, than facilities in the United States (2.4 versus 3.4 forms per facility for paper mills and 5.3 forms per facility for combination paper mills). In both NPRI and TRI, only three chemicals (methanol, phosphoric acid, and chlorine) were reported by more than 20 percent of the paper mills. Phosphoric acid is used as a nutrient in wastewater treatment and for paint removal.

Unlike most other sectors, releases from paper mills reported to NPRI showed an increase in 1995 from 1994 levels. However, this was almost entirely due to one facility, Domtar in Red Rock, Ontario. As discussed above, Domtar Red Rock had to report its releases of methanol for the first time in 1995 because of the change in reporting requirements concerning by-products.

Chemicals from Paper Mills

Methanol. As was the case for pulp mills, most of the reported releases from

paper mills were methanol, accounting for 84 percent of reported releases from paper mills to NPRI, and 70 percent in TRI. The proportion of facilities submitting forms, though, was similar, 38 percent for NPRI to 37 percent for TRI. Those facilities that submitted forms for methanol to NPRI, however, reported just 6 percent higher average releases per form than those in TRI (292,530 kg versus 275,311 kg per reporting facility). NPRI facilities reported minimal transfers of methanol, unlike their TRI counterparts. Therefore, total releases and transfers of methanol from TRI paper mills are, on average, 30 percent higher per form.

8.7.3 Paperboard Mills (SIC 263)

Only one paperboard mill reported to NPRI in 1994 and 1995. The mill, Dover Industries of Burlington, Ontario, halved its releases of isopropyl alcohol and methyl ethyl ketone from 1994 to 1995.

Fifty paperboard mills reported to TRI in 1995, representing 11 percent of all TRI facilities and 15 percent of total releases and transfers in the paper industry. An additional 33 TRI facilities had combination paper-making operations that included paperboard. With these facilities included, paperboard mills accounted for 19 percent of paper industry facilities and 31 percent of total releases and transfers. More than 94 percent of releases from paperboard mills were to the air, and more than 99 percent of transfers were to sewage. The limited number of paperboard mills reporting to NPRI does not permit detailed quantitative comparison between TRI and NPRI.

8.7.4 Paperboard Boxes (SIC 265)

Five paperboard box manufacturing facilities reported to NPRI, and 21 reported to TRI, with an additional

seven TRI facilities manufacturing paperboard boxes in combination with other paper-making operations. This amounts to only 4 percent of NPRI facilities and about 6 percent of TRI facilities for the paper sector, but an even smaller fraction of total forms (less than 3 percent in both NPRI and TRI). Releases and transfers reported on these forms represented 1 percent of total releases and transfers for the paper sector for both NPRI and TRI.

Releases and transfers per facility in this subsector were the lowest of any in the paper industry (29,361 kg/facility in NPRI, 28,097 kg/facility in TRI for single SIC code facilities and 39,102 kg/facility when multiple SIC code facilities are included). Due to the small role this sector plays in the overall paper industry and the diverse nature of the sector, a detailed analysis is not presented.

8.7.5 Miscellaneous Converted Paper Products (SIC 267)

Twenty-nine NPRI and 143 TRI facilities reported in this diverse subsector (plus an additional 20 TRI facilities with other paper-making operations in combination with converted paper products operations—see **Table 8-7**). Altogether, these facilities constituted 25 percent of the total paper sector facilities reporting to NPRI, and 32 percent of TRI facilities. They reported a smaller fraction of total releases and transfers for the paper sector than would be expected from the number of reporting facilities (roughly half as much): 12 percent of NPRI releases and transfers, and 10 percent of TRI releases and transfers (13 percent when the multiple operations facilities are included).

Figure 8-3 shows the distribution of releases and transfers for facilities producing converted paper products. Both TRI and NPRI facilities in this

subsector reported practically all releases to air, and over 80 percent of transfers were to treatment.

Average total releases and transfers per facility for NPRI facilities in this subsector were higher than those for TRI. They were 57 percent higher than for TRI facilities that make only converted paper products and 32 percent higher than for those TRI facilities in combination with others that have additional paper-making operations. TRI facilities in this subsector submitted somewhat more forms than did NPRI facilities (2.3 to 2.6 forms per TRI facility versus 1.8 forms per NPRI facility).

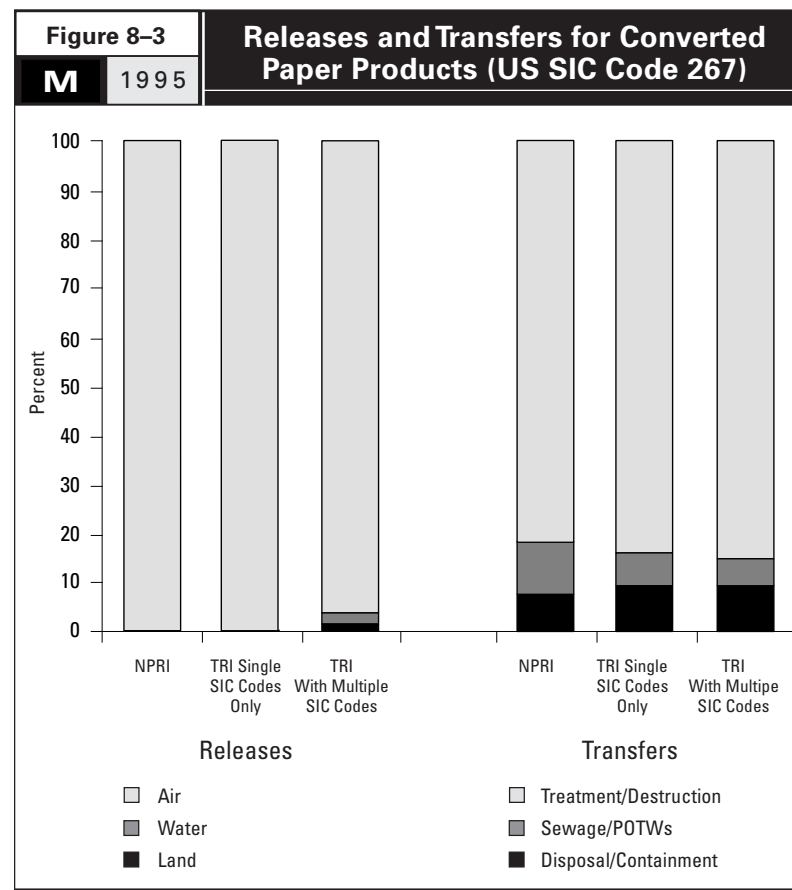
As opposed to the situation prevailing for many of the other subsectors in the pulp and paper industry, in miscellaneous converted paper products manufacturing there is a pronounced difference in the pattern of reporting between NPRI and TRI facilities. This difference does not appear simply in the amounts or identities of reported chemicals. While both NPRI and TRI forms here cover a wide range of chemicals (18 with non-zero releases for NPRI, 30 for TRI), no single chemical was reported by more than 30 percent of NPRI facilities, while more than 70 percent of the TRI facilities in this subsector reported toluene, and more than 40 percent reported methyl ethyl ketone.

Toluene was the chemical responsible for the largest share of releases and transfers in both NPRI and TRI reports from this subsector, but it accounted for only 27 percent of the NPRI total, while representing 52 percent in TRI. The NPRI facilities manufacturing converted paper products reported significant releases of toluene and xylene—for NPRI in 1995, seven facilities reported 13 percent of the total toluene reported to the entire NPRI database, and two facilities reported 10 percent of the total

Table 8-7		Releases and Transfers for Converted Paper Products (US SIC Code 267)		
M	1995			
		TRI		
	NPRI (Number)	Single SIC Codes (Number)	Multiple SIC Code Facilities Included (Number)	
Facilities	29	143	163	
Forms	51	328	427	
	kg	kg	kg	
Total Air Emissions	3,315,865	10,452,434	13,881,276	
Surface Water Discharges	1,500	15	288,425	
Underground Injection	0	0	0	
On-Site Land Releases	1,210	113	192,056	
Matched Releases	3,319,602	10,452,562	14,361,757	
Treatment/Destruction	147,816	453,432	456,686	
Sewage/POTWs	20,986	37,249	37,249	
Disposal/Containment	13,234	48,462	48,464	
Matched Transfers	182,036	539,143	542,399	
Matched Releases and Transfers	3,501,638	10,991,706	14,904,157	
Average Forms/Facility	1.8	2.3	2.6	
Average Releases				
per Facility	114,469	73,095	88,109	
per Form	65,090	31,868	33,634	
Average Transfers				
per Facility	6,277	3,770	3,328	
per Form	3,569	1,644	1,270	
Average Releases and Transfers				
per Facility	120,746	76,865	91,437	
per Form	68,660	33,511	34,904	
Toluene	Number	Number	Number	
Forms	8	97	100	
	kg	kg	kg	
Total Air Emissions	904,217	7,514,127	7,552,782	
Surface Water Discharges	0	5	5	
Underground Injection	0	0	0	
On-Site Land Releases	0	113	113	
Matched Releases	904,217	7,514,245	7,552,900	
Treatment/Destruction	26,000	129,929	132,983	
Sewage/POTWs	0	1,985	1,985	
Disposal/Containment	0	1,935	1,935	
Matched Transfers	26,000	133,849	136,902	
Matched Releases and Transfers	930,217	7,648,094	7,689,803	
Average Releases per Form	113,027	77,466	75,529	
Average Transfers per Form	3,250	1,380	1,369	
Average Releases and Transfers per Form	116,277	78,846	76,898	

xylene. This sector also had the number one facility for both toluene (Canadian Technical Tape in St-Laurent, Quebec) and xylenes (Les Papiers Perkins, Ltee, in Candiac, Quebec) for all NPRI releases in 1994.

For those facilities that reported releases or transfers of toluene, the average total releases and transfers for NPRI was 50 percent greater than for TRI.



8.8 Conclusions

While the pulp and paper industry is a major contributor to the total reported releases and transfers in each country, marked differences exist between NPRI and TRI in the reporting from the sector. The differences include the distribution of the types of releases and transfers, the number of substances reported, and the types of pulping and paper-making operations at the facilities. In addition, from 1994 to 1995, substantial reductions in pollutants were reported from NPRI facilities while almost no change was reported by TRI facilities. Differences in regulations and estimating guidelines are also factors that may have affected the results.

- The distribution of types of releases and transfers is different. For NPRI, air emissions represented 52 percent and surface water discharges 40 percent of total releases and transfers. For TRI, air emissions accounted for 71 percent and transfers to sewage 17 percent of the total.
- TRI pulp and paper facilities submitted reports, on average, for more chemicals than did those reporting to NPRI. The TRI average was 4.2 forms per facility as opposed to 2.7 for NPRI. [This is for the common list of substances reportable to both countries.]
- Overall, the average releases and transfers reported by paper industry facilities was about the same in both countries. However, because TRI paper industry facilities submitted more chemical forms, the average releases and transfers per form for TRI was lower than the average per form from an NPRI paper industry facility.
- The NPRI paper industry is dominated by pulp mills while the TRI paper industry has fewer pulp mills and more paper mills and facilities manufacturing converted paper products. Pulp mills in both countries reported the highest average releases and transfers. Canadian pulp mills reported about the same average releases and transfers per facility as those reporting to TRI, but the figure is higher when looked at on a per form basis.
- For NPRI, total releases were 10 percent lower in 1995 than in 1994, despite a 14 percent increase in the number of facilities reporting. Total transfers were 40 percent lower. TRI paper industry facilities reported almost no change from 1994 to 1995.
- The reductions reported by NPRI facilities may have been driven, in part, by new federal and provincial regulations in Canada that came into effect in the 1994–1995 time period requiring process and end-of-pipe controls.
- For TRI, significant changes have been observed in reported releases and transfers for the pulp and paper industry in previous years. These changes reflect both real shifts in the industry that are symptomatic of a complex interplay between existing and proposed regulations and market demand, and changes in estimation methods that do not reflect actual production or operational changes.
- Paper industry facilities in both countries are switching from chlorine-based bleaching to processes using chlorine dioxide or oxygen, and these should further reduce pollutant levels in future years.