5. PRODUCTION, IMPORT/EXPORT, USE, AND DISPOSAL

5.1 PRODUCTION

Table 5-1 lists the production year, number of facilities, the state where each facility is located, and the range (in pounds) for each domestic manufacturer that reported the production or formulation of nitrate compounds in 2012 (TRI12 2014). Table 5-2 lists Toxics Release Inventory (TRI) data for sodium nitrite, a common nitrite salt. Table 5-3 lists the TRI data for ammonia. Manufacturers are required to report Toxics Release Inventory (TRI) data to satisfy EPA requirements. The TRI data should be used with caution since only certain types of facilities are required to report (EPA 2005). Facilities that must report to the TRI include industries in a specific business sector such as manufacturing, mining, or electric generation, employ ≥10 full-time employees, and manufacture or process 25,000 pounds of a TRI-listed chemical or use >10,000 pounds of a TRI listed chemical per calendar year. Therefore, there are some facilities that may be processing or using nitrate and/or nitrite, but are not required to report to TRI because they do not meet the regulatory criteria. The amounts reported in Tables 5-1, 5-2, and 5-3 represent those reported by all facilities in each state that are required to report to the TRI and represent the range of minimum to maximum amounts of each chemical present on-site at these facilities during the year. This is not an exhaustive list.

Nitrate and nitrite are not stable compounds, but rather the ionic portions of compounds such as inorganic salts. As used in this profile, the word "ion" is implied and not used, unless added for clarity. Nitrate and nitrite occur naturally in the environment as a part of the nitrogen cycle. Nitrogen fixation is part of the natural process by which free nitrogen gas (N_2) is converted to nitrite, then to nitrate, used by plants, and returned as free N_2 to the atmosphere. This is called the nitrogen cycle, and is shown in Figure 5-1. This cycle occurs through the global environment (Newton 2005). Nitrogen exists naturally in soils. Topsoils contain nitrogen, at content levels as high as 2 to 4 tons/hectare (roughly 1.2–2.4 kg/m^3 in the upper 15 cm of soil; topsoil depths can range between 0 and 30 cm [Hill Laboratories 2014]), typically bound to organic matter and mineral soil material; available forms of nitrogen, including nitrate, are present in soils at a few kg/hectare (Taylor 2004). Nitrate is also formed naturally as an end product of oxidation of vegetable debris and animal and human waste, mainly urine disposed of in waste water. This process is known as nitrification, which is a microbial process that converts ammonia to nitrate and is the principal source for nitrate in the terrestrial and aquatic environment (Environment Canada 2012). Under aerobic conditions, the ammonium ion (e.g., from fertilizer or manure, or discharge from municipal and onsite waste water treatment systems) is converted to nitrite ion via ammonia-oxidizing bacteria (Nolan 1999).

Table 5-1. Facilities that Produce, Process, or Use Nitrate Compounds

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
AK	2	1,000,000	9,999,999	1, 5, 12, 14
AL	56	0	49,999,999	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14
AR	26	0	49,999,999	1, 3, 4, 5, 7, 9, 11, 12, 13
AZ	32	0	99,999,999	1, 4, 5, 6, 7, 11, 12
CA	139	0	499,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
CO	39	0	10,000,000,000	1, 5, 7, 11, 12, 13, 14
CT	26	0	99,999	1, 3, 5, 7, 8, 10, 12
DC	4	1,000	9,999	7, 8
DE	6	0	9,999,999	1, 5, 7, 13, 14
FL	36	0	9,999,999	1, 3, 4, 5, 6, 7, 9, 11, 12, 13, 14
GA	57	0	99,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
GU	1	100,000	999,999	1, 5
HI	7	0	99,999	1, 5, 9
IA	46	0	999,999,999	1, 3, 4, 5, 7, 8, 10, 11, 12, 13
ID	25	0	9,999,999	1, 2, 3, 5, 6, 7, 8, 10, 12, 13, 14
IL	108	0	499,999,999	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
IN	62	0	9,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
KS	27	0	999,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
KY	44	0	999,999	1, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13
LA	48	0	999,999,999	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14
MA	42	0	9,999,999	1, 3, 5, 6, 7, 11, 12, 13
MD	21	0	999,999	1, 3, 4, 5, 6, 7, 8, 10, 13, 14
ME	12	0	99,999	1, 5, 11, 12
MI	105	0	9,999,999	1, 5, 6, 7, 8, 9, 10, 11, 12, 14
MN	53	0	999,999,999	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 14
MO	37	0	49,999,999	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14
MS	28	100	49,999,999	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12
MT	10	100	999,999	1, 3, 5, 7, 11, 12, 13
NC	41	0	9,999,999	1, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13
ND	10	100	999,999	1, 5, 7, 8, 13
NE	25	100	99,999,999	1, 3, 4, 5, 6, 7, 10, 12, 13
NH	7	0	99,999	1, 5, 7, 10, 11, 12
NJ	40	100	999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14
NM	14	0	499,999,999	1, 5, 6, 10, 11, 12
NV	27	0	499,999,999	1, 2, 3, 5, 6, 7, 10, 11, 12, 13, 14
NY	73	0	999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
OH	111	0	499,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
OK	37	100	99,999,999	1, 3, 4, 5, 6, 7, 10, 11, 12, 14
OR	40	0	49,999,999	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12

Table 5-1. Facilities that Produce, Process, or Use Nitrate Compounds

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
PA	67	0	499,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
PR	7	100	999,999	1, 3, 5, 7, 8, 14
RI	6	100	99,999	1, 2, 3, 5, 6, 12
SC	43	0	999,999	1, 2, 3, 5, 6, 7, 10, 11, 12, 13, 14
SD	8	1,000	9,999,999	1, 5
TN	45	0	49,999,999	1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14
TX	132	0	49,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
UT	38	0	49,999,999	1, 2, 3, 4, 5, 6, 7, 9, 10, 12, 13
VA	42	0	9,999,999	1, 3, 5, 7, 8, 9, 10, 11, 12, 13
VT	6	100	9,999,999	1, 5, 6, 10, 12
WA	46	0	99,999,999	1, 3, 4, 5, 6, 7, 9, 12, 13, 14
WI	127	0	499,999,999	1, 4, 5, 7, 9, 10, 11, 12, 13, 14
WV	18	0	9,999,999	1, 3, 4, 5, 6, 7, 10, 12, 13, 14
WY	5	10,000	99,999,999	1, 3, 4, 6, 7, 11

[a]Post office state abbreviations used.
[b]Amounts on site reported by facilities in each state.
[c]Activities/Uses:

1. Produce
2. Import
3. Onsite use/processing
4. Sale/Distribution
5. Byproduct
6. Reactant
7. Formulation Component
8. Article Component
9. Repackaging
10. Chemical Processing Aid
11. Manufacturing Aid
12. Ancillary/Other Uses
13. Manufacturing Impurity
14. Process Impurity

Source: TRI13 2014 (Data are from 2013)

Table 5-2. Facilities that Produce, Process, or Use Sodium Nitrite

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
AL	7	1,000	999,999	1, 5, 6, 7, 10, 11, 12
AR	8	0	99,999	2, 3, 5, 6, 8, 9, 12
AZ	3	1,000	9,999	12
CA	11	1,000	499,999,999	1, 3, 6, 7, 9, 11
CO	2	1,000	99,999	7, 9, 11
FL	1	10,000	99,999	12
GA	11	1,000	99,999	1, 5, 6, 7, 9, 11
IA	3	100	99,999	6, 10
ID	1	10,000	99,999	11
IL	32	0	999,999	1, 3, 4, 5, 6, 7, 9, 10, 11, 12
IN	20	100	9,999,999	1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 13
KS	2	1,000	9,999	10, 12
KY	10	100	999,999	6, 7, 10, 11, 12
LA	9	1,000	9,999,999	1, 5, 6, 7, 10, 11, 12
MA	5	1,000	99,999	6, 12
MD	1	10,000	99,999	2, 3, 11
MI	43	0	9,999,999	2, 3, 6, 7, 8, 9, 10, 11, 12
MN	6	10,000	999,999	10, 12
MO	13	0	99,999,999	2, 3, 6, 7, 10, 11, 12
MS	6	1,000	99,999	7, 10, 11, 12
NC	4	1,000	99,999	1, 5, 7, 12
NE	4	1,000	99,999	7, 8, 9
NJ	9	1,000	999,999	7, 9, 11, 12
NM	1	1,000	9,999	12
NV	1	10,000	99,999	2, 3, 12
NY	8	0	9,999,999	1, 4, 5, 7, 10, 11, 12
OH	35	100	999,999	1, 2, 3, 5, 6, 7, 10, 11, 12
OK	3	100	999,999	1, 5, 7, 11
OR	2	10,000	99,999	11
PA	15	0	9,999,999	1, 5, 6, 7, 10, 11, 12
RI	1	100	999	1, 5, 12
SC	19	100	9,999,999	1, 2, 3, 5, 6, 7, 8, 10, 11, 12
SD	3	1,000	99,999	1, 5, 7
TN	5	1,000	999,999	2, 3, 4, 7, 8, 9, 10, 11, 12
TX	38	0	9,999,999	1, 5, 6, 7, 8, 9, 10, 11, 12, 13
UT	1	0	0	0
VA	4	1,000	999,999	7, 8, 11, 12
WA	1	0	0	0

Table 5-2. Facilities that Produce, Process, or Use Sodium Nitrite

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
WI	13	100	999,999	7, 9, 11, 12
WV	4	1,000	9,999,999	1, 5, 7, 11, 13

[a]Post office state abbreviations used.
[b]Amounts on site reported by facilities in each state.
[c]Activities/Uses:

1. Produce
2. Import
3. Onsite use/processing
4. Sale/Distribution
5. Byproduct
6. Reactant
7. Formulation Component
8. Article Component
9. Repackaging
10. Chemical Processing Aid
11. Manufacturing Aid
12. Ancillary/Other Uses
13. Manufacturing Impurity
14. Process Impurity

Source: TRI13 2014 (Data are from 2013)

Table 5-3. Facilities that Produce, Process, or Use Ammonia

State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
AK	6	0	999,999	1, 2, 3, 5, 11, 12
AL	70	0	49,999,999	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14
AR	49	0	49,999,999	1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 13
AS	1	1,000	9,999	12
AZ	20	0	49,999,999	1, 5, 6, 7, 9, 10, 11, 12
CA	120	0	99,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
CO	19	0	9,999,999	1, 2, 3, 4, 5, 7, 9, 10, 11, 12, 13, 14
CT	15	0	999,999	1, 2, 3, 5, 6, 7, 8, 10, 11, 12
DC	2	10,000	99,999	12
DE	7	1,000	9,999,999	1, 3, 5, 6, 7, 11, 12
FL	64	0	499,999,999	1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 13
GA	81	0	99,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
HI	9	0	999,999	1, 3, 5, 6, 7, 9, 10, 11, 12, 13, 14
IA	79	100	999,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
ID	19	100	49,999,999	1, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13
IL	112	100	99,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14
IN	65	0	9,999,999	1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 13, 14
KS	37	0	99,999,999	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14
KY	47	0	49,999,999	1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 13, 14
LA	72	0	499,999,999	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14
ME	10	0	999,999	1, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13
MI	70	0	9,999,999	1, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13, 14
MN	61	0	49,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
MO	46	0	9,999,999	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13
MS	34	0	99,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
MT	10	0	9,999,999	1, 2, 3, 5, 6, 9, 10, 12, 13
NC	86	0	49,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
ND	13	0	99,999,999	1, 3, 4, 5, 6, 9, 10, 11, 12
NE	45	100	499,999,999	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14
NH	9	0	9,999,999	1, 3, 5, 6, 10, 11, 12
NJ	43	0	999,999	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13
NM	6	0	99,999	1, 3, 5, 6, 11, 12, 13, 14
NV	12	0	9,999,999	1, 2, 3, 5, 6, 7, 9, 12, 13, 14
NY	50	0	999,999	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 14
OH	115	0	10,000,000,000	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
OK	24	0	99,999,999	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14
OR	31	0	9,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
PA	95	0	49,999,999	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14

Table 5-3. Facilities that Produce, Process, or Use Ammonia

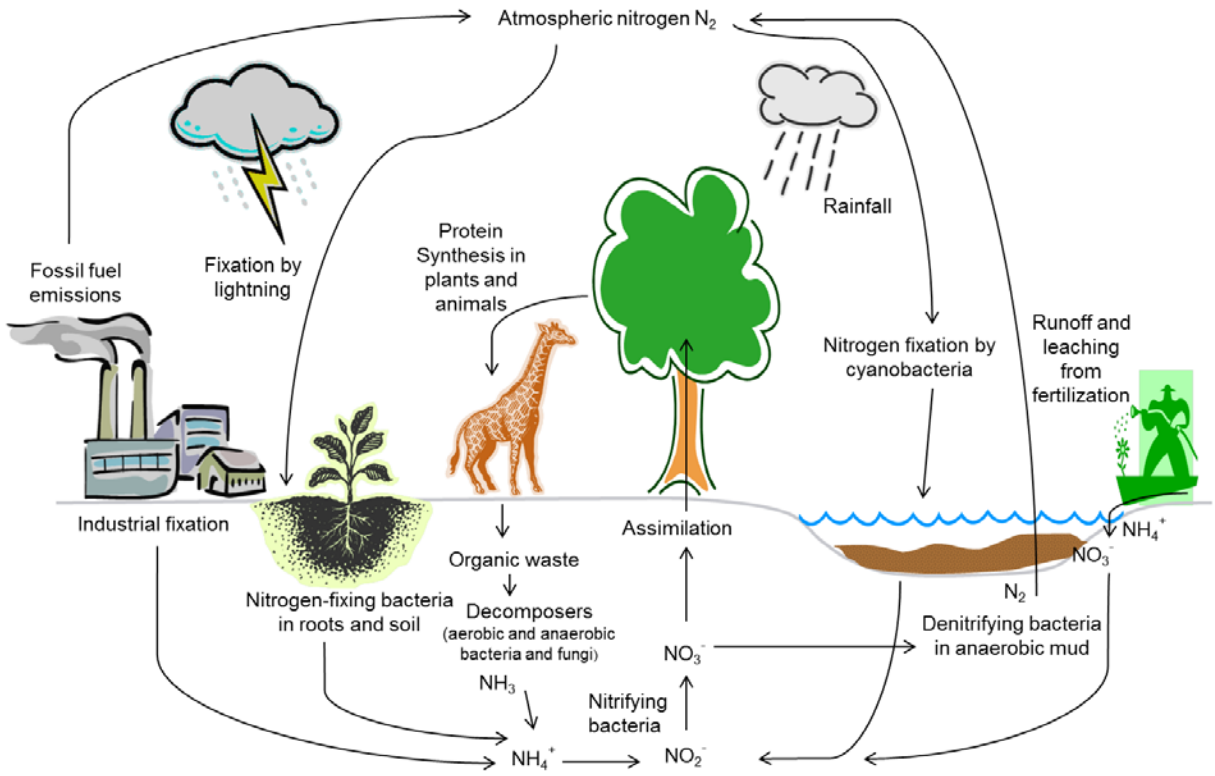
State[a]	Number of facilities	Minimum amount on site in pounds[b]	Maximum amount on site in pounds[b]	Activities and uses[c]
PR	10	0	999,999	1, 2, 3, 4, 5, 6, 7, 10, 12
RI	10	1,000	9,999,999	1, 2, 3, 4, 5, 6, 9, 10, 11
SC	54	0	499,999,999	1, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
SD	10	1,000	999,999	1, 2, 5, 7, 10, 11, 13
TN	70	0	999,999	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13
TX	211	0	99,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
UT	27	0	9,999,999	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12
WA	29	0	9,999,999	1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 13
WI	81	0	49,999,999	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
WV	34	0	49,999,999	1, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13, 14
WY	14	0	99,999,999	1, 2, 3, 4, 5, 6, 7, 10, 12, 13

[a]Post office state abbreviations used.
[b]Amounts on site reported by facilities in each state.
[c]Activities/Uses:

1. Produce
2. Import
3. Onsite use/processing
4. Sale/Distribution
5. Byproduct
6. Reactant
7. Formulation Component
8. Article Component
9. Repackaging
10. Chemical Processing Aid
11. Manufacturing Aid
12. Ancillary/Other Uses
13. Manufacturing Impurity
14. Process Impurity

Source: TRI13 2014 (Data are from 2013)

Figure 5-1. Simplified Schematic of the Nitrogen Cycle



Adapted from EEA 2010; EPA 2012a; Vitousek et al. 1997

This oxidation process is an intermediate step in the nitrogen cycle, followed by further oxidation of nitrite to nitrate ion via nitrite-oxidizing bacteria. These two reactions are mediated by aerobic chemolithotrophs, *Nitrosomonas* and *Nitrobactor*, respectively (WHO 1978). Microbial conversion of nitrate to nitrite (reduction) may also occur, especially after prolonged storage of vegetables that make the environment anaerobic.

In nature, nitrate can also be found in igneous and volcanic rocks; however, the high solubility of nitrogen salts makes minerals containing nitrate rare. Major minerals known are saltpeter (KNO_3) found in India, and Chile saltpeter ($NaNO_3$) found in deserts of northern Chile (Environment Canada 2012; Hammerl and Klapotke 2006).

Plants and mammals naturally contain nitrate and nitrite (WHO 2011b). Assimilation of nitrite from soils occurs via reduction of nitrate to nitrite, which is facilitated by various bacteria and catalyzed by nitrate reductase (WHO 1978). Mammals endogenously produce nitrate and excrete it in their waste products (WHO 1978, 2011b).

Various industrial process produce nitrate in their waste streams. Specifically, potassium nitrate, calcium nitrate, silver nitrate, and sodium nitrate used in several industrial applications have waste waters with high-nitrate concentrations (Environment Canada 2012).

A major source of anthropogenic nitrate and nitrite is artificial fertilizers (WHO 1978). The majority of nitrate in the environment derived from fertilizers does not solely originate from nitrate-containing fertilizers; it also comes from ammonium and urea fertilizers. Nitrate from ammonium and urea fertilizers is produced through biological processes involving hydrolysis of urea to ammonium and ammonium nitrification (Kissel et al. 2008). Approximately 11.5 million tons of nitrogen are applied yearly (as of 1994) in the United States as fertilizer in agricultural areas (Nolan et al. 1997). The Association of American Plant Food Control Officials and The Fertilizer Institute reported that the United States used 13.5 thousand tons of nitrogen fertilizer in 2012 (TFI 2014). Ammonium, calcium, potassium, and sodium salts are all used in commercial fertilizers compounds (IARC 2010; WHO 2011b). The most common nitrite salt, sodium nitrite, is produced commercially via the reaction of nitrogen oxides with sodium carbonate or sodium hydroxide solution, typically at a pH higher than 8 (Hammerl and Klapotke 2006). In 2004, global production of sodium nitrate was about 63 kilotons (IARC 2010). Ammonium nitrate is manufactured through the reaction of nitric acid and ammonium (HSDB 2007). Global production of ammonium nitrate in 2002 was reported at 13,608 kilotons (IARC 2010). Between

1998 and 1999, 90 kilotons of Canadian fertilizers were nitrate compounds: 82% as ammonium nitrate and the remaining 18% from calcium nitrate, calcium ammonium nitrate, and potassium nitrate (Environment Canada 2012).

According to the 2011 SRI Directory of Chemical Producers, there are 15 domestic producers of ammonium nitrate in the United States, with an annual capacity of 2,290 metric tons (SRI 2011). There were six producers of sodium nitrate, two producers of sodium nitrite, and one producer of potassium nitrite; however, no production volumes or capacities were reported for any of these substances (SRI 2011). Production of ammonium nitrate in 2004 by the United States chemical industry was reported as 6,558 thousands of metric tons and preliminary production data reported 6,353 thousands of metric tons for the year 2005 (HSDB 2007). Production of ammonium nitrate by the U.S. chemical industry in 1994 through 2003 is listed in Table 5-4. U.S. production of sodium nitrate in 1982 was estimated as $4.75x10^7$ kg and at least $5.0x10^7$ kg in 1977; U.S. production of sodium nitrite in 1977 was reported as at least $5.0x10^6$ kg; U.S. production of potassium nitrate in 1972 and 1975 were reported as $4.23x10^7$ and $9.89x10^7$ kg, respectively (HSDB 2007).

Production of ammonia by the U.S. chemical industry in 1995 through 2002 is listed in Table 5-5. According to 2012 Chemical Data Reporting (CDR) data, the total reported production volumes for ammonia and urea were 1.75 $x10^{10}$ kg/year and 1.17 $x10^{10}$, respectively (EPA 2014g) Consumption patterns indicate that the major use for these chemicals is in the fertilizer industry (HSDB 2003, 2012).

5.2 IMPORT/EXPORT

In 1984, United States imports of ammonium nitrate were $1.14x10^{11}$ g (109,247 metric tons) and exports in 1975 were reported as $3.18x10^{10}$ (31,298 metric tons) (HSDB 2007). In 1986, U.S. imports of potassium nitrate were $3.62x10^6$ g (3.56 metric tons) and exports in 1975 were reported as negligible (HSDB 2007). In 1985, U.S. imports of sodium nitrate were $6.44x10^7$ g (63.4 metric tons) and exports in 1985 were reported as $4.81x10^6$ (4.73 metric tons) (HSDB 2007). In 1984, U.S. imports of sodium nitrite were $8.14x10^9$ g (8,011 metric tons) and exports in 1984 were reported as $4.03x10^{11}$ (396,635 metric tons) (exports related to general sodium compounds) (HSDB 2007).

Table 5-4. Production of Ammonium Nitrate by the U.S. Chemical Industry

Year	Thousands of metric tons
1994	7,771
1995	7,700
1996	7,708
1997	7,804
1998	8,235
1999	6,920
2000	7,237
2001	5,833
2002	6,436
2003	5,733

Source: HSDB 2007

Table 5-5. Production of Ammonia by the U.S. Chemical Industry

Year	Millions of metric tons
1994	64,510
1995	35,600
1999	16.6
2000	15.7
2001	9.5
2002	10.8

Source: HSDB 2012

The U.S. Department of Agriculture (USDA 2013) has compiled annual import/export data on nitrate fertilizers (ammonium nitrate, potassium nitrate, and sodium nitrate) for years 2000–2012. The volumes for ammonium nitrate are provided in Table 5-6, followed by a 2012 comparison for all three fertilizers (Table 5-7).

5.3 USE

The majority of nitrate in commerce is used in common inorganic fertilizers. Ammonia, urea, ammonium nitrate, sodium nitrate, potassium nitrate, and calcium nitrate are used as commercial fertilizers; ammonium nitrate and sodium nitrate are also used in munitions and explosives. These chemicals have uses defined in several other industrial and consumer categories. Nitrate and nitrite salts are used as preservatives in beverages. Additional uses include oxidizing agents, in instant cold packs and for the production of nitrous oxide (ammonium nitrate), and for glass making (potassium nitrate) (EPA 2009a; IARC 2010; Taylor 2004; WHO 2011b). Potassium and ammonium nitrate may also be used in pyrotechnics, herbicides, and insecticides (HSDB 2007). Sodium nitrite is mainly used in the food industry as a preservative, in cured meats for preventing botulism (e.g., it inhibits microbial activity of certain *Clostridium* species in cheeses), and in the chemical, pharmaceutical, and agricultural industries (Hammerl and Klapotke 2006; HSDB 2007; WHO 2011b). Sodium nitrite also has therapeutic uses such as an antidote for cyanide poisoning and as an antifungal topical agent, for example against MRSA strains (HSDB 2007; Ormerod et al. 2011; Pokorny and Maturana 2006). Due to the bioactivity of NO, an endogenous metabolite of nitrite produced under hypoxic conditions, sodium nitrite is being used in medicinal applications, such as for the treatment of pulmonary arterial hypertension (Blood and Power 2015; Lundberg et al. 2008; Rix et al. 2015). Potassium nitrate has been added to some toothpastes for cavity prevention and to reduce sensitivity, as well as being used as a curing agent and color fixative in meats (HSDB 2007). In nature, plants utilize nitrate as an essential nutrient (WHO 2011b).

5.4 DISPOSAL

Disposal methods for anthropogenic sources of nitrate and nitrite are general; unused portions of the material should be recycled for the approved use or returned to the manufacturer or supplier, while leaks or spills should be resolved wearing appropriate protective equipment and taking care not to create a flammable or explosive environment. Response to a small liquid spill involves stopping the leak, soaking up the liquid with vermiculite or sand, and placing it in a non-combustible container. Response to a large liquid spill on land involves diking, product recovery, treating residue with soda ash and neutralizing it with HCl, and flushing residue from the area with water. Response to a solid spill involves picking up the

Table 5-6. U.S. Imports and Exports (Metric Tons) of Selected Fertilizers 2000–2012

Year	Ammonium nitrate exports	Ammonium nitrate imports	Calcium nitrate exports	Calcium nitrate imports	Potassium nitrate exports	Potassium nitrate imports	Sodium nitrate exports	Sodium nitrate imports
2012	335,080	851,196	Not reported	38,550	15,746	159,135	3,348	148,898
2011	314,764	633,974	Not reported	33,998	16,449	114,861	3,286	90,470
2010	317,737	548,976	Not reported	34,490	9,991	76,849	2,429	70,156
2009	195,455	450,664	Not reported	123,168	8,449	73,871	2,536	79,741
2008	188,818	706,955	Not reported	204,552	4,322	132,571	5,783	149,467
2007	194,038	1,107,220	Not reported	187,640	Not reported	135,912	3,139	72,892
2006	127,244	1,150,523	Not reported	156,997	Not reported	149,633	2,827	68,416
2005	82,237	907,618	Not reported	119,448	Not reported	86,961	2,289	66,655
2004	109,972	1,055,949	Not reported	126,498	Not reported	66,381	2,838	62,812
2003	51,856	1,203,985	Not reported	90,989	Not reported	78,754	2,465	85,565
2002	98,218	989,507	Not reported	99,200	Not reported	100,712	2,810	72,568
2001	19,277	925,534	Not reported	127,586	Not reported	50,791	2,199	89,422
2000	21,611	838,035	Not reported	108,269	Not reported	40,941	2,264	96,067

Source: USDA 2013

Table 5-7. U.S. Exports and Imports for Nitrate Fertilizers in 2012 (Short Tons)

Fertilizer	Exports	Imports
Ammonium nitrate	369,362	938,283
Potassium nitrate	17,357	175,416
Sodium nitrate	3,691	164,132
Urea	370,694	7,654,464
Anhydrous ammonia	41,504	6,938,744
Aqua ammonia	6,549	96,517
All fertilizers[a]	10,783,383	35,552,395

[a]Includes nitrogen, potassium and phosphate fertilizers

Source: USDA 2013

material with implements (e.g., shovels, broom, and pan), placing in a non-combustible container, and loosely capping the container. Spills to water can be treated with activated charcoal. Ultimate disposal of the chemicals should take into account several factors (the material's impact on air quality; migration characteristics; effects on animal, aquatic, and plant life) and must take into account compliance with environmental and public health regulations. Generally, this involves treatment with sodium carbonate, neutralization with HCl, and disposal of the resulting sludge in a secure landfill. If incineration is used, processes to remove nitrogen dioxide and nitrogen oxide should be included (HSDB 2007).