EPA United States Environmental Protection Agency

Guide to Calculating Environmental Benefits of Enforcement Cases:

FY2005 CCDS Update

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1.0 INTRODUCTION

1.1 Background

EPA implemented the Case Conclusion Data Sheet (CCDS) in FY 1996 to capture relevant information on results and environmental benefits of concluded enforcement cases including pollutant reduction benefits. CCDS information must be provided whenever any formal enforcement case is "concluded." For civil judicial cases, the information is reported when a consent decree, court order, or judgment is entered (not lodged). For administrative cases, information is reported when an administrative order or final agreement is signed (usually by the Regional Administrator) and issued. To ensure good data quality, several regions will not sign off on an administrative order unless the CCDS is attached and has been reviewed.

During 1999-2000, EPA assessed the quality and completeness of the data being provided by the CCDS form and identified areas for improvement. As part of this effort, OECA developed a training booklet and course to help explain the underlying value of the data provided by the CCDS and to provide methodologies for regional staff to use in developing pollutant reductions for various types of cases. In November 2000, OECA published the *Case Conclusion Data Sheet Training Booklet* and *Quick Guide for Case Conclusion Data Sheet* and then conducted CCDS training the following year at each of EPA's regional offices.

This booklet is an update to the November 2000 training booklet. This booklet has been revised to address suggestions and input collected from the regional training courses conducted in 2001 and to incorporate additional pollutant reduction calculation methodologies and policies that have been developed since that time.

1.2 How CCDS Data are Used by EPA/OECA

The data from completed CCDS forms are entered by each of the EPA's regional offices into OECA's enforcement and compliance data system - ICIS (Integrated Compliance Information System). The data are used:

- To report OECA's accomplishments under the Government Planning and Results Act (GPRA) on an annual basis;
- As a management tool to assess regional case performance;
- To describe the results of our enforcement program to the public, Congress, and others.

OECA's emphasis on the environmental benefits of its compliance and enforcement activities is growing, and OECA needs to be able to assess the impact and benefit to the environment from these actions. The data collected on the CCDS is key to achieving this goal and therefore improving the quality of the CCDS data, which has been an imperative of the Agency. Most recently, the importance of this data has been made clear by the fact that regions are now asked to certify that the estimates of environmental benefits were calculated using current guidance and methodologies, and are complete and entered into ICIS.

1.3 How This Document Is Organized

This training booklet is organized to present the overall CCDS process, including:

- Quality Assurance/Quality Control (QA/QC; Section 2.0);
- Guidance on completing the form (Section 3.0);
- General guidance on estimating pollutant reductions resulting from enforcement actions (Section 4.0);
- Regulatory Act-specific guidance and examples for estimating pollutant reductions (Sections 5.0 - 9.0);
- A summary of pollutant densities and unit conversions for use in estimating pollutant reductions (Section 10.0);
- Look up tables for use in some of the water and air examples (Section 11.0); and
- Explanation of new "filtering" compliance actions by statute in ICIS (Section 12.0).

2.0 QUALITY ASSURANCE/QUALITY CONTROL FOR THE CCDS PROCESS

This section provides a process for assessing the quality of estimated pollutant reductions, reconciling inaccurate, incomplete, and inconsistent data entries, and facilitating regional review of completed CCDS forms. The CCDS review methodology includes an independent review of the CCDS form and the use of two checklists to provide a consistent and documentable QA/QC program. Regions need to ensure that a data quality review process is implemented; while it may differ in specific detail, it needs to address similar principles of data review and correction. In addition, calculation sheets used for determining pollutant reduction amounts need to be included with the review package and retained in the case file for auditing purposes.

The CCDS completion process involves the attorney and/or program staff who provide the case information, the reviewers of the form, and the ICIS data entry staff. Once a case file is received, the CCDS must be completed and input into ICIS in a timely manner. The basic steps in the CCDS QA/QC process are:

1. Complete the CCDS form;
2. Review key data on the form;
3. Reconcile inconsistencies and incomplete entries as needed; and
4. Enter CCDS data into ICIS.
5. Certify that the data is complete and accurate at mid-year and end-of-year.

2.1 Completing the Form

The CCDS contains information about the case including facility information, reasons for the enforcement action/order, costs/penalties associated with the action/order, and the resulting environmental benefits. Sections 3.0 through 12.0 of this training booklet provide guidance for use in completing this form.

2.2 Review of the CCDS Form

It is important that the completed CCDS be reviewed by another program staff member; otherwise, key information may be mis-reported, or not reported at all. An independent reviewer can often spot problems or omissions by reviewing the form. EPA has prepared two checklists to facilitate this review. One is for a completeness check and the second is for a check on pollutant reduction calculations. These checklists are discussed below.

Figure 2-1 presents a checklist to use for a completeness review. The reviewer indicates that the proper information has been provided on the CCDS by completing the last column in Figure 2-1. This checklist also has a sign-off table at the top for tracking the status of the CCDS form and its review. Each person signs and dates this box when they have completed their tasks or when the form is transferred to the next person. A reviewer should not sign off on the form until all issues have been resolved to his/her satisfaction. The end of the checklist includes a yes/no question to identify if the CCDS needs to be returned to the person who completed it because fields are blank, with no explanation as to why.

Figure 2-1. CCDS Completion Checklist

ICIS Case Number ___________

CCDS Sign Off	Name of Person	Date
CCDS Completed By		
CCDS Review Completed By		
CCDS Returned for Problem Resolution To Yes___ N/A___		
CCDS ICIS Entry Completed By		

CCDS Field	Completed (Y, N)
Are all questions required for ICIS entry complete? Includes questions in Sections A, B, C, and E (Section D questions will apply if a SEP is included with the enforcement action)	
If not, which questions are not complete?	

☐ Form Complete ____/____/____

☐ Revision(s) Required ____/____/____

Indicate Problem (s) / missing item(s):

Figure 2-2. CCDS Calculation Checklist

ICIS Case Number__________

CCDS Question #/Description	Completed (Y, N, N/A)*	Reviewer Comments
General		
Do laws violated (Q. 8) correspond with the multi-media check (Q. 11)?		
Q. 17 Supplemental Environmental Projects (SEPs)		
Are any of the following categories checked? - Pollution prevention - Pollution reduction		
If yes, is corresponding information presented in Question 19?		
Are valid pollutant names provided?		
Are reduction/elimination amounts provided in acceptable units for the media affected?		
Is the affected media indicated?		
Does the affected media correspond to the statutes violated and the actions checked?		
Are calculation sheets included in the review package?		
Were the approved methodologies in the CCDS guide used in developing the calculations? If not, why not and what alternative calculation was used?		
Can you verify that the estimation methods are valid?		
Can you replicate the calculations?		
Q. 20 Violator Actions (Non-SEP Related)		
Are any Q. 20, Column 1 actions (Direct Actions, Preventative Actions) checked?		
If yes, is corresponding information presented in Question 22?		
Are valid pollutant names provided?		
Are reduction/elimination/treatment/managed/prevention amounts provided in acceptable units for the media affected?		
Is the affected media indicated?		
Does the affected media correspond to the statutes violated and the actions checked?		
Are calculation sheets included in the review package?		
Were the approved methodologies in the CCDS guide used in developing the calculations? If not, why not and what alternative calculation was used?		
Can you verify that the estimation methods are valid?		
Can you replicate the calculations?		

* N/A = Not Applicable

Generally, reporting errors and/or inconsistencies are most common when pollutant reductions are being reported. If pollutant reductions/eliminations are reported in CCDS Question 19 and/or 22 (see page 3-3, 3-4), the reviewer should use Figure 2-2 to verify that these are correctly reported. The reviewer should evaluate the case file, case summary, or referral transmission memo that should accompany the CCDS, including the calculation sheets used to quantify environmental benefits. If sufficient information is not provided, the reviewer should return the CCDS to the person who completed it and not submit it for entry into ICIS until it is fully complete.

EPA recommends that all case conclusion data sheets be reviewed for completeness using the Figure 2-1 checklist, or an equivalent written process, and that all forms that require a pollutant reduction calculation be reviewed using the Figure 2-2 checklist. We also recommend that copies of pollutant-reduction calculations, including densities used for converting to pounds, be kept in case files.

2.3 Reconciliation of Inconsistent and Incomplete Forms

As noted above, the reviewer is responsible for verifying that the CCDS is complete and contains accurate pollutant reduction data. If fields are left blank, calculations are in error, or calculations cannot be verified, then the form should be returned to the originator for corrections.

2.4 CCDS Data Entry into ICIS

Entry of the CCDS data into ICIS should occur within 2 weeks of a judicial case being entered or an administrative actions becoming final. Data may be entered by program personnel directly or a Region may have a specified data entry person. *(Currently the process for entry of ICIS data varies by EPA region)*

Questions related to CCDS data entry into ICIS should be brought to the Regional System Administrator. Questions may also be directed to EPA's Federal ICIS Administrator, Mr. Michael Mundell at mundell.michael@epa.gov and (202) 564-7069.

3.0 CCDS FORM AND INSTRUCTIONS

This section provides a general discussion of the CCDS form (Section 3.1) and question-specific instructions (Section 3.2).

3.1 The Revised CCDS Form

This section presents the revised CCDS form for illustrative purposes. Note that various regions may have their own versions of this form. The CCDS form asks for case information as follows:

- Case and Facility Background (Questions 1-10);
- Penalty Information (Questions 11-13);
- Cost Recovery (Question 14);
- Supplemental Environmental Project (SEP) Information (Questions 15-19); and
- Injunctive Relief/Compliance Actions Information (Questions 20-22).

One important aspect of the CCDS is the quantification of pollutant reductions and/or environmental benefits that occur as a result of enforcement activities. These reductions and/or benefits are quantified using the following questions on the form:

- Categories of supplemental environmental projects (SEP(s)) (Q. 17);
- Quantitative environmental impacts of these SEP activities (Q. 19);
- Injunctive relief/Compliance actions (non- SEP) (Q. 20); and
- Quantitative environmental impacts of these activities (Q. 22).

EPA has categorized complying action types into the following groups:

Actions with <u>Direct</u> Environmental Benefits/Response/Corrective Action: those actions that treat, reduce, or eliminate a pollutant or emission/discharge stream to reduce/eliminate human health exposure or environmental impact (e.g., source reduction, emissions/discharge change, implementing best management practices, removal). .OC measures the direct environmental benefits in terms of quantity, volume, area, and people protected.

Preventative Actions to Reduce the Likelihood of Future Releases: those actions that properly manage a waste stream or prevent a release or exposure. Preventative actions may reduce the likelihood of future human health risk or environmental impact by maintenance of proper controls prior to a release or waste stream being generated (e.g., plug and abandon wells, develop spill prevention plan, secondary containment, asbestos removal training) or after it has been generated as a waste (e.g., RCRA labeling, storage change, disposal change). OC measures the environmental benefits of these actions in terms of quantity, volume, area, schools/housing/building units, wells, and people protected.

Facility/Site Management and Information Practices (FMIP): those actions that a facility conducts to better manage their environmental program and to inform the public/permitting authority of the toxicity, quantity, and location of their chemicals, waste streams, and emissions (e.g., auditing, environmental management review, site assessment, testing, recordkeeping, reporting). OC does not try to quantify the environmental benefits of Facility/Site Management and Information Practices.

Beginning in FY 2005, when entering environmental benefit data into ICIS, the system will automatically filter the possible selections for complying action types, units, and potentially impacted media.

Case Conclusion Data Sheet

A. Case and Facility Background

1 Enforcement Action ID __-____-____

2 Enforcement Action Name ________________

3 Settlement Action Type

____(a) Consent decree or court order resolving a judicial action
____(b) Admin Compliance Order (with/without injunctive relief)
____©) Admin Penalty Order (with/without injunctive relief)
____(d) Notice of Determination
____(e) Federal Facility Compliance Agreement (not incl RCRA matters)
____(f) Superfund Administrative Order for Cost Recovery

4 Was Alternative Dispute Resolution used in this action (Y/N) _______

5 Was an Environmental Management System requested (Y/N) _______

6 Administrative Action Date Final Order Issued ___________
or
Civil Action Date CD Lodged_________ CD Entered__________

7 Respondent(s) ____________________

8 Federal Statute(s) violated (e g, CAA, EPCRA, etc) (Not U S C or CFR) __________, __________, __________, __________

9 Facility Name(s) ____________________

10 Facility Address(s) Street ______________City ______________County ___________ St ______ Zip ________

B. Penalty (if there is no penalty, enter 0 and proceed to #15)

11 For multimedia actions, Cash Civil Penalty Amount Required by statute

Statute	Amount
______________	$____________
______________	$____________

12 Federal Penalty Required $___________

13 (if shared) State/Local Penalty Amount $____________

C. Cost Recovery

14 Amount cost recovery Required $_________ EPA $_________ State and/or Local Government $_________ Other

D. Supplemental Environmental Project (SEP) Information (Y/N) If Yes, for each SEP provide the following

15 Is Environmental Justice addressed by impact of SEP? (Y/N)

16 SEP description ____________________

17 Category of SEP(s)

- __(a) Public Health
- __(b) Pollution Prevention (Complete Q 19)
  - __(1) equipment/technology modifications
  - __(2) process/procedure modification
  - __(3) product reformulation/redesign
  - __(4) raw materials substitution
  - __(5) improved housekeeping/O&M/training/inventory-control
  - __(6) in-process recycling
  - __(7) energy efficiency/conservation
- __©) Pollution Reduction (Complete Q 19)
- __(d) Environmental Restoration and Protection
- __(e) Assessments and Audits
- __(f) Environmental Compliance Promotion
- __(g) Emergency Planning and Preparedness
- __(h) Other Program Specific SEP

18 Cost of SEP Cost calculated by the Project Model is required $ __________________

19 Quantitative environmental pollutants and/or chemicals and/or waste-streams, amount of reductions/eliminations (e g ,emissions/discharges)

ENVIRONMENTAL BENEFIT OF SEP

Pollutant/Chemical/Waste Stream	Amount	Units (circle one)	Potentially Impacted Media
______________	________	Pounds/yr	Air
		People	Land
		Acres	Water (navigable/surface)
		Linear Feet ss	Water (wetlands)
		Linear Feet ms	Water (wastewater to a POTW)
		Linear Feet ls	Water (underground source of drinking water)
		Gallons/yr	Water (ground)
		Pounds	Animals/Plants/Humans
			Buildings/Houses/Schools

E. Injunctive Relief/Compliance Actions (Non-SEP)(APO's w/o inj relief [4©) above], Superfund Admin Cost Recovery Agreements[4(f) above] SKIP THIS SECTION)

20 What action did violator accomplish prior to receipt of settlement/order or will take to return to compliance or meet addl requirements (other than what has already been reported on the Inspection Conclusion Data Sheet (ICDS)) This may be due to settlement/order requirements or otherwise required by statute or regulation (e g actions related to an APO which did not specify compliance requirements) Where separate penalty and/or compliance orders are issued in connection w/same violation(s), report the following information for only one Select response(s) from the following

Actions with Direct Environmental Benefits and/or Direct Response/Corrective Action

___ Source Reduction/Waste Minimization (RCRA)
___ Industrial/Municipal Process Change (includes flow reduction)
___ Emissions/Discharge Change (e g end-of-pipe treatment)
___ Implement Best Management Practices (BMPs)
___ Wetlands Mitigation
___ In-situ and Ex-situ Treatment (CERCLA/RCRA Corrective Action)
___ Waste Treatment (RCRA/TSCA)
___ Removal of Spill
___ Removal of Contaminated Medium (soil, drums etc)
___ Containment (CERCLA)
___ Leak Repair (CAA)
___ Import Denied (FIFRA)

Preventative Actions to Reduce Likelihood of Future Releases

___ Disposal Change
___ Storage Change
___ Develop/Implement Asbestos Management Plan
___ Develop/Implement Spill Prevention and Countermeasures Control (SPCC) Plan
___ Obtain Permit for Underground Injection (UIC)
___ UIC Plug and Abandon
___ UIC Demonstrate Mechanical Integrity
___ UST Tank Closure
___ UST Secondary Containment
___ UST Corrosion or Overfill Protection
___ RCRA Labeling/Manifesting
___ RCRA Waste Identification
___ RCRA Secondary Containment
___ Lead-Based Paint Disclosure
___ Lead-Based Paint Removal Training/Certification (TSCA 402, 1018, 206)
___ Asbestos Training/Certification/Accreditation
___ Asbestos Abatement
___ Notification (SDWA, FIFRA)
___ Worker Protection (FIFRA)
___ Pesticide Registered (FIFRA)
___ Pesticide Certified (FIFRA)
___ Pesticide Claim Removed (FIFRA)
___ Pesticide Label Revision (FIFRA)

Facility/Site Management and Info. Practices

___ Testing/Sampling
___ Auditing
___ Labeling/Manifesting
___ Record keeping
___ Reporting
___ Information Letter Response
___ Financial Responsibility Requirements
___ Environmental Management Review
___ RI/FS or RD (CERCLA)
___ Site Assessment/Characterization (CERCLA)
___ Provide Site Access (CERCLA)
___ Monitoring
___ UST Release Detection
___ Storm water Site Inspections
___ Asbestos Inspections
___ Training
___ Planning
___ Permit Application
___ Work Practices
___ Notification (TSCA Section 6)
___ Leak Detection (CAA)
___ Spill Notification

21 Cost of actions described in item #21 (Actual cost data supplied by violator is preferred figure)
Physical actions $______________________ Non-Physical actions $___________________

22 Quantitative environmental impact of actions described in item #21 (Add additional pollutants on blank sheet)

REDUCTIONS/ELIMINATIONS/TREATMENT

Pollutant/Chemical/Waste Stream	Annual Amount	Units	Potentially Impacted Media
______________________	__________	Pounds/yr	Air
		People	Land
		Cubic Yards	Soil
		Acres	Water (navigable/surface)
		Linear Feet (ss/ms/ls)	Water (wetlands)
		Gallons/yr	Water (underground source of drinking water)
		Pounds	Water (ground)
		Miles of Stream Impacted	Animals/Plants/Humans

PREVENTION

Pollutant/Chemical/Waste Stream	Amount	Units	Potentially Impacted Media
______________________	__________	Wells	Water (underground source of drinking water)
		Gallons	Water (navigable/surface)
		SF/MF/Housing units	Schools/Housing/Buildings
		Building Units	Animals/Plants/Humans
		Schools	
		People	
		Pounds	

This form is for illustrative purposes - When entering quantitative data into ICIS, the system will automatically filter the possible selections for complying action types, units, and potentially impacted media.

Not all improvement actions have quantifiable benefits. The actions listed on Question 20 are divided into two groups as shown in Table 3-1 below. Actions checked in the first column should have pollutant reductions or environmental benefits quantified in Question 22. Actions checked in the second column may have identification of a pollutant(s) at the facility as part of the action or order but will not result in quantifiable pollutant reduction. For these activities no pollutant reductions should be identified in Question 22.

Table 3-1. Question 20 Actions

Actions with Direct Environmental Benefits and/or Direct Response/Corrective Action; Preventative Actions to Reduce Likelihood of Future Releases	Facility/Site Management and Information Practices
Source Reduction/Waste Minimization	Testing/Sampling
Industrial/Municipal Process Change	Auditing
Emissions/Discharge Change	Labeling/Manifesting
Implement Best Management Practices (BMPs)	Record keeping
Wetlands Mitigation	Reporting
In-situ and ex-situ Treatment (CERCLA and RCRA Corrective Action)	Information Letter Response
Waste Treatment (RCRA and TSCA)	Financial Responsibility Requirements
Removal of Spill	Environmental Management Review
Removal of Contaminated Medium	RI/FS or RD (CERCLA)
Containment	Site Assessment/Characterization (CERCLA)
Leak Repair (CAA)	Provide Site Access (CERCLA)
Import Denied (FIFRA)	Monitoring
Disposal Change	UST Release Detection
Storage Change	Storm water Site Inspections
Develop/Implement Asbestos Management Plan	Asbestos Inspections
Develop/Implement Spill Prevention and Countermeasures Control Plan (SPCC)	Training
Obtain Permit for Underground Injection (UIC)	Planning
UIC Plug and Abandon	Permit Application
UIC Demonstrate Mechanical Integrity	Work Practices
UST Tank Closure	Notification (TSCA Section 6)
UST Secondary Containment	Leak Detection (CAA)
UST Corrosion or Overfill Protection	Spill Notification
RCRA Labeling/Manifesting	
RCRA Waste Identification	
RCRA Secondary Containment	

Table 3-1. Question 20 Actions (Continued)

Actions with <u>Direct</u> Environmental Benefits and/or Direct Response/Corrective Action; <u>Preventative</u> Actions to Reduce Likelihood of Future Releases	**Facility/Site Management and Information Practices**
Lead-Based Paint Disclosure	
Lead-Based Paint Removal Training/Certification	
Asbestos Training/Certification/Accreditation	
Asbestos Abatement	
Notification (SDWA/FIFRA)	
Worker Protection (FIFRA)	
Pesticide Registered (FIFRA)	
Pesticide Certified (FIFRA)	
Pesticide Claim Removed (FIFRA)	
Pesticide Label Revision (FIFRA)	

Actions where quantitative benefits ***can*** be tracked are those that treat, reduce, or eliminate a pollutant or emission/discharge stream to reduce or eliminate human health exposure or environmental impact. Also included are those actions that reduce the likelihood of future human health risk or environmental impact by proper management or through ensuring proper operation of existing controls.

OECA also tracks the environmental benefits that result from SEPs. Table 3-2 lists the key SEP actions (from CCDS Question 17) and identifies those actions that result in quantifiable environmental benefits.

Table 3-2. Key SEP Actions to Track

Public Health
Pollution Prevention*
Pollution Reduction*
Environmental Restoration and Protection*
Assessments and Audits
Environmental Compliance Promotion
Emergency Planning and Preparedness

*** Items where benefits can (and should) be quantified.**

Once you have determined that an enforcement action has resulted in a quantifiable pollutant reduction, you need to complete Question 19 and/or Question 22 of the CCDS. You must correctly identify the pollutant(s) affected, quantify the amount of contamination that has been reduced, eliminated, treated, properly managed, or prevented, and identify the affected media.

3.2 Form Instructions

Table 3-3 provides instructions for completing the CCDS form. This table is followed by Tables 3-4 through 3-9 which provide information on specific valid inputs for the form.

Table 3-3. CCDS Form Instructions

Question #	Instructions
1	This is the unique alphanumeric identifier used to identify a specific Enforcement Action pertaining to a regulated entity or facility
2	Enter the enforcement action name exactly as it appears in the caption of the enforcement instrument.
3	Indicate the type of action (consent decree, APO, etc.) from the list provided.
4	This question asks whether an alternative dispute resolution process was used in the development of the requirements of the action Alternative Dispute Resolution (ADR) is a procedure, such as mediation or arbitration, used by EPA in resolving differences with companies, groups, and/or individuals over enforcement-related issues
5	This is the flag to indicate whether Environmental Management System (EMS) input was requested for this settlement
6	For Administrative actions, the **Final Order** date is the date the Complaint or Administrative Order was signed by the appropriate EPA official and issued to the respondent. The **Final Order** date is the date the compliance order becomes effective without further administrative appeal For unappealed or unilateral administrative compliance orders, the final date is the signature date of the EPA issuing official For two-step orders, both issue date and final date should be provided on the form, even if the issue and final date are the same. For Civil actions, the **CD lodged and entered** date is the date the complaint was signed by the appropriate EPA official and issued to the respondent. The **CD lodged and entered** dates apply to the consent decree resulting from the civil action Enter as mm/dd/yy.
7	This is the Respondent's name
8	Enter the acronym for the law violated (CWA, CAA, RCRA).
9	Name of facility against which the enforcement action is lodged.
10	The street address of the facility against which the enforcement action is lodged (where the violation(s) occurred) **Do Not** use Post Office Box number for this address.
11-13	These questions report in dollars the Penalty associated with the case.
14	This question reports the amount in dollars of cost recovery associated with the case.
15	This question asks whether Environmental Justice (EJ) is addressed by the SEP.
16	Provide a brief description of the SEP Indicate what activities are included as part of the SEP and the purpose of those activities (what environmental benefit is intended by the SEP).
17	Check **only** the actions that apply to the SEP Table 3-8 provides definitions for the different SEP actions. If 17(b) or 17(c) is checked, Question 19 should be completed including pollutants, amount, units, and media. If only actions that do not result in a pollutant reduction/elimination are checked, then SKIP Question 19.
18	This question reports the cost in dollars of the SEP.

Table 3-3. CCDS Form Instructions (Continued)

Question #	Instructions
19	Complete this question if you have checked 17(b) or 17(c). See instructions under Question 22.
20	Check the appropriate action type from the list on the CCDS form. Check **only** the actions that apply to the settlement or order. Table 3-5 below provides definitions for the different violator actions. If an action is checked from the first column then Question 22 should be completed including pollutants, amount, units, and media If only actions from the second column are checked, then pollutant reductions/eliminations do not apply and you can SKIP Question 22.
21	Identify the cost of implementation of the actions identified in Question 20. Actual cost data supplied by the violator are preferred. For Superfund actions, this should be the estimated value of Responsible Party work to be performed as included in the ROD or other documents
22	Complete this question if you have checked any actions from the first column of Question 20. If you checked items from the first column calculate pollutant reduction/elimination or environmental benefit as appropriate (See Section 4.0). The impacted media is the media where the pollutant(s) or waste were emitted/discharged Table 3-6 lists the valid entries possible for this column Do include units with any pollutant amount provided ICIS preferred units are "pounds". Table 3-7 lists the valid entries possible for this column

Table 3-4. Reference Law Sections, Question 8

Law	Law Section Code	Law Section Description	Law	Law Section Code	Law Section Description
CAA	110	State Implementation Plan Standards	CAA	173	New Source Review Permit Requirements
CAA	111	New Source Performance Standards (NSPS)	CAA	183E1A	Federal Ozone Measures
CAA	112	Hazardous Air Pollutants except 112(r)	CAA	183E1B	Federal Ozone Measures
CAA	112(R)(1)	Prevention of Accidental Release/General Duty Clause	CAA	183 F	Federal Ozone Measures
CAA	112(R)(7)	Prevention of Accidental Release/Risk Management Plans (RMPs)	CAA	202	Emission Std. for New Motor Vehicles and Engines
CAA	112B	Asbestos	CAA	203	Prohibited Acts Mobile Sources
CAA	112D	MACT Standards	CAA	208	Record keeping, Insp, Info Request
CAA	112E	MACT Adoption Schedule	CAA	211	Fuel Regulation
CAA	112G	Modification	CAA	213	Non-road Engines & Vehicles
CAA	112H	Work Practices	CAA	219	Urban Bus Standards
CAA	112I	Permits/Compliance Schedule	CAA	303	Imminent/Substantial Endanger.
CAA	112K	Area Source MACT	CAA	412	Acid Rain Requirements
CAA	112R	General Duty/Accidental Release	CAA	502	Operating Permits (Title V)
CAA	113A	Violation of Existing Administrative Order	CAA	608	CFC Recycling/Emission Red.
CAA	114	Recordkeeping, Insp., Info. Request	CAA	609	Motor Vehicle Air Conditioning (CFCs)
CAA	118D	Fed Facility Motor Vehicles	CAA	610	Non-essential CFC Products
CAA	129	Solid Waste Fuel Combustion	CAA	611	CFC Labeling
CAA	165	Prevention of Significant Deterioration (PSD)			
CERCLA	103A	Notification of Hazardous Reportable Quantity Release	CERCLA	107M	Maritime Lien
CERCLA	103D2	Destruction of Records	CERCLA	108	Violation of Financial Resp.
CERCLA	104E2	Information and/or Access	CERCLA	109A5	Violation of 109(a)(5) Subpoena

Table 3-4. Reference Law Sections, Question 8 (Continued)

Law	Law Section Code	Law Section Description	Law	Law Section Code	Law Section Description
CERCLA	104E3	Entry Access	CERCLA	120E	Federal Facility Interagency Agreement
CERCLA	104E4	Inspection and Samples	CERCLA	122A	Agreement to Do 104B RI/FS
CERCLA	104E5	Violation of 104(e) Compliance Order	CERCLA	122D3	Violation of Existing AO or CD
CERCLA	106A	Imminent & Substantial Endangerment Order	CERCLA	122E3B	Violation of 122(e)(3)(B) Subpoena
CERCLA	107A	Cost Recovery	CERCLA	122G	Admin. De Minimis Settlement
CERCLA	107C3	Treble Damages	CERCLA	122H	Admin. Cost Recovery Settlement
CERCLA	107L	Lien			
CWA	301	NPDES Discharge w/o Permit	CWA	309	Violation of Existing AO
CWA	301/307	Toxic and Pretreatment Effluent Standards	CWA	309G3/ 311B6H	Collection Action
CWA	301/311B	Oil & Hazardous Substances Discharge	CWA	311F	Oil Removal Cost Recovery
CWA	301/311C/ 311E	Emergency Powers Oil Imminent & Substantial Endangerment	CWA	311J	SPCC and/or Federal Response Plan Violations
CWA	301/402	NPDES Wet Weather/Other Permit Violations	CWA	405	Sewage Sludge Disposal
CWA	301/404	Discharge/Dredge and Fill Permit Violations	CWA	504	Emergency Powers
CWA	308	Information Request, Records, Entry			
EPCRA	302	List Presence of Substances/Notify	EPCRA	312	Inventory of Chemicals
EPCRA	303	Emergency Response Plans	EPCRA	313	Toxic Chemical Release Reporting (TRI)
EPCRA	304	Emergency Release Notification	EPCRA	322	Trade Secrets
EPCRA	311	Material Safety Data Sheets	EPCRA	323	Provide Info to Health Professionals
FIFRA	12A1A	Unregistered Pesticide	FIFRA	12A2H	Contrary Use - Experimental Permit
FIFRA	12A1B	Claim Difference	FIFRA	12A2I	Violate SSUR Order

Table 3-4. Reference Law Sections, Question 8 (Continued)

Law	Law Section Code	Law Section Description	Law	Law Section Code	Law Section Description
FIFRA	12A1C	Composition Difference	FIFRA	12A2J	Violate Suspension Order
FIFRA	12A1D	Colored/Discolored	FIFRA	12A2K	Violate Cancellation Order
FIFRA	12A1E	Adulterated/Misbranded	FIFRA	12A2L	Establishment Registration
FIFRA	12A1F	Device Misbranded	FIFRA	12A2M	Falsify Application, Information, etc
FIFRA	12A2A	Label Alter/Detach	FIFRA	12A2N	Failure to File Reports
FIFRA	12A2B	Refuse Records, Repts, Entry	FIFRA	12A2O	Add/Remove Substance
FIFRA	12A2C	False Guaranty	FIFRA	12A2P	Test Pesticide on Humans
FIFRA	12A2D	Confidential Information Revealed	FIFRA	12A2Q	Falsify Testing Information
FIFRA	12A2E	Advertise w/o Classification	FIFRA	12A2R	Falsify Registration Data
FIFRA	12A2F	Restricted Usage	FIFRA	12A2S	Violate Regs Under 3(a) or 19
FIFRA	12A2G	Misuse	FIFRA	13	Stop Sale, Remove, and Seizure
MCRBMA	103A	Rechargeable Batteries, Rechargeable Consumer Products, Easy Removability & Labeling	MCRBMA	205	Button Cell Mercuric Oxide Batteries
MCRBMA	103B	Regulated Batteries & Rechargeable Consumer Products	MCRBMA	206	Non-Button Cell Mercuric Oxide Batteries
MCRBMA	104A	Collection, Storage, and Transportation of Spent Rechargeable Batteries & Rechargeable Consumer Products	MCRBMA	5A	Violation of MCRBMA Section 5(A) AO or Civil Action in District Court
MCRBMA	104B	Enforcement of Handling Requirements under RCRA	MCRBMA	5F	Violation of 5(F) Subpoena
MCRBMA	203	Alkaline-Manganese Batteries	MCRBMA	6	Reports, Records, Access
MCRBMA	204	Zinc-Carbon Batteries			
MPRSA	101A	Mar Prot, Res & Sanc Act	MPRSA	101B	Mar. Prot, Res & Sanc Act
RCRA	3002	Haz Waste Generator Regs	RCRA	3013	Monitoring, Analysis, Testing Order
RCRA	3003	Haz Waste Transporter Regs	RCRA	3014	Recycled Oil

Table 3-4. Reference Law Sections, Question 8 (Continued)

Law	Law Section Code	Law Section Description	Law	Law Section Code	Law Section Description
RCRA	3004	Treatment, Storage, and Disposal (TSD) Standards	RCRA	3017	Export of Haz Waste
RCRA	3004 VU	TSD Corrective Action	RCRA	3018D	Information Gathering & Enforcement Authority - Domestic Sewage
RCRA	3005	TSD Permit Requirements	RCRA	3020	Underground Injection of Hazardous Waste
RCRA	3005D	Revocation of Permit	RCRA	3023	HW Discharge to Fed-Owned Treatment Works
RCRA	3005F	Reclamation Permit	RCRA	4005A	Solid Waste Management - Subtitle D
RCRA	3005G	RD&D Permits	RCRA	7003	Imminent Order: Solid or Hazardous Waste
RCRA	3007	Recordkeeping, Inspection, Information Request	RCRA	9002	UST Notification Requirements
RCRA	3008A	Compliance Order Injunctive & Penalty	RCRA	9003	UST Release Detection, Prevention, Correction
RCRA	3008C	Violation of Compliance Order	RCRA	9003C (3)-(4)	UST Release Detection, Prevention, Correction
RCRA	3008G	Penalty Authority	RCRA	9005	Inspection, Monitoring, Testing, Corrections
RCRA	3008H	Interim Status Corrective Action Order	RCRA	9006A	UST Compliance Order
RCRA	3010	Notification of HW Activity	RCRA	9006D	UST Civil Penalties
SDWA	1412	National Drinking Water Compliance Schedule - Effective Date	SDWA	1422/ 1423	UIC Regulations Classes I-V
SDWA	1412/ 1414	National Drinking Water Regulations	SDWA	1423C	UIC - Violation of 1423(c) AO
SDWA	1414C	PWS - Notice to Persons Served	SDWA	1423C7	UIC Administrative Penalty Case Collection Action
SDWA	1414G	PWS - Viol of 1414(g) AO	SDWA	1431	Emergency Powers
SDWA	1414 G3D	PWS Administrative Penalty Case Collection Action	SDWA	1432	Tampering with a PWS
SDWA	1415	Variances	SDWA	1441	Adequate Supplies of Chems
SDWA	1416	Exemptions	SDWA	1445	Recordkeeping & Access
SDWA	1417	Lead Pipe, Solder & Flux	SDWA	1463	Lead in Water Coolers
SDWA	1421	UIC Regulations			

Table 3-4. Reference Law Sections, Question 8 (Continued)

Law	Law Section Code	Law Section Description	Law	Law Section Code	Law Section Description
TSCA	11	Inspections & Subpoenas	TSCA	406B	Renovation/Lead Haz Pamphlet
TSCA	12	Exports	TSCA	409	Violation of Section 1018
TSCA	13	Imports	TSCA	5A/5B	Failure to Comply w/ Significant New Use Rules and Pre-manufacture Notice
TSCA	15-2	Knowing Commercial Use	TSCA	5E	Failure to Comply with 5E Consent Order
TSCA	16A4	Failure to Pay Civil Penalty	TSCA	5F	Violation of Unreasonable Risk AO
TSCA	203	School Asbestos Regs	TSCA	5H	Failure to Comply w/ New Chemical
TSCA	205	Plan Submission - LEA	TSCA	6	Asbestos Hazard Emergency Response Act (AHERA)
TSCA	206	Asbestos - Contractor/Lab Certification	TSCA	6-PCBS	PCBs
TSCA	207A2	False Information on Asbestos Inspection	TSCA	7	Imminent Hazard
TSCA	207A5	False Asbestos Information under 205(d)	TSCA	8	Reporting & Records Retention
TSCA	208	Asbestos Emergency Auth	TSCA	8A	Failure to Comply w/ Prelim. Assess Inf Repting & Chemical Specific Record-keeping Rules
TSCA	215	Asbestos Worker Protection	TSCA	8B	Failure to Comply w/ Invention Update Rule
TSCA	4	Good Laboratory Practices and Testing Requirements	TSCA	8C	Failure to Comply w/ Allegations of Sig Adverse React. Record & Rpting Rule
TSCA	402	Lead (Pb) Paint Training and/or Certification	TSCA	8D	Failure to Comply w/ Health and Safety
TSCA	406A	HUD 1018 Disclosure Rule	TSCA	8	Failure to Comply w/ Substance Risk

Table 3-5. Definitions for Question 20

Compliance Action	Definition
Actions with Direct Environmental Benefits and/or Direct Response/Corrective Action	
Source Reduction/Waste Minimization (RCRA)	This category covers the reduced use of chemicals or other input materials at the beginning of an industrial process, thereby eliminating the amount of waste/emission/discharge produced by the process.
Industrial/Municipal Process Change (includes flow reduction)	This category includes process-based facility-specific activities relating to changes in industrial processes and procedures other than pollution control equipment. E.g., upgrading of equipment or processes to reduce the emission of a pollutant at the point of its generation
Emissions/Discharge Change	This category primarily impacts CWA and CAA cases where water discharges or air emissions are reduced through end-of-pipe treatment technologies. Examples include bringing wastewater discharges into compliance with NPDES standards or water quality standards, requiring air emission reductions to comply with CAA standards, or eliminating a pollutant discharge to surface water or groundwater.
Implement Best Management Practices (BMPs)	This category covers practices that have been determined to be the most effective and practical means of preventing or reducing pollution These practices are often employed in agriculture, forestry, mining, and construction. EPA has published BMPs for soil erosion, wastewater treatment, fuel storage, pesticide and fertilizer handling and the management of livestock yards This action type is applicable to SPCC, storm water, some NPDES requirements, and CAFO cases
Wetlands Mitigation	This category involves returning a developed or degraded location to its previous undeveloped state or to that which mimics natural characteristics. This category includes wetlands restoration, creation, and preservation of wetlands.
In-situ and Ex-situ Treatment	This category covers CWA/OPA, CERCLA and RCRA corrective action clean-up activities in which a contaminated medium is treated (either in-situ or ex-situ), stabilized or otherwise addressed E.g., CERCLA clean-up activities involving contaminated soil and/or groundwater in-situ treatment
Waste Treatment (RCRA/TSCA)	Any method, technique, or process designed to physically, chemically, or biologically change the nature of a hazardous waste.
Removal of Spill	This category covers oil spill cleanups under CWA 311(b)
Removal of Contaminated Medium	This category covers cleanup of wastes or contaminated material to address acute threats to humans, environment, or property for underground storage tank spill clean ups and corrective action clean ups under CERCLA/RCRA.
Containment (CERCLA)	This category includes response or corrective actions that encapsulate, cover, or create physical forces (e.g., hydraulic gradients) to keep contaminants in place but do not reduce the concentration or physical extent of the contamination.

Table 3-5. Definitions for Question 20 (Continued)

Compliance Action	Definition
Leak Repair (CAA)	This category includes process piping and equipment repair activities that stop fugitive emissions from process equipment leaks from occurring. This category is specific to CAA.
Import Denied (FIFRA)	This category includes all persons or companies importing pesticides into the United States who's EPA Form 3540-1 has been denied acceptance This form, which is presented to U.S. Customs at the time the pesticide is being imported, gives basic information on the chemical formulation of the product being imported, the names of the broker and shipper, the EPA Registration Number and other information Import can be denied without completion and acceptance of this form.
Preventative Actions to Reduce Likelihood of Future Releases	
Disposal Change	This category includes activities involving disposal of waste and spent products. This action will commonly occur under a RCRA or TSCA PCB action where improper storage, transportation, or disposal of hazardous waste results in an action forcing proper waste disposal An example includes proper disposal of waste and spent products at an approved hazardous waste landfill
Storage Change	This category includes activities involving storage of waste and spent products. Examples include modifications of the storage for used oil at a facility, changes in CAFO storage pond requirements and changes to hazardous waste storage areas, and container management.
Develop/Implement Asbestos Management Plan	This category covers actions requiring the development and implementation of an asbestos management plan under TSCA 203
Develop/Implement Spill Prevention and Countermeasures Control (SPCC) Plan	This category covers actions requiring the development of a spill prevention plan under CWA - 311(j).
Obtain Permit for Underground Injection (UIC)	This category is specific to the underground injection (UIC) program when an entity is cited for failure to obtain a permit for an underground injection well.
UIC Plug and Abandon	This category refers specifically to the plugging and abandonment of injection wells under the UIC program.
UIC Demonstrate Mechanical Integrity	This category refers to action in the UIC program that will provide assurance that there will not be fluid movement in the well annulus.
UST Tank Closure	This category is specific to the requirement that an UST storage tank be closed.
UST Secondary Containment	This category is specific to the implementation of a secondary containment system around an underground storage tank
UST Corrosion or Overfill Protection	This category is specific to the implementation of corrosion or overfill prevention technologies on an underground storage tank (e.g., addition of level controls/alarms for overfill prevention or cathodic protection)
RCRA Labeling/Manifesting	This category is specific to actions that require proper labeling and manifesting of RCRA hazardous wastes.

Table 3-5. Definitions for Question 20 (Continued)

Compliance Action	Definition
RCRA Waste Identification	This category is specific to the identification of hazardous waste under RCRA.
RCRA Secondary Containment	This category is specific to the implementation of a secondary containment system around an underground or above ground storage tank
Lead-Based Paint Disclosure	Lead rules require disclosure of known lead-based paint and/or lead-based painting hazards by persons selling or leasing housing constructed before 1978 and ensures that information is provided to owners and occupants concerning potential hazards of lead-based paint exposure before certain renovations are begun.
Lead-Based Paint Removal Training/Certification	Covers TSCA 402, 1018, and 206 requirements regarding training and certification Lead rules require that training programs and training providers be approved and accredited.and that firms and/or persons conducting certain activities be properly trained and certified.
Asbestos Training/Certification/ Accreditation	AHERA requires that persons conducting specified asbestos activities be trained and accredited.
Asbestos Abatement	This applies to asbestos NESHAP cases requiring the removal and disposal of asbestos materials from buildings, schools, and housing as part of renovation and demolition projects.
Notification (SDWA, FIFRA)	This category covers compliance actions requiring a facility to provide public notice under SDWA or FIFRA, or notification to the public or a government agency of a release (e.g , required notifications to the National Response Center, or notification of hazardous reportable quantity release).
Worker Protection (FIFRA)	The purpose of EPA's Worker Protection Standard (WPS) is to protect agricultural workers from the effects of exposure to pesticides This standard is aimed at reducing the risk of pesticide poisonings and injuries among agricultural workers and handlers of agricultural pesticides.
Pesticide Registered (FIFRA)	Registered pesticides are those pesticides that EPA has approved -- after strict testing -- for use in your home Pesticides are regulated under several laws, primarily the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which authorizes EPA to oversee the registration, distribution, sale, and use of pesticides. Individuals registering pesticides must do so in a manner not only consistent with federal laws, but also consistent with state laws and regulations which differ from state to state.
Pesticide Certified (FIFRA)	Certain Pesticides may be applied only by or under the direct supervision of specially trained and certified applicators Certification and training programs are conducted by states, territories, and tribes in accordance with national standards.
Pesticide Claim Removed (FIFRA)	This category includes action to make a pesticide manufacturer remove certain claims from their products. For example, a manufacturer could be required to remove the claim "this product disinfects" if the product is not registered under FIFRA

Table 3-5. Definitions for Question 20 (Continued)

Compliance Action	Definition
Pesticide Label Revision (FIFRA)	In general, states have primary authority for enforcing against use of pesticides in violation of the labeling requirements The agency with primary responsibility for pesticides differs from state to state. Usually it is a state's department of agriculture, but may be a state's environmental agency or other agency. Pesticide labeling is also regulated under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).
Facility/Site Management and Information Practices (FMIP)	
Testing/Sampling	Laboratory or other types of testing and sampling to determine the hazard of a waste or the toxicity of a chemical or release
Auditing	This category involves cases where environmental audit is included with the settlement/order as a means for identifying problems and reducing the likelihood of similar problems recurring
Labeling/Manifesting (non-RCRA)	This category applies to actions that require proper labeling and manifesting for non-RCRA cases
Record-keeping	This category includes types of record keeping ranging from records of sampling and analysis of hazardous waste to records of inspections and maintenance. E g., requiring a facility to maintain underground storage tank monitoring records
Reporting	This category includes reporting required by regulations or permits, e g , DMR reports required under the NPDES regulations
Information Letter Response	This category includes compelling response by a recipient to a formal request for information relating to an uncontrolled hazardous waste site
Financial Responsibility Requirements	This category includes actions that compel owners or operators to show that they have the financial resources to clean up a site if a release occurs, correct environmental damage, and/or compensate third parties for injury to their properties or themselves.
Environmental Management Review	This category covers conducting an environmental management review, which includes reviewing organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing, and maintaining an organization's environmental policy
RI/FS or RD (CERCLA)	Remedial Investigation(RI)/Feasibility Study(FS) or Remedial Design(RD) This category covers investigation and study of requirements for extensive cleanup of a hazardous waste site E.g., evaluating where buried waste may have migrated into adjoining watercourses
Site Assessment/ Characterization (CERCLA)	This category includes collecting site samples and data to assess the severity of a contamination hazard. E.g., a site/facility where indications suggest an extensive cleanup may be required

Table 3-5. Definitions for Question 20 (Continued)

Compliance Action	Definition
Provide Site Access (CERCLA)	This category includes compelling facility/site owners to admit EPA officials entry to inspect or assess hazards E g., gaining entrance to a fenced, locked storage area containing potential leaking drums where admittance has been denied
Monitoring	This category includes monitoring activities performed to assess whether a pollutant release is occurring.
UST Release Detection	This category includes leak detection activities performed to assess whether a pollutant release is occurring. This category is specific to RCRA UST cases.
Storm water Site Inspections	This category refers to the storm water site BMP inspections required by federal storm water regulations.
Asbestos Inspections	This category refers to asbestos inspections required under TSCA 203 (AHERA)
Training	This category includes worker training programs
Planning	This category covers actions requiring the development of or improvement to a plan. E.g., preparation of a Storm Water Pollution Prevention Plan Implementation of a plan should be reported under individual implementation activities (e g use reduction, BMPs, etc)
Permit Application	This category includes participation in a required permit process by an un-permitted facility. E.g., an inspected facility storing hazardous wastes onsite without notification or permit.
Work Practices	This category includes any modification of business practice to facilitate the protection of human health and the environment For example, a business may be sand-blasting part of a bridge without proper environmental protection and this practice is stopped (Unlike BMP's, this type of pollutant reduction is not quantifiable
Notification (TSCA Section 6)	This category includes notification of fire response personnel and adjacent building owners in the event of a release of PCBS
Leak Detection (CAA)	This category includes leak detection activities performed to assess whether a pollutant release is occurring This category is specific to CAA cases
Spill Notification	This category covers oil and hazardous substance spill notification requirements covered by CWA Section 311.

Table 3-6. Question 19 and 22 Entries for "Media"

Air	Water (ground)
Animals/Plants/Humans	Water (underground source of drinking water)
Land	Water (navigable/surface)
Schools/Housing/Buildings	Water (sediment)
Soil	Water (storm water)
Soil Vapor	Water (wastewater to POTW)
Water (biosolids and other sludges)	Water (wetlands)
Water (drinking)	

Table 3-7. Question 19 and 22 Entries for "Units"

Units	Definition	Units	Definition
ACRES	Acres	LBS/YR	Pounds Per Year
Building units	Number of Building units	LFss	Linear Feet of small stream (< 10 ft wide)
yd3	Cubic Yards	LFms	Linear Feet of medium stream (10-20 ft wide)
gal	Gallons	LFls	Linear Feet of large stream (> 20 ft wide)
Gals	Gallons Spilled	PEOPLE	People (SDWA/FIFRA)
Housing units SF	Number of Single Family Housing units	Schools	Number of Schools
Housing units MF	Number of Multi-family Housing units	Wells	Number of Wells
lbs	Pounds		

Table 3-8. Definitions for Question 17

SEP Category	Definition
Public Health	A project which provides diagnostic, preventative, and/or remedial components of human health care related to the health damage caused by the violation
Pollution Prevention	A project which reduces the generation of pollution through source reduction This category includes seven specific subcategories of actions including, equipment or technology modifications; process or procedure modifications; product reformulation or redesign, raw materials substitution; improved housekeeping, operation and maintenance activities, training, or inventory-control, in-process recycling; and energy efficiency and conservation activities. If the pollutant or waste stream has been generated, pollution prevention is no longer possible and the waste must be handled by appropriate recycling, treatment or disposal methods.
Pollution Reduction	A project which results in a decrease in the amount or toxicity of any hazardous substance, pollutant or contaminant entering a waste stream or otherwise being released into the environment (e g, waste recycling, waste treatment).
Environmental Restoration and Protection	A project which goes beyond repairing the damage caused by the violation to enhance the condition of the environment adversely affected.
Assessments and Audits	Pollution prevention assessments are systematic, internal reviews of specific processes and operations designed to identify and provide information about opportunities to reduce the use, production, and generation of toxic and hazardous materials and other wastes. Site assessments are investigations of the condition of the environment at a site, or of the environment impacted by a site, and/or investigations of threats to human health or the environment relating to a site. Environmental compliance audits are an independent evaluation of a defendant/respondent's compliance status with environmental requirements
Environmental Compliance Promotion	A project which involves disseminating information or providing training or technical support to a regulated party or to some or all members of the defendant/respondent's economic sector
Emergency Planning and Preparedness	A project where a defendant/respondent provides assistance, such as computers and software, telephone/radio communication systems, chemical emission detection and inactivation equipment, HAZMAT equipment, or training for first responders to chemical emergencies, to a responsible state or local planning entity.

4.0 GUIDE FOR POLLUTANT REDUCTION/ELIMINATION CALCULATIONS

This section presents a general overview of when and how to estimate pollutant reductions/eliminations associated with enforcement actions. Sections 5.0 through 10.0 present the following Regulatory Act discussions and specific examples for water, air, and solid/hazardous wastes:

Act	Media	Example Description	Section Number
CWA/ SDWA	Water	CWA/NPDES	5.1
		CWA/SPCC	5.2
		Storm water Violations	5.3
		Violations for CAFOs	5.4
		Combined Sewer Overflow CSO	5.5
		Sanitary Sewer Overflow SSO	5.6
		Wetlands	5.7
		SDWA PWSS Violations	5.8
		SDWA UIC Violations	5.9
CAA	Air	NO_x Reduction at a Petroleum Refinery under PSD/NSR	6.1
		SO_2 and HAP Reduction at a Pulp and Paper Mill under MACT	6.2
		Leak Detection And Repair	6.3
RCRA/ CERCLA	Solid/Hazardous Waste	RCRA Subtitle C	7.1
		RCRA UST	7.2
		RCRA/Superfund Corrective Actions	7.3
TSCA	Solid/Hazardous Waste	TSCA Lead-based Paint	8.1
		TSCA Section 6	8.2
		Asbestos under TSCA/AHERA and CAA NESHAP	8.3
FIFRA	Solid/Hazardous Waste	FIFRA	9.1

4.1 When Do You Need to Calculate Pollutant Reductions/Eliminations or Environmental Benefit?

When the civil, judicial or administrative order requires the respondent to take actions that reduce, eliminate, or treat pollutant releases; or properly manage waste streams, then the program office technical lead or lead attorney should report an estimate of the environmental benefit of those actions at CCDS Question 22. The first column of CCDS Question 20 can be broken down into the following types of complying actions:

Actions with Direct Environmental Benefits/Response/Corrective Action	Source Reduction/Waste Minimization Industrial/Municipal Process Change Emissions/Discharge Change Implement Best Management Practices Wetlands Mitigation In-situ and Ex-situ Treatment Waste Treatment Removal of Spill Removal of Contaminated Medium Containment Leak Repair Import Denied
Preventative Actions to Reduce the Likelihood of Future Releases	Disposal Change Storage Change Develop/Implement Asbestos Management Plan Develop/Implement Spill Prevention and Countermeasures Control (SPCC) Plan Obtain Permit for Underground Injection (UIC) UIC Plug and Abandon UIC Demonstrate Mechanical Integrity UST Tank Closure UST Secondary Containment UST Corrosion or Overfill Protection RCRA Labeling/Manifesting RCRA Waste Identification RCRA Secondary Containment Lead-Based Paint Disclosure Lead-Based Paint Removal Training/Certification Asbestos Training/Certification/Accreditation Asbestos Abatement Notification (SDWA, FIFRA) Worker Protection Pesticide Registered Pesticide Certified Pesticide Claim Removed Pesticide Label Revision

EPA regional workgroups have evaluated each of these complying action types and have determined on a statute basis the best method for determining the environmental benefit. Depending on the statute and complying action, the environmental benefit may be measured as a reduction/elimination or treatment of pollutants (reported in pounds) or may include other units of measure to represent the environmental or human health benefit (such as acres or linear feet for wetland cases and population for SDWA cases). A discussion of appropriate calculation methodologies and measurement units is provided in the subsections of Sections 5.0 through 9.0 below. In addition, if a case includes a SEP incorporating pollution prevention, pollution reduction, or environmental restoration, then the environmental benefit of the SEP project should be estimated and reported at CCDS Question 19.

4.2 How Do You Calculate Pollutant Reductions/Eliminations?

The following sections present the basic methodology to use in estimating pollutant reductions or eliminations and a discussion of the time basis to use in these calculations.

4.2.1 Categories of Outcomes for GPRA Reporting Purposes

OECA currently reports the lbs of pollutants estimated to be reduced or treated under GPRA. OECA expands on this outcome measure for our End-of-Year reporting purposes to include: estimated cubic yards of contaminated soil/aquifer to be cleaned up; linear feet of stream miles mitigated; acres of wetlands protected/mitigated; and number of people receiving cleaner drinking water. With the addition of the new prevention measures covered in this guide, these EOY categories are likely to expand to also include: number of underground injection wells protected from leaking; gallons of oil prevented from spilling or leaking; number of housing units notified of lead-paint risks; school and buildings protected from asbestos exposure; people notified of potential drinking water hazardous; and pounds of unregistered pesticides removed from commerce.

4.2.2 Basic Methodology

For many of the CWA and CAA cases you will calculate the estimated reduction that will occur in the pollutant or pollutants of concern in terms of the level that they are being released at above the allowable permit level. The enforcement action is estimated to return the facility to compliance and therefore bring the allowable amount of pollutant level down to the permitted level. To commonly describe these reductions across media we express this reduction in pounds. For RCRA, CERCLA and TSCA (asbestos, PCB, and lead-based paint) cases that involve in-situ or ex-situ treatment, removal, and proper disposal of contaminated media, you should report the volume of contaminated media impacted by the action instead of pounds of pollutant.

To calculate pollutant reductions or eliminations for water and air cases, you need to use the difference between the current "out of compliance" concentration and the post-action "in compliance" concentration for each pollutant of concern. This difference is then converted to mass per time using flow or quantity information from the case. The following steps outline the general method to follow to estimate a pollutant reduction/elimination.

Step A Determine the average "out of compliance" concentration of each pollutant (concentrations are usually reported in mg/l or ug/l).

Step B Determine the post-action concentration for each pollutant (this may be a permit limit, a prescribed action level, or the assumption of complete elimination of the pollutant).

Step C Determine average flow or quantity of media impacted.

Step D Determine the incremental concentration by which the pollutant is out of compliance by subtracting the post-action concentration from the "out of compliance" concentration.

Incremental Concentration = Out of compliance conc. - Post-action conc.

Step E Determine the incremental loading using flow or quantity information, for example:

Loading (lbs/day) = Incremental Concentration (mg/L) × Flow (MGD) × 8.34

- *8.34 (Conversion Factor) = (g/1000 mg) × (lb/454 g) × (3.78 L/gal) × (1E6 gal/Mgal)*

Step F Report on the CCDS form the total pollutant reduction that will occur during the first year of post-action compliance.

Pollutant Reduction (lbs) = Loading (lbs/day) × Discharge Time (days/year) × 1 year

4.2.3 Calculation Basis for Time

OECA has conservatively chosen to use one year as the period of time over which a reduction/ elimination credit is taken. OECA is requesting that the annual pollutant reduction ONCE the complying action(s) have been fully implemented be reported on the CCDS form. Thus, if the pollutant reduction is a continuous action (e.g., implementation of a treatment technology), you would report one year's worth of pollutant removal benefits. For example, if the complying action will include the addition of new treatment technology over several years at a facility, then the pollutant benefit for CCDS represents the pollutant reduction that occurs over one year once the technology has been put into place. If the pollutant reduction occurs as a one time (or short term) action then you report the total pollutant removal benefit.

Despite when the benefits occur (whether they will occur now or later), report benefits in the year in which the case is settled.

For complying actions that properly manage a waste (e.g., corrective actions) or result in prevention of pollution, report the total amount/volume of media impacted by the action. For statute specific instructions and examples see the subsections in Sections 5.0 through 9.0 below.

5.0 WATER EXAMPLES

Under the CWA the following types of enforcement cases are typical:

- 5.1 Enforcement actions against facilities that are out of compliance with their NPDES permit, including cases involving a violation of permit limits or conditions, discharge without a permit, and cases for industrial users subject to pretreatment standards. (pg. 5-2)

- 5.2 Enforcement actions resulting from an oil spill or the need to prevent oil spills under CWA 311, the Spill Prevention, Control and Countermeasures (SPCC) program. (pg. 5-6)

- 5.3 Enforcement actions to control solids (sediment) and other pollutant loses from CWA 301/402 cases related to stormwater violations. (pg. 5-8)

- 5.4 Enforcement actions to control wastewater discharges or releases occurring at concentrated animal feeding operations (CAFOs). These cases reduce or eliminate the discharge of storm water contaminated with raw animal manure whose pollutants of concern include BOD, COD, TSS, phosphorus, nitrogen, and pathogens. (pg. 5-16)

> EPA is currently developing desk-top based "expert system/spreadsheets" for CAFO, CSO and SSO type cases that will walk you through the calculations (including the conversions of concentration to mass).

- 5.5 & 5.6 Enforcement actions limiting or eliminating combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs). These cases reduce or eliminate the discharge of sanitary wastewater whose pollutants of concern include BOD, COD, TSS, phosphorus, nitrogen, and pathogens. (pgs. 5-26, 5-30)

- 5.7 Enforcement actions under CWA 404 impacting wetlands. (pg. 5-33)

- 5.8 & 5.9 Actions stemming from Safe Drinking Water Act violations under the Public Water Supervision (PWSS) program and the Underground Injection Control (UIC) program. (pgs. 5-35, 5-36)

The sections below present methodologies for determining pollutant reductions and environmental benefit for typical cases involving a water media. Each section includes information on the following:

- Background;
- Calculation methodology; and
- Example calculations and ICIS input using specific scenarios.

5.1 Clean Water Act/NPDES

5.1.1 Background

The CWA requires point sources discharging to waters of the United States to obtain a National Pollutant Discharge Elimination System (NPDES) Permit. The NPDES program is implemented through site-specific or general permits that may be as stringent as or more stringent than national regulations. The NPDES program is enforced by comparing actual discharges or discharge conditions to the permitted level of pollutant discharges or discharge conditions.

The NPDES program regulates industrial process discharges from direct and indirect dischargers, municipal sewage treatment plant effluent, and storm water runoff. Direct dischargers discharge water directly to surface waters while indirect dischargers discharge to a publicly owned treatment works (POTW). Limitations may be set for indirect dischargers to prevent interference with POTW treatment processes or pass-through of the pollutants to surface waters. EPA's Office of Water, Office of Science and Technology has set effluent limits for various industries. Information can be found on their website at www.epa.gov/waterscience/guide. The regulations are listed in 40 CFR Part 401 through Part 471.

General permits cover several facilities that have the same type of discharge and are located in a specific geographic area. General permits apply the same or similar conditions to all dischargers covered under the general permit. An example would be an industrial facility whose stormwater discharges are covered by a general stormwater permit. Information on general permits can be found on EPA's website at http://cfpub.epa.gov/npdes/permitissuance/genpermits.cfm.

Many NPDES cases will involve complying actions that reduce, eliminate or treat specific pollutants. The pollutant reduction may be realized through changes to an end-of-pipe treatment system, process-based activities, chemical use reduction or chemical substitution, or implementation of a best management practice. Typical physical CWA/NPDES complying actions include:

Actions with Direct Environmental Benefits/Response or Corrective Action	Source Reduction Industrial/Municipal Process Change Emissions/Discharge Change Implement Best Management Practices (BMPs)

For these cases you should:

- Check those complying actions that apply;
- Identify the pollutant name(s) impacted by the action, and
- Calculate pollutant reductions estimated to occur from implementation of the action.

The typical units and media that will apply for the direct complying actions are "**pounds**" (of pollutant reduced per year) and "**Water (navigable/surface)**" or "**Water (wastewater to POTW)**".

5.1.2 Calculation Methodology

To calculate pollutant reductions for water, use the difference between the permit limit (which will be expressed as a concentration and/or mass) and the sampled concentrations or mass. For cases based on a one-day violation, use the daily maximum concentration as your exceedence concentration and calculate the loadings for one-day pollutant reduction. For cases based on a one- to three-month violation, use the highest monthly average concentration as your initial out-of-compliance concentration and calculate the reductions for that time period.

If facility history indicates that there has been potentially long term non compliance, for example, it has had more than three months of exceedences or is on the EPA Watch List or QNCR Exceptions list, then you may want to assume that they would have continued violating throughout the year had the action not stopped. For these cases, use the highest monthly exceedence and calculate one year's worth of reductions.

The following steps outline the general method that should be followed to calculate the pollutant reduction for exceedences that are more than a one day event. This method can be used for all pollutants for which pre-compliance and permit concentrations are known.

Methodology to Calculate Pollutant Reductions for Water

Step A Determine the monthly average "out-of-compliance" concentration of each pollutant in mg/L.

Step B Determine the enforceable limits for each pollutant in mg/L.

[In cases where both a maximum daily and a monthly average limit are given, the pollutant reduction should be calculated using the monthly average Mass limits can be converted to concentration limits as follows

Concentration limits (mg/L) = Mass limits (lbs/day)/ [Flow (MGD) × 8 34 lbs/MG/mg/L]

Step C Determine average flow in million gallons per day (MGD).

Step D Determine the concentration by which the pollutant is out of compliance by subtracting the permit limit from the "out-of-compliance" concentration.

Exceeded Concentration (mg/L) = Out-of-compliance concentration - Permit Limit

Step E Determine the exceeded loading in pounds by using the following formula:

Loading (lbs/day) = Exceeded Concentration (mg/L) × Flow (MGD) × 8 34

8 34 (Conversion Factor) = (g/1000 mg) × (lb/454 g) × (3 78 L/gal) × (1x10^{6} gal/MG)

Step F Report the total pollutant reduction in pounds in ICIS. Identify "Water (navigable/surface)" or "Water (wastewater to POTW)" as the impacted media.

5.1.3 Example Calculations and Input for ICIS

Example 1. NPDES Permit Violation for Direct Industrial Discharger

The method used to calculate pollutant reductions for a permit violation by an industrial discharger is similar for all industries. The permit limits (either as a concentration or an allowable mass discharge) are compared with the average "out-of-compliance" pollutant concentration (or mass discharge) obtained from sampling. This example calculates a pollutant reduction from a chemical manufacturing plant but could be used for any industry.

NPDES sampling by the Sunburst Chemical Company indicates that the plant has been consistently discharging elevated concentrations of Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) for over four months. Under an enforcement order, the facility is upgrading their end-of-pipe treatment system to bring the plant into compliance. The highest monthly out of compliance average effluent concentrations of BOD and TSS are 100 mg/L and 120 mg/L, respectively, and the mill's treatment system processes on average 6.0 million gallons per day (MGD). The plant's permit specifies a BOD limit of 1,000 pounds/day and a TSS limit of 1,500 pounds/day. The plant discharges 365 days per year.

Since this facility has a history of out-of-compliance discharges, use their highest monthly average concentrations as the out-of-compliance concentration and determine one year's worth of reductions.

Step A Out-of-compliance concentrations:
BOD = 100 mg/L
TSS = 120 mg/L

Converted to mass discharge:
BOD mass discharge = 100 mg/L × 6.0 MGD × 8.34 = 5,000 lbs/day
TSS mass discharge = 120 mg/L × 6.0 MGD × 8.34 = 6,000 lbs/day

Step B Enforceable limits in mass per day:
BOD = 1,000 lbs/day
TSS = 1,500 lbs/day

Step C Flow = 6.0 MGD

Step D and E BOD Exceeded Mass = 5,000 lbs/day - 1,000 lbs/day = 4,000 lbs/day
TSS Exceeded Mass = 6,000 lbs/day - 1,500 lbs/day = 4,500 lbs/day

Step F Assume that the chronic nature of the plants exceedences will result in a full years worth of environmental benefit once the compliance action has been implemented. Pollutant Reduction (lbs) = Loading (lbs/day) × Time (days/year) × 1 year

BOD Reduction = 4,000 lbs/day × 365 days/yr. × 1 yr. = 1,460,000 lbs.

TSS Reduction = 4,500 lbs/day × 365 days/yr × 1 yr.= 1,640,000 lbs.

Input for ICIS is as follows:

- **Complying Action**: Emissions/Discharge Change;
- **Pollutant**: BOD
- **Unit**: 1,460,000 Pounds
- **Media**: Water (navigable/surface)
  AND
- **Pollutant**: TSS
- **Unit**: 1,640,000 Pounds
- **Media**: Water (navigable/surface).

Example 2. NPDES Permit Violation for an Indirect Discharger (Pretreatment Violation)

Note: For pretreatment cases, the time frame to use in determining pollutant reductions should be determined based on the nature of the case and best professional judgement. This may be a particular issue with batch processing where exceedences do not occur continuously.

Sampling at ThinkFast Printed Wiring Board Manufacturing Corporation indicated elevated concentrations of cadmium during a two month period. The average elevated effluent concentration of cadmium for the two month period was 0.39 mg/L. ThinkFast discharges wastewater to the local POTW. Their pretreatment permit limits cadmium at a maximum daily effluent concentration of 0.14 mg/L and a maximum monthly average of 0.09 mg/L. Under an enforcement order, the facility is implementing a process change to bring the plant into compliance. The average annual discharge of the plant is 25 million gallons. The plant operates and discharges wastewater 5 days a week, 24 hours a day.

Step A Actual average concentration:
Cadmium = 0.39 mg/L

Step B Enforceable limit:
Cadmium = 0.09 maximum monthly average

Step C Flow = 25 MG/year
Compute flow in million gallons per day. The site operates 5 days a week.
Flow (MGD) = 25 MG/year × 1year/260 days = 0.0962 MGD

Step D Cadmium Exceeded Concentration = 0.39 - 0.09 = 0.30 mg/L

Step E Pollutant Reduction (lbs/day) = Incremental Concentration (mg/L) × Flow (MGD) × 8.34 (lbs/MG/mg/L)

Cadmium Loading = 0.30 (mg/L) × 0.0962 (MGD) × 8.34 = 0.2407 lbs/day

Step F Since the exceedences were only temporary, only two months of environmental benefit will be reported in ICIS. Therefore, Pollutant Reduction (lbs) = Loading (lbs/day) × 30 days/month × 2 months
Cadmium Reduction = 0.2407 lbs/day × 30 days/mo. × 2 mo. = 14.4 lbs

Input to ICIS is as follows:

- **Complying Action**: Industrial/Municipal Process Change
- **Pollutant**: Cadmium
- **Unit**: 14.4 Pounds
- **Media**: Water (wastewater to POTW)

5.2 Clean Water Act - 311 SPCC and Spill Clean-up Provisions

5.2.1 Background and Methodology

Section 311 of the CWA addresses pollution from oil and hazardous substance releases and provides EPA with the authority to establish programs for preventing, preparing for, and responding to oil spills that occur in navigable waters of the U.S. In addition, in August 1990, the Oil Pollution Act (OPA) was signed into law. The OPA, enacted largely in response to public concern after the Exxon Valdez incident, improved the nation's ability to prevent and respond to oil spills by requiring facility owners or operators to prepare facility response plans addressing a worst-case discharge of oil. The statute requires the notification of authorities of oil or hazardous substance discharges. The regulations require the Oil Spill Prevention, Control, and Countermeasures (SPCC) program and the Facility Response Program (FRP). The SPCC program applies to non-transportation related facilities that have a large oil storage capacity and could reasonably be expected to discharge oil into navigable waters. The SPCC regulations require each owner or operator of a regulated facility to prepare an SPCC plan.

Enforcement actions related to CWA SPCC cases may include the following types of direct and preventive complying actions:

Statute/Section Violated	Actions with Direct Environmental Benefits/Response or Corrective Action	Pollutant Name	Amount	Unit	Potential Impacted Media
Oil or hazardous substance spill 311(b)(3)	Removal of spill	Oil or name of hazardous substance	Total amount recoverable	Gallons Spilled (Recoverable gallons) Pounds	Water (navigable/ surface)
RCRA 7003	Removal of Contaminated Medium In-situ and Ex-situ Treatment	Oil-contaminated soil	Cubic yards of soil removed	Cubic yards	Soil

Statute/Section Violated	Preventative Actions to Reduce Likelihood of Future Releases	Pollutant Name	Amount	Unit	Potential Impacted Media
Spill prevention CWA 311(j)	Develop Spill Prevention and Countermeasures Control Plan (SPCC)	Oil	Capacity of holding vessel	Gallons	Water (navigable/ surface)

In addition, it is also very common for there to be an administrative penalty only type of situation where an oil spill release has occurred. In these cases, the administrative action does NOT require clean up - though the facility receiving the penalty may choose to conduct a clean up on its own. These cases do not result in a direct or preventative action since they are "penalty only" and you should not report an environmental benefit for these types of administrative actions.

5.2.2 Examples and Input for ICIS

Three types of CWA/SPCC examples are presented below. Under the first example, an administrative penalty is lodged against a facility for an oil spill. This is an example of a "penalty only" type of action. In the second example, an enforcement action has been lodged against a facility to require removal of an oil spill into a navigable body of water adjacent to the oil storage facility. A determination of the gallons of recoverable oil and the amount of contaminated soil to be removed is required for this case. The third example covers an enforcement case requiring the facility to incorporate preventive measures.

Example 1. CWA/SPCC Administrative Penalty

ABC oil storage facility has been cited for an oil spill release from one of their tanks which has reached and contaminated a nearby stream. The administrative action applies a penalty to the oil storage facility.

Input for ICIS:

This is a "penalty only" action and no information on environmental benefit is reported into ICIS.

Example 2. CWA/SPCC Removal

ABC oil storage facility has been cited for an oil spill release from one of their tanks which has reached and contaminated a nearby stream. EPA issues a judicial case against the facility ordering them to recover the spill. It is estimated that 10,000 gallons of No. 5 Fuel Oil were released in the spill and that 8,000 of them were recoverable.

Input for ICIS:

- **Complying Action**: Removal of spill
- **Pollutant**: Oil
- **Unit**: 10,000 Gallons Spilled
- **Media**: Water (navigable/surface)

Example 3. CWA/SPCC Prevention

Under an Expedited Settlement Agreement, XYZ oil storage facility has agreed to prepare an Oil Spill Prevention Plan. The agreement requires the facility to develop and implement a plan and will also require notification, and training of facility personnel once the spill prevention plan has been developed. The facility includes 2 oil storage tanks with a total holding capacity of 30,000 gallons.

Input for ICIS:

- **Complying Actions**: Develop/Implement Spill Prevention and Countermeasures Control (SPCC) Plan (Preventative), Spill Notification and Training (FMIP)
- **Pollutant:** Oil
- **Unit:** 30,000 gallons
- **Media:** Water (navigable/surface)

5.3 Stormwater Violations

5.3.1 Background and Methodology

Stormwater provisions under CWA Sections 301/402 impact stormwater discharges from construction activities, industrial facilities, and municipalities.

Stormwater runoff from construction activities can have a significant impact on water quality. As stormwater flows over a construction site, it picks up pollutants like sediment, debris, and chemicals. Polluted stormwater runoff can harm or kill fish and other wildlife. Sedimentation can destroy aquatic habitat and high volumes of runoff can cause stream bank erosion. The NPDES Stormwater program requires operators of construction sites one acre or larger (including smaller sites that are part of a larger common plan of development) to obtain authorization to discharge stormwater under an NPDES construction stormwater permit. The NPDES stormwater permits for regulated construction activities focus on the development and implementation of stormwater pollution prevention plans. Environmental benefits of storm water cases at construction sites are to be measured in terms of pounds of sediment reduced.

Stormwater is also an issue at industrial facilities and from Municipal Separate Storm Sewer Systems (MS4s). Activities that take place at industrial facilities, such as material handling and storage, are often exposed to stormwater. The runoff from these activities discharges industrial pollutants into nearby storm sewer systems and water bodies. This situation may also adversely impact water quality. To limit pollutants in stormwater discharges from industrial facilities, the NPDES Phase I Storm Water Program includes an industrial stormwater permitting component. Operators of industrial facilities included in one of 11 categories of "stormwater discharges associated with industrial activity" that discharge stormwater to a MS4 or directly to waters of the United States require authorization under a NPDES industrial stormwater permit. If an industrial facility has a Standard Industrial Classification (SIC) code or meets the narrative description listed in the 11 categories, the facility operator must determine if the facility is eligible for coverage under a general or an individual NPDES industrial stormwater permit. In some cases, a facility operator may be eligible for a conditional/temporary exclusion from permitting requirements. OECA is in the process of developing a pollutant reduction methodology for reductions from industrial sites. In the interim, you should report acres covered by the stormwater permit in ICIS.

The NPDES Phase I and II Stormwater Programs also required NPDES permit coverage for stormwater discharge from Medium and Large MS4s located in incorporated places or counties with populations of 100,000 or more and for certain regulated Small MS4s. Environmental benefits of stormwater cases at MS4 sites has not yet been determined and reporting on MS4 environmental benefits is not currently required.

Enforcement actions related to CWA storm water cases may include the following types of direct and FMIP complying actions:

Statute/Section Violated	Complying Actions with Direct Environmental Benefits	Pollutant Name	Amount	Unit	Potential Impacted Media
CWA 301/402 (for Construction Permits)	Implement Best Management Practices	Sediment	Amount of sediment	Pounds	Water (navigable/ surface)
CWA 301/402 (for Industrial and MS4 Permits)	Implement Best Management Practices	Stormwater	Number of Acres covered by SWPP [1]	Acres	Water (navigable/ surface)

[1] Will be changed to a pollutant reduction measure once a methodology is developed in 2005.

Statute/Section Violated	Complying Actions with Facility Management and Information Practices (FMIP)	Pollutant Name	Amount	Unit	Potential Impacted Media
CWA 301/402 (for Construction, Industrial, and MS4 permits)	Develop a Plan (e.g., SWPPP or SWMP)	Storm Water	NA	NA	NA
CWA 301/402 (for Construction, Industrial, and MS4 Permits)	Permit Application	Storm Water	NA	NA	NA

5.3.2 Calculation Methodology for Determining Pounds of Sediment Reduced As a Result of the Implementation of Best Management Practices at Construction Sites

EPA developed a model to estimate sediment reduction at construction sites as a result of the implementation of stormwater best management practices. The model is available as an Excel spreadsheet at http://intranet.epa.gov/oeca/NPMAS. The model utilizes the Revised Universal Soil Loss Equation (RUSLE) to determine soil loss and soil loss reduction. RUSLE was developed by the United States Department of Agriculture (USDA) to estimate erosion. The RUSLE equation uses the erosivity of rainfall, the erodibility of the soil, the length and slope of the land area, and cover and conservation management practices on the land to estimate erosion from a specific area. The RUSLE equation is expressed as:

$$\mathbf{T = RKLSCP}$$

Where:

T	=	Predicted Soil Loss (tons per acre per year)
R	=	Annual Rainfall-Runoff Erosivity Factor
K	=	Soil Erodibility Factor
LS	=	Length/Slope Factor
C	=	Cover Management Factor
P	=	Conservation Practice Factor

For the purposes of EPA's model, T will be expressed as tons of sediment loss per construction site (or specified area of a construction site). The equation used in the EPA model is:

$$\mathbf{T = A \times (RF) \times K \times LS \times C \times [1 - (Eff. \times E)]}$$

Where:

T	=	Predicted Soil Loss (tons)
A*	=	Area of Construction Site (in acres)
RF*	=	Erosivity Index (which incorporates the annual rainfall-runoff erosivity factor (R) with the time period of construction (F))
K	=	Soil Erodibility Factor
LS	=	Length/Slope Factor
C	=	Cover Management Factor
Eff.*	=	Efficiency of the Conservation Practice
E*	=	Effectiveness Factor for an existing BMP

* The area (A) and time period of construction (F) factors were added to the RUSLE equation to determine soil loss in tons. The conservation practice efficiency (Eff.) is being adjusted by the BMP effectiveness factor (E) to address cases where existing BMPs are improperly maintained. The conservation practice factor (P) is equal to [1 - Eff.]

The following steps outline the general method that should be followed to calculate the sediment reduction for construction stormwater cases:

Methodology to Calculate Sediment Reductions for Construction Stormwater Cases

Step A Determine the best method of using the EPA model for the specific site If appropriate, split up the construction site into drainage areas or areas with specific BMPs

Step B Enter the disturbed area of the construction site (in acres) into the model

Step C Using the location and a one year time frame for the construction project, determine the location specific RF factor appropriate for the site from the Texas A&M Erosivity Index Calculator website link provided in the model Alternatively, use the model's drop down menu to identify the state in which the construction site is located.

Step D Select an appropriate soil type for the site. Alternatively, you can input a specific soil erodibility factor into the model.

Step E Select an appropriate length and slope for the site. Alternatively, you can input a specific length/slope factor into the model

Step F The C factor for the site is being set to 1.0

Step G Determine the BMP Eff factor for the site for pre-compliance conditions and the post-compliance conditions. If there are existing BMPs at the site that are not being maintained or are being used improperly, include an effectiveness factor (E) for the pre-compliance BMP efficiency factor

Step H Report the total sediment.reduction (in pounds) from the model output into ICIS Identify "Water (navigable/surface)" as the impacted media.

From an inspection, you should have information on the location and acreage of the construction site and erosion and sediment control BMPs that are used on site or that are being required as part of the enforcement action. This information is needed to determine the erosivity index (RF) factor, the area of construction (A) factor, and the efficiency of the conservation practice (Eff.) for the model. You may or may not have specific information to determine the other factors in the model. For each of these other factors, the model will present you with a drop down menu of choices. You should use your best professional judgement to select one of the drop down menu choices. If you do not know what menu item to select, then an average value can be used as described in the questions and answers below.

How do I determine the acreage (A) to use in this model?

The disturbed area that is the basis of the enforcement action (in acres) should be estimated and input for the area of construction (A) factor in the model.

How do I determine the rainfall-runoff erosivity (R) factor to use in this model?

Use the Texas A&M Erosivity Calculator (located on the internet at http://ei.tamu.edu/index.html) to determine the value to input for this factor. Inputs for the Texas A&M Erosivity Calculator are the location of the construction site (the city or county and the state) and a time period for construction. The spreadsheet model will provide you with the internet link and the output from the erosivity index calculator can then be input into the model.

As an alternative to the Erosivity Calculator, the model includes a drop down menu where you can select the state in which the construction site is located (which will provide the model with a state specific default R factor).

What should the time frame be for calculating pollutant reductions for storm water cases?

EPA is using an estimated benefit period of one year for construction stormwater cases to correspond with the one year benefit periods for most other types of cases reported in ICIS. EPA realizes that the benefits from BMPs at construction sites may occur over shorter or longer time frames.

Thus, if you use the Texas A&M Erosivity Calculator, you should input the location of the construction site (using the city or county and the state) and a time period for construction. The time period of construction should be estimated as one year (e.g., input January 1, 2004 to December 31, 2004 into the erosivity index calculator). Or, if you use the drop down menu in the storm water model as an alternative to the erosivity index calculator, you can select the state in which the construction site is located (which will provide the model with a state specific default R factor) and the model will automatically assume a one year time frame.

How do I determine the soil erodibility (K) factor to use in this model?

Based on your general knowledge of the predominant soil type common in the area in which the construction site is located, you can select a soil type from the model drop down menu. Selection options include sandy loam, clay, loam, or silty clay loam K values for each of these soil types are included in the spreadsheet model and range from 0.13 to 0.32. If the type of soil is unknown, then you can input an average value of 0.22 for this factor.

How do I determine the length/slope (LS) factor to use in this model?

For the length/slope factor, use your visual observations from the inspection to estimate whether the site slope would be considered predominantly flat, moderate, or steep and estimate an average slope length for the whole site. If there are significantly different grades at the construction site then subdivision of the construction area (modeling each separately) may be appropriate. If you do not have any information about the site to estimate a length/slope factor, then you can input an average value of 6.1, where typical LS factors range from 0.09 (for a 1% slope and 15 foot slope length) to 12.23 (for a 14% slope and a 1,000 foot slope length.)

What cover management (C) factor is used in this model?

EPA expects, for most cases, that the disturbed acreage of a construction site will have been cleared of cover. EPA is therefore assuming a cover factor of 1.0 in the spreadsheet model and no input for this factor is required.

How do I determine the efficiency of the conservation practice (Eff.) to use in this model?

The model will set a default efficiency by the type of sediment erosion control practice (or BMP) that you select for current (or pre-compliance) conditions and for post-compliance conditions. The reduction in sediment loss between these conditions is the reduction that should be reported in ICIS. The types of BMPs used on the site or required by the enforcement action will determine which BMP efficiency you pick from the drop down menu. For the current conditions, use observations from the inspection on current erosion control BMPs to determine which item to select from the drop down menu. The requirements of the enforcement action will determine which BMPs are going to be put into place to address deficiencies for the post-compliance conditions.

How do I determine the effectiveness factor (E) of the existing BMPs present on site?

The effectiveness factor would be used in cases where BMPs currently exist at a site and are not working properly. This factor is an estimate of how well the existing BMPS are working. Use best professional judgement to estimate the effectiveness factor based on observations from the inspection. ***Example:*** You visit a site that has a silt fence installed, but about one third of the silt fence is falling down and torn. Because about 30 percent of the fence is not working properly, the effectiveness factor (E) is estimated to be 70 percent. If the site does not have existing BMPs then the E factor should be set to 100%

Are return inspections required to collect information for the factor values in this model?

No. The sediment reductions calculated for a case and input into ICIS are estimates based on the information that you have for the case and your best professional judgement. The Office of Compliance is developing the construction site sediment reduction spreadsheet model in an effort to standardize the approach used by all the regions in estimating these sediment reductions.

What data should I start collecting at future inspections?

For future inspections, make observations that will help you determine factor values or which drop down menu options to select. For example,

- Request information on the disturbed acreage of the site,
- Request information on the time period for construction,
- Note the soil type common to the site area,
- Observe how steep the site appears to be and estimate average slope lengths, and
- Observe whether there are existing BMPs, and their condition.

What if the construction site has different slope characteristics in different areas?

If your site does not lend itself to one overall slope for the entire area, you can run the model multiple times to capture different slope characteristics present. ***Example:*** A site is 4 acres in area. About half of site has a moderate slope, and the remaining area has a steep slope. Run the model twice: 1) for the 2 acre area with moderate slope and 2) for the 2 acre area with a steep slope. The total amount of sediment loss will be the sum of the sediment loss from those two portions of the construction site.

What if the construction area has or will require multiple management practices?

Where different erosion and/or sediment loss management practices occur at different locations within a construction site, model each area separately and sum the sediment losses to determine the total site sediment loss. Where multiple BMPs are incorporated for the same area, use the cumulative efficiency of the practices in the spreadsheet model. For example, hydroseeding should result in a 50 percent sediment removal efficiency. If the site will also include straw bales then an additional 70 percent removal efficiency can be achieved. Overall the site would experience 50 percent sediment removal from hydroseeding + 70 percent removal of the remaining sediment loss (from the straw bales) = 0.5 + (0.70 × 0.50) = 0.5 + 0.35 = 0.85 or 85 percent total removal efficiency. The model has a separate tab to use if multiple BMPs apply. If a construction site has BMPs and they are not functioning, then the Eff. should be set to 0 as if there were no BMPs on site.

5.3.3 Example and Input for ICIS

Kandle Construction Company is building a shopping mall in Camden, New Jersey. The site is 5 acres in area and construction is occurring from May 1, 2004 through October 1, 2004. A site visit reveals that the site is located on an area with a moderate slope and sandy loam soil. Existing BMPs include a silt fence around approximately 2 acres of the site that slope towards a drainage ditch and no erosion control surrounding the rest of the site. The site visit showed that about one third of the silt fence was falling down and torn. The site will be addressed through an enforcement action requiring that the existing silt fence be repaired and properly maintained and the area of the construction site with no erosion controls will be hydroseeded.

Step A Determine the best method of using the EPA model for the specific site.

The site will be modeled to determine the current (pre-compliance) sediment loss and a post-compliance sediment loss for two areas: Area 1) the three acre area that has no current soil erosion BMP and Area 2) the two acre area that has a silt fence that is not being properly maintained. The post-compliance situation will include hydroseeding on Area 1 and silt fence repair on Area 2. The reduction in sediment loss (from pre-compliance to post-compliance conditions) for the two areas will be summed and reported in ICIS for this case.

Step B Enter the area of the construction site.

Area 1 = 3 acres
Area 2 = 2 acres

Step C Determine the location specific RF factor appropriate for the site from the website link provided in the model. (http://ei.tamu.edu/index.html) This website link is for the Texas A&M Erosivity Index Calculator.

For our example,"Camden, New Jersey" and the start and stop date for the construction project are input into the erosivity index calculator and a (RF) value of 124.03 is provided as output from the calculator. This index factor is then input into the EPA spreadsheet model.

Step D Determine the appropriate K factor for the soil type.

For our example, "Sandy Loam" is selected from the drop down menu in the model.

Step E Determine the LS factor for the site. The model user may:

- Select the slope and slope length from a drop-down menu in the model (which will select an LS factor for the site); or
- Determine an LS factor by interpolating the information from an LS table provided in the model.

For this example, a "Moderate" slope with a slope length of "1,000 feet" are selected from the drop-down menus in the model.

Step F The C Factor is set in the model at 1.0.

Step G Determine the Eff. factor of the existing BMPs at the site.

For Area 1, "none" is selected from the list in the model.
For Area 2, "silt fence" is selected from the list in the model. Also, since the silt fence at the site is not being maintained properly, a BMP effectiveness factor will also be input into the model. The model user must use best professional judgement to estimate the effectiveness of the existing BMPs. For this site, because the about one third of the silt fence located on this site is falling down and torn, only two thirds of the fence is effective; the effectiveness factor is about 67 percent. For this example an E factor of 67% is input into the model.

Determine the Eff. factor for the post-compliance conditions at the site. For Area 1 chose "Hydroseeding" and for Area 2 chose "Silt Fence" from the drop down list in the model.

Step H After all inputs are made, the model will estimate the amount of sediment reduction for the construction site (or portion of the construction site modeled) as a result of the BMPs.

In this example the sediment reduction in pounds is:
Area 1 = 159,627 pounds
Area 2 = 49,165 pounds
For a total sediment reduction of 208,792 pounds

Input for ICIS is as follows:

- **Complying Action:** Implement Best Management Practices;
- **Pollutant:** Sediment;
- **Unit:** 208,792 Pounds
- **Media:** Water (navigable/surface).

5.4 Stormwater Violation for CAFOs

5.4.1 Background

EPA has promulgated regulations to reduce the amount of water pollution from Concentrated Animal Feeding Operations (CAFOs). The final rule updates regulations that are more than 20 years old and will result in more effective, nationally consistent regulations to protect water resources.

CAFO cases are expected to include the following types of discharge violations:

- Contaminated surface runoff from CAFO areas which do not have runoff storage and control;
- Releases from storage lagoons or runoff ponds which are caused by storm event spills or lagoon leaks; and
- Releases due to over application of manure wastes.

Typical complying actions that may apply to these cases include:

Actions with Direct Environmental Benefits/Response or Corrective Action	Emission/Discharge Change Implement Best Management Practices
Preventive Actions to Reduce Likelihood of Future Releases	Storage Change

For CAFO cases, you can calculate pollutant reductions for BOD_5, COD, TSS, nitrogen, phosphorus, and potassium using information from the case file on the type of animal operation, areas impacted by the action, and the volumes of manure or wastewater handled/released. If manure or wastewater characterization data are not known, Tables 11-1 through 11-4 (located in Section 11 at the end of this booklet) can be used.

Tables 11-1 and 11-2 present typical pollutant concentrations in manure as excreted based on animal type. Table 11-1 covers beef and dairy cattle and Table 11-2 covers swine. To find manure characteristics for other animal types see USDA's Agricultural Waste Management Field Handbook at: www.ftw.nrcs.usda.gov/awmfh.html, Chapter 4. These tables include information for the following pollutants, Total Solids (TS), Chemical Oxygen Demand (COD), 5-day Biochemical Oxygen Demand (BOD_5), Nitrogen (N), Phosphorus (P), and Potassium (K).

Table 11-3 presents typical pollutant concentrations for stored manure supernate. Since manure storage often occurs in lagoons, these values are useful for enforcement actions where a facility has had spills or overflows from their storage lagoons. A storage lagoon will have sludge accumulate at the bottom and a liquid supernate will rest above the sludge layer. Spills and leaks are most likely to have supernate characteristics.

Not all manure that is excreted at a CAFO is available for collection, storage, treatment or transfer, since there are typically some losses associated with these operations. Table 11-4 presents typical recoverability factors for manure based on the animal type. In addition, nitrogen and phosphorus volatilization losses also occur during collection, storage, treatment, or transfer. These losses are also presented in Table 11-4.

5.4.2 Calculation Methodology

The calculation of pollutant reductions for CAFOs will depend on the type of discharge violation. Step-by-step instructions are provided below for surface runoff violations, storage lagoon spills or leaks, and over application violations.

Surface Runoff Violation

This approach applies to those cases where the CAFO has no storage or control of feedlot runoff and assumes that approximately 1.5% of the annual runoff volume is solids. *(Based on the Livestock Waste Facilities Handbook, Second Edition, 1985)* This approach also assumes that the composition of solids in the runoff is the same as in the facility's manure as excreted.

Surface Runoff Violation

Step A Determine the type(s) of animals at the facility.

Step B Using local annual rainfall data and the area of the CAFO site, determine the volume of surface runoff generated over one year

Annual runoff volume (cu.ft./yr) = Runoff coefficient × Annual precipitation (inches/yr) × CAFO facility area (sq. ft.) × 1 ft./12 inches

Note The runoff coefficient that you use should take into account the type of soil, percent of impervious area, and the ground slope If you have sufficient case information to develop a specific runoff coefficient you should, otherwise you can use a default value of 0 4 which assumes that 40% of the total precipitation will runoff a drylot that is 20% paved (Shuyler, 1999) The following table provides runoff coefficients for various surface types at a 1 to 2% slope

Type of Surface	*Runoff coefficient*
For macadam or other impervious materials	*0 70 to 0 95*
For gravel or crushed stone or s	*0 35 to 0 70*
For impervious soils (heavy)	*0 40 to 0 65*
For impervious soils, with turf	*0 30 to 0 55*
For slightly pervious soils	*0 15 to 0 40*
For slightly pervious soils, with turf	*0 10 to 0 30*
For moderately pervious soils	*0 05 to 0 20*
For moderately pervious soils, with turf	*0 to 0 10*

Values for average rainfall can be found on the Internet at
http://www5.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals pl

Surface Runoff Violation (Continued)

Step C Since an enforcement action will result in storage and/or control of the facility's surface runoff, you can assume that manure releases will no longer occur in the surface runoff after the compliance action is completed Therefore, assume that all of the manure that was being released in surface runoff annually will now be reduced *[Note Sites may still be allowed to have some runoff discharges due to 25 or 100-year storm events]*

Manure Reduction (lbs/yr) = Annual runoff volume (cu ft /yr) × 0 015 (manure volume/runoff volume) × manure density (lbs/cu.ft)

Manure density by animal type is provided in Table 11-5

Step D Using the characterization data from Table 11-1 or Table 11-2, determine pollutant reductions as·

Pollutant reduction (lbs/yr) = Manure reduction (lbs/yr) × [Pollutant characterization from Table 11-1 or Table 11-2 (lbs/d/1000#)/ Manure characterization from Table 11-1 or Table 11-2 (lbs/d/1000#)]

Step E Report the total pollutant reduction (for one year) in pounds in ICIS Identify "Water (navigable/surface)" as the impacted media

Lagoon/Storage Pond Spill or Leak

This approach applies to those cases where the CAFO operation uses a waste storage pond or lagoon. Spills are assumed to occur during a wet weather event where the storage pond or lagoon has insufficient freeboard and overflows. Leaks are assumed to be the result of poor maintenance or damage.

Lagoon/Storage Pond Spill or Leak

Step A Determine the type of animal operation at the facility and the facility's manure management practices (i e , type of storage lagoon or runoff pond)

Step B Determine the volume of stored waste released in gallons.

For a spill due to a storm event this may be determined from the storm event data (rainfall in inches) × the surface area of the storage lagoon (sq ft.) × 1 ft/12 inches × 7.481 gal/1 cu.ft).

[Note This calculation assumes that the storage lagoon has no freeboard If the site's lagoon is maintained with some freeboard, then you should subtract from the storm event volume the free board volume]

For a leak this may be determined from the storage lagoon liquid height before and after the leak (height change (ft.) × the surface area of the storage lagoon (sq ft.) × 7 481 ga/1 cu.ft.)

Step C Determine the pollutant concentration in the lagoon

If this information is not known you can use typical values from Table 11-3.

Lagoon/Storage Pond Spill or Leak (Continued)

Step D Assume that the enforcement action will result in no further spills or releases and that the losses from the spill/leak will no longer occur. Determine the reduction in pollutant as:

Pollutant Reduction (lbs) = Volume of spill/leak released (gal) × Pollutant concentration (lbs/1000 gal)

Step E Report the total pollutant reduction in pounds in ICIS. Identify "Water (navigable/surface)" as the impacted media.

Over Application Violation

CAFOs may use land application of manure as a beneficial reuse option in lieu of or in addition to manure storage and treatment. In this process, manure is applied to crop or pasture lands through various types of application devices depending on the nature of the manure (i.e., manure is applied as a dry solid, a slurry, or a wastewater). A CAFO should determine proper application rates of manure based on the amount of land available for manure application, specific crops that are grown on that land, and the expected crop yields and soils analysis.

Enforcement actions have occurred against CAFOs that perform land application of manure in amounts that far exceed a proper application rate. An enforcement authority may determine that over application is occurring by checking actual manure application rates against the application rates required by the crop or it may be evident from visible manure releases from crop/pasture land into nearby water bodies or by elevated levels of nutrients in waterbodies adjacent to land application operations. In these cases, an enforcement action against a CAFO may include the requirement that the facility develop a Nutrient Management Plan (NMP). As part of the NMP, the CAFO would be required to calculate the application rates that are appropriate for the type of land application practices conducted by the facility and these rates could then be monitored to see that they are not exceeded.

Over Application Violation

The methodology described below is a simplified evaluation of manure application vs. crop uptake. This calculation methodology has the following flaws:

- It assumes that manure application for nutrient needs will not exceed the hydraulic capacity of the soil. If the hydraulic capacity of the soil is more limiting than the nutrient capacity then the hydraulic flow rate becomes the determining factor.
- This approach does not take into account the manure decomposition rate. Since it may take more than a year for applied manure to breakdown into its component nutrients, manure may be applied at a greater rate so that sufficient nutrients are available for crop uptake the first year. This issue should be considered when you evaluate the specifics of the enforcement case.

The nitrogen and phosphorus pollutant reductions that would occur from an enforcement action against over application of manure can be estimated using the following steps.

Over Application Violation (Continued)

Step A Determine the type of animal operation and land application information (amount of land available for application, crops grown on that land, expected crop yields)

Step B Identify the current manure application rate (lbs manure applied/yr).

This rate should be known or can be calculated if the facility land applies all of the manure generated onsite

Manure generated onsite (lbs/year) = number of animals × avg weight/animal (from Table 11-5) × lbs manure generated as excreted (from Table 11-1 or 11-2 expressed as lbs manure/d/1000#) × days/yr the animal is onsite × recoverability factor (from Table 11-4)

Step C Using the current manure application rate, calculate the equivalent amount of nitrogen and phosphorus that is being land applied.

Nitrogen land applied (lbs/yr) = Quantity of manure land applied (lbs/yr) × [Nitrogen characterization data from Table 11-1 or Table 11-2 (lbs/d/1000#)/ Manure characterization data from Table 11-1 or Table 11-2 (lbs/d/1000#)] × ((100 - typical % nitrogen loss factor from Table 11-4)/100)

Phosphorus land applied (lbs/yr) = Quantity of manure land applied (lbs/yr) × [Phosphorus characterization data from Table 11-1 or Table 11-2 (lbs/d/1000#)/ Manure characterization data from Table 11-1 or Table 11-2 (lbs/d/1000#)] × ((100 - typical % nitrogen loss factor from Table 11-4)/100)

Step D Using the land application information, calculate the amount of nitrogen and phosphorus that will be taken up by the crops grown

Crop nitrogen requirements (lbs) = Crop yield (tons/acre) × Crop uptake (lbs nitrogen/ton of crop) × area of crop land (acres)

Crop phosphorus requirements (lbs) = Crop yield (tons/acre) × Crop uptake (lbs phosphorus/ton of crop) × area of crop land (acres)

Typical crop yields can be found by state and county at www.nass usda.gov 81/ipedb
Typical crop uptake values for nitrogen and phosphorus are shown in Table 11-6

Step E If more than one crop is grown on a field per year, determine the total annual nitrogen and phosphorus land application needs

For example, if two crops are grown on the land for the year (corn in summer and winter wheat in the winter) then the total annual nitrogen needs will be the sum of the corn crop nitrogen needs + the winter wheat crop nitrogen needs)

Over Application Violation (Continued)

Step F Determine the annual amount of nitrogen and/or phosphorus removal that will occur once the CAFO comes into compliance with proper land application rates.

The ratio of nitrogen to phosphorus in the manure will determine the reduction of the non-limiting nutrient.

Whether nitrogen or phosphorus is the limiting nutrient will depend on whether the land application area is susceptible to phosphorus leaching (primarily karst terrain). If it is, then the manure should be applied to meet the crop's phosphorus requirements and the nitrogen from the manure should be supplemented with commercial nitrogen fertilizer.

If the land application area is not susceptible to phosphorus leaching then the manure should be applied to meet the crop's nitrogen requirements and there will be a slow build up of excess phosphorus in the soil.

Nitrogen or Phosphorus removal (lbs/yr) = Total nitrogen or phosphorus land applied (lbs/yr) - Annual crop nitrogen or phosphorus needs (lbs/yr)

Non-limiting nutrient removal (lbs/yr) = limiting nutrient reduction (lbs/yr) × ratio of non-limiting nutrient/limiting nutrient in the manure.

Step G Report the total pollutant reduction (for one year) in pounds in ICIS Identify "Water (navigable/surface)" as the impacted media

5.4.3 Example Calculations and Input for ICIS

CAFO Surface Runoff Violation

EPA visited a beef cattle CAFO in response to fish kills downstream of the feedlot. A review of operations at the site identified that the feedlot facility had no control or storage of site runoff and the topography of the site resulted in runoff flowing to the affected stream. The facility is the subject of a judicial order compelling the operation to put in runoff control (using berms and grading) and storage in a runoff storage pond. The operation has the capacity for 1,500 head of beef cattle and has continuous turnover of cattle to stay at capacity throughout the year. The area of the CAFO is 690,000 sq. ft. Local meteorological data for the area indicate that the average annual rainfall for the past year was 26 inches.

Step A The operation handles beef cattle

Step B Using the local annual rainfall data and the size of the feedlot, the volume of surface runoff generated over one year is:

Annual volume of runoff (cu. ft./yr) = 0.4 × 26 inches/yr × 690,000 sq. ft. × 1 ft./12 inches = 598,000 cu. ft./yr

Step C Since the compliance action will result in the elimination of feedlot runoff, the reduction in manure discharge will equal the current level of manure discharge in runoff.

Manure reduction (lbs/yr) = 598,000 cu. ft./yr × 0.015 × 62 lb/cu. ft. (Beef cattle manure density) = 556,140 lbs/yr

Step D Pollutant reductions (using characterization data from Table 11-1) are:

Total Solids reduction (lbs/yr) = 556,140 lbs manure/yr × (7.30/63.00)
= 64,442 lbs/yr

COD reduction (lbs/yr) = 556,140 lbs manure/yr × (6.00/63.00)
= 52,966 lbs/yr

BOD_5 reduction (lbs/yr) = 556,140 lbs manure/yr × (1.20/63.00)
= 10,593 lbs/yr

Nitrogen reduction (lbs/yr) = 556,140 lbs manure/yr × (0.33/63.00)
= 2,913 lbs/yr

Phosphorus reduction (lbs/yr) = 556,140 lbs manure/yr × (0.12/63.00)
= 1,059 lbs/yr

Potassium reduction (lbs/yr) = 556,140 lbs manure/yr × (0.26/63.00)
= 2,295 lbs/yr

Step E Input for ICIS is as follows:

- **Complying Action:** Implement Best Management Practices
- **Pollutant:** and **Unit:** TSS and 64,442 pounds
- **Pollutant:** and **Unit:** COD and 52,966 pounds
- **Pollutant:** and **Unit:** BOD_5 and 10,593 pounds
- **Pollutant:** and **Unit:** Nitrogen and 2,913 pounds
- **Pollutant:** and **Unit:** Phosphorus and 1,059 pounds
- **Pollutant:** and **Unit:** Potassium, 2,295 pounds
- **Media:** Water (navigable/surface)

Lagoon/Storage Pond Spill or Leak

A large swine operation located in North Carolina has been cited in an enforcement action. The site's anaerobic storage lagoon located next to a tributary of Pamlico Bay was found to be overflowing and a spill of lagoon supernate is believed to have occurred during a recent intense 24-hour storm event. The facility lagoon is 500 feet by 250 feet in size and the recent storm event totaled 2.5 inches of rain. The enforcement action will result in additional site storage and lowering of the current lagoon level to allow for sufficient freeboard in the storage lagoon.

Step A The facility is a swine operation and uses an anaerobic storage lagoon.

Step B Assuming that the storage lagoon was maintained with no freeboard, waste discharged from the lagoon is equal to the volume of lagoon supernate displaced by the rainfall:

The volume of stored waste released (gallons) = 2.5 inches of rainfall × 500 feet × 250 feet × 1 ft/12 inches × 7.481 gal/1 cu.ft. = 194,800 gallons

Step C Typical pollutant concentrations in the lagoon supernate (using Table 11-3) are:

Total solids = 20.83 lbs/1,000 gal
COD = 10.00 lbs/1,000 gal
BOD_5 = 3.33 lbs/1,000 gal
Nitrogen = 2.91 lbs/1,000 gal
Phosphorus = 0.63 lbs/1,000 gal
Potassium = 3.16 lbs/1,000 gal

Step D Pollutant amounts brought under proper management after compliance will be:

Total solids = 20.83 lbs/1,000 gal x194,800 gal	= 4,058 lbs TS
COD = 10.00 lbs/1,000 gal × 194,800 gal	= 1,948 lbs COD
BOD_5 = 3.33 lbs/1,000 gal × 194,800 gal	= 649 lbs BOD_5
Nitrogen = 2.91 lbs/1,000 gal x194,800 gal	= 567 lbs Nitrogen
Phosphorus = 0.63 lbs/1,000 gal × 194,800 gal	= 123 lbs Phosphorus
Potassium = 3.16 lbs/1,000 gal × 194,800 gal	= 615 lbs Potassium

Step E Input for ICIS is as follows:

- **Complying Action:** Implement Best Management Practices
- **Pollutant:** and **Unit:** Total Solids and 4,058 pounds
- **Pollutant:** and **Unit:** COD and 1,948 pounds
- **Pollutant:** and **Unit:** BOD_5 and 649 pounds
- **Pollutant:** and **Unit:** Nitrogen and 567 pounds
- **Pollutant:** and **Unit:** Phosphorus and 123 pounds
- **Pollutant:** and **Unit:** Potassium and 615 pounds
- **Media:** Water (navigable/surface)

Over Application Violation

EPA has completed an administrative order for a dairy facility located in central Indiana. An investigation into the dairy operation found that the facility was disposing of all manure generated onsite by land application onto 200 acres of nearby farm land. An evaluation of the land application rates revealed that the site was over applying and excess manure appears to be washing off of the farm land and into a stream that runs through the area. The facility handles 800 head of mature dairy cows during the year. The farm land on which land application operations are occurring is used to grow corn during the spring/summer and winter wheat during the fall/winter. Under the administrative order, the facility will be required to cut back their land application rates to those that meet (and don't exceed) the crop's nitrogen requirements. The remaining site manure will require storage and application on additional farm land or composting for sale.

Step A The CAFO is a dairy cow facility whose manure management practices consist of land application of all manure generated onsite. The facility handles 800 head of mature dairy cows throughout the year. The farm land available for land application is 200 acres. The crops grown on that farm land are corn for grain in the spring/summer and winter wheat in the fall/winter.

Using www.nass.usda.gov:81/ipedb; the expected crop yields for 2000 in Indiana are 147 bushels of corn/acre and 69 bushels of winter wheat/acre.

Step B The current manure application rate is equal to the amount of manure generated at the site by the dairy cows.

Lbs manure generated at the site = # of cows × avg. weight/cow (from Table 11-5) × lbs manure/d/1000# (from Table 11-1) × days/year × recoverability factor (from Table 11-4)

Lbs manure applied/yr = [800 dairy cows × 1,350 lbs/cow × 80 lbs manure/d/1000# × 365 d/yr] × 0.98
= 30,900,000 lbs manure/yr

Step C The equivalent amount of nitrogen and phosphorus that is being land applied is:

N land applied (lb/yr) = 30,900,000 lbs manure/yr × [(0.45 lbs. N/d/1000#)/(80 lbs. manure/d/1000#)] × [(100 - 59.8)/100]
= 69,900 lbs. N/yr

P land applied (lb/yr) = 30,900,000 lbs manure/yr × [(0.07 lbs. N/d/1000#)/(80 lbs. manure/d/1000#)] × [(100 - 14.1)/100]
= 23,200 lbs. P/yr

Step D Nitrogen and phosphorus that will be taken up by the crops grown is:

From Table 11-6 the nitrogen and phosphorus uptake in the two crops grown at the land application site are:

Corn for grain: N = 0.80 lbs/bushel
P = 0.15 lbs/bushel

Winter Wheat: N = 1.02 lbs/bushel
P = 0.20 lbs/bushel

Crop nitrogen requirements (lbs/yr) =
Corn: 0.80 lbs N/bushel × 147 bushels/acre × 200 acres = 23,520 lbs/yr
Wheat: 1.02 lbs N/bushel × 69 bushels/acre × 200 acres = 14,076 lbs/yr

Crop phosphorus requirements (lbs/yr) =
Corn: 0.15 lbs P/bushel × 147 bushels/acre × 200 acres = 4,410 lbs/yr
Wheat: 0.20 lbs P/bushel × 69 bushels/acre × 200 acres = 2,760 lbs/yr

Step E The total annual nitrogen and phosphorus land application needs are:
Nitrogen needs = 23,520 + 14,076 = 37,600 lbs/yr
Phosphorus needs = 4,410 + 2,760 = 7,170 lbs/yr

Comparing these numbers to the amount of nitrogen and phosphorus that is currently being land applied shows that nitrogen is being applied at almost double that required.

(69,900 lbs N applied - 37,600 lbs N needed)/ 69,900 lbs N applied × 100 = 46% over application of nitrogen

(23,200 lbs P applied - 7,170 lbs P needed)/ 23,200 lbs N applied × 100 = 69% over application of phosphorus

Step F The amount of nitrogen and phosphorus that will be brought under proper management once the dairy complies with appropriate nitrogen application rates is:

69,900 lbs N currently applied - 37,600 lbs N needed = 32,300 lbs N reduction/yr.

The manure containing this excess nitrogen will be either land applied onto additional farmland or might be composted for sale.

For dairy manure the ratio of phosphorus to nitrogen (from Table 11-1) is:
(0.07 lb P/d/1000#)/(0.45 lb N/d/1000#) = 0.16

Therefore the amount of phosphorus that will be reduced is:
32,300 lbs N reduction/yr × 0.16 lbs P/lbs N = 5,168 lbs P reduction/yr.

Step G Input for ICIS is as follows:

- **Complying Action:** Implement Best Management Practices
- **Pollutant:** and **Unit:** Nitrogen and 32,300 pounds
- **Pollutant:** and **Unit:** Phosphorus and 5,168 pounds
- **Media:** Water (navigable/surface)

5.4.4 Additional Reporting Requirements for CAFO Performance Based Strategy Implementation

In order to track progress against the goals laid out in the performance-based strategy for CAFOs, we will be asking the regions to input additional data into ICIS from the CCDS form. See sample ICIS entry below:

Pollutant	Amount	Unit	Impacted Media
Nitrogen	5,000	Pounds	Water (navigable/surface)
Phosphorus	5,000	Pounds	Water (navigable/surface)
Manure	1,000	Pounds	Water (navigable/surface)
Manure Runoff	10	Stream miles	Water (streams)

5.5 Combined Sewer Overflow (CSO)

5.5.1 Background

Combined sewers collect both storm water and sanitary sewage in the same piping system. During rainfall, the sewer capacity can be exceeded and the sewer may overflow, which is known as a combined sewer overflow or CSO. Combined sewer overflows may contain contaminated stormwater along with human and industrial waste. CSOs are primarily a problem in cities with old infrastructure and are most common in the Northeast and Great Lakes Region.

EPA's CSO Control Policy (published April 19, 1994) requires communities to implement nine minimum CSO controls. In addition, EPA expects communities with a combined sewer system to develop a long-term CSO control plan that will ultimately provide for full compliance with the Clean Water Act. The nine minimum controls are:

- Proper operation and maintenance of the combined sewer system;
- Maximum use of the collection system for storage;
- Review and modification of pretreatment requirements to assure CSO impacts are minimized;
- Maximization of flow to the publicly owned treatment works (POTW) for treatment;
- Prohibition of CSOs during dry weather;
- Control of solids and floatable materials in CSOs;
- Pollution prevention;

- Public notification of CSO occurrences and impacts; and

- Monitoring of CSO impacts and the effectiveness of CSO controls.

Long-term plans must evaluate control strategies and identify control measures and should include monitoring and modeling. EPA provides guidance on developing a long term CSO control plan on the Internet at http://cfpub.epa.gov/npdes/cso/cpolicy.cfm.

Most CSO cases will involve system modifications that result in either:

- A greater amount of flow treated through the municipal treatment system;

- Additional primary treatment of CSO flows prior to discharge; or

- Specialized in-line treatment systems such as holding tanks/facilities and swirl concentrators.

The complying action that applies to system modifications (including flow reduction) is **"industrial/municipal process change"**. For cases where additional primary treatment of CSO flow occurs, the complying action that applies is **"emissions/discharge change"**. The impacted media should be identified as "**water (navigable/surface)**".

You can calculate pollutant reductions for BOD_5, COD, TSS, and nitrogen and phosphorus using information on the reduction of untreated CSO flow due to the action or information on the amount of direct discharged CSO flow that will undergo primary treatment due to the action. When available, use case specific information for flow and wastewater characterization. If flow and/or wastewater characterization data are not known the methodology and tables below can be used.

Table 5-1. Typical Pollutant Concentrations (in mg/L) by Source

Source	TSS	BOD_5	COD[a]	Total Kjeldahl Nitrogen	Total Phosphorus
Urban Stormwater Median Value (or range)	58	8.6	20-600	1.4	0.27
Combined Sewer Overflows	4-4,420 (median = 70)	4-699 (median = 40)	20-1,000 (median = 367)	0.01-16.6 (median = 1.17)	0.15-6.36 (median = 1.04)
Municipal Sewage, untreated	118-487 (median = 217)	88-451 (median = 209)	250-750	11.4-61 (median = 33)	1.3-15 7 (median = 5.8)
Municipal Sewage, treated	30	30	25-80	0.5-32 (median = 3 95)	0 07-6 (median = 1.65)

Source USEPA, Report to Congress on the Impacts and Control of CSOs and SSOs [Publication Pending] (except where noted)
a - From. Control and Treatment of Combined Sewer Overflows, P.E. Moffa, 1990.

Table 5-2. CSO Treatment Process Efficiencies (in %)

Physical Unit Process	Total Suspended Solids	BOD_5	COD	Total Kjeldahl Nitrogen	Total Phosphorus
Sedimentation					
Without chemicals	20-60	30	34	38	20
Chemically assisted	68	68	45	-	-
Swirl Regulator/ Concentrator	40-60	25-60	-	-	-
Screening					
Microstrainers	50-95	10-50	35	30	20
Drum screens	30-55	10-40	25	17	10
Rotary screens	20-35	1-30	15	10	12
Disc screens	10-45	5-20	15	-	-
Static screens	5-25	0-20	13	8	10

Source: Control and Treatment of Combined Sewer Overflows, P E Moffa, 1990.

5.5.2 Calculation Methodology

Step A Determine the volume of CSO flow that will undergo treatment due to the compliance action

This may occur as overflow reduction (e g , greater storage in the system that results in more CSO flow through the POTW) or as primary treatment of CSO at the overflow point(s)

If flow is unknown it can be estimated as follows

1) Estimate stormwater flow per year = yearly rainfall × surface area × runoff coefficient

Where the surface area is the area of the municipality that feeds the combined sewer, and The runoff coefficient is an average value for the area (e g , 0 3 for rural areas, 0 65-1 0 for urban areas)

2) Estimate the current volume of overflow per year = stormwater flow per year - extra POTW capacity above dry weather flow (this is usually 1 to 2 times the dry weather flow). This can be calculated as the POTW flow capacity above dry weather flow × the number of days per year overflows occur.

3) Estimate the volume of overflow that undergoes treatment = volume of overflow per year × 0.85

This assumes that 85% of the overflow per year will undergo treatment under the enforcement action (either as primary treatment of overflow or reduction in overflow)

Step B Determine the pollutant concentration reduction as the pollutant concentration in untreated CSO - the pollutant concentration after treatment

There are representative values that can be used to estimate CSO concentrations before and after treatment if system specific information is not available, See Table 5-1 above (This calculation does not apply to microbials)

(Continued)

Step C Determine the reduction in pollutant loading

Pollutant reduction (lbs/yr) = volume of overflow that undergoes treatment (volume/yr) × pollutant concentration reduction (mass/volume)

Step D Report the total pollutant reduction (for one year) in pounds in ICIS Identify "Water (navigable/surface) as the impacted media.

5.5.3 Example Calculation and ICIS Input

As an example, a small urban municipality with a combined sewer system has the following characteristics:

- A drainage area of 1,000 acres;
- An average annual rainfall amount of 20 inches;
- An estimated overall runoff coefficient of 0.75;
- 30 days during the year where the POTW system exceeded its flow capacity; and
- POTW capacity of 1 MGD flow above its dry weather flow.

The municipality will incorporate sewer system and POTW system upgrades to maximize the system's storage capacity during wet weather events. Therefore, the reduction in CSOs is occurring as a result of additional flow through the POTW.

Step A Stormwater flow per year = 20 inches/year × 1,000 acres × 0.75 (estimated runoff coefficient) × 1 ft/12 inches × 43,560 sq. ft./acre × 7.481 gal/1 cu. ft. × MG/1,000,000 gal = 407.3 MGY
Overflow per year = 407.3 MGY - [30 days/yr. × 1 MGD] = 377.3 MGY

Volume of overflow that undergoes treatment = 377.3 MGY × 0.85 = 320.7 MGY

Step B The system's CSO flow will go from a median untreated overflow concentration to the effluent concentrations from the POTW. Using Table 5-1 estimates for representative CSO pollutant concentrations and average treated concentrations, the reductions will be:

TSS = 70 mg/l - 30 mg/l = 40 mg/l

BOD_5 = 40 mg/l - 30 mg/l = 10 mg/l

COD = 367 mg/l - 50 mg/l = 317 mg/l

Typical POTW effluents for Total N and Total P are equal to or higher than the typical values for these pollutants in CSO. Therefore, assume in this example that no additional treatment of these pollutants will be effected.

Step C TSS reductions = 320.7 MGY × 40 mg/l × 3.785 l/gal × 1,000,000 gal/MG × g/1,000 mg × 1 lb/454 g = 106,900 lbs/year TSS

BOD_5 reductions = 320.7 MGY × 10 mg/l × 3.785 l/gal × 1,000,000 gal/MG × g/1,000 mg × 1 lb/454 g = 26,700 lbs/year BOD_5

COD reductions = 320.7 MGY × 317 mg/l × 3.785 l/gal × 1,000,000 gal/MG × g/1,000 mg × 1 lb/454 g = 847,500 lbs/year COD

Step D Input for ICIS is as follows:

- **Complying Action:** Emissions/Discharge Change
- **Pollutant:** and **Unit:** TSS and 106,900 pounds
- **Pollutant:** and **Unit:** BOD_5 and 26,700 pounds
- **Pollutant:** and **Unit:** COD and 847,500 pounds
- **Media:** Water (navigable/surface)

5.6 Sanitary Sewer Overflow (SSO)

5.6.1 Background

Properly designed, operated, and maintained sanitary sewer systems are meant to collect and transport sewage to a publicly owned treatment works (POTW). However, occasional unintentional discharges of raw sewage from municipal sanitary sewers occur. These types of discharges are called sanitary sewer overflows (SSOs) and EPA estimates that there are at least 40,000 SSOs each year. SSOs have a variety of causes, including but not limited to severe weather, damage and blockages due to grease and roots, improper system operation and maintenance leading to inflow and infiltration (I/I) problems, and vandalism. The untreated sewage from these overflows can contaminate our waters, causing serious water quality problems.

Capacity, Management, Operation, and Maintenance (CMOM) techniques as well as system rehabilitation and diagnostic methods have been shown to reduce SSO occurrences and volumes. Examples of CMOM and I/I reduction techniques include implementing central control of system maintenance (for systems that have fragmented authorities with control over pieces of the system), tracking and recording service complaints, repairing or replacing manhole structures, identifying and disconnecting un-permitted sources of storm water inflow on private property, and clarifying how to respond to system problems.

Most SSO cases will involve system upgrades and maintenance to eliminate SSOs. The complying action type that applies to these situations is **"industrial/municipal process change"** which includes municipal system changes. The impacted media should be identified as **"water (navigable/surface)"**. Pollutant reductions occur from SSO cases due to the reduction in the amount of untreated sewage that overflows. The system improvements that result from these cases eliminate overflows. Thus, the sanitary wastewater stays in the system and is treated through the municipalities POTW, receiving the appropriate secondary treatment.

The main problem in estimating pollutant reductions for SSO cases is the lack of information on the volume of SSO that occurs. Based on the information that EPA has to date, the SSO CCDS methodology will use the following assumptions when case specific information is not available:

- Unless specific quantities are know or can be determined, the annual volume of SSO can be estimated to be equivalent to 0.5 to 3% of the average daily wastewater flow to the POTW. If the average daily wastewater flow to the municipality is unknown (e.g., a satellite system), you can estimate the daily wastewater flow from the service population using a standard value of 120 gallons per capita per day.

- Assume that the case once it has been fully implemented will result in 100% SSO elimination.

You can calculate pollutant reductions for BOD_5, COD, TSS, and nitrogen and phosphorus using information on the SSO flow and wastewater characterization data. When available, use case specific information for flow and wastewater characterization. If flow and/or wastewater characterization data are not known, the methodology and Table 5-1 (pg. 5-27) can be used.

5.6.2 Calculation Methodology

Step A Determine the annual amount of sanitary sewer overflow that occurs for the municipality (in million gallons MG)

If the annual volume of SSO can be estimated by the utility, use this volume

If not and the average daily flow discharged to the POTW is known, use from 0 5 to 3% of one day's flow to estimate the volume of SSO For example, a utility with severe SSO problems and a daily flow discharge of 20 MGD would be estimated to have (0.03 × 20 MGD) = 0.6 MG of SSO annually The less severe the SSO problems or more arid the region, the lower the percentage you would use for the estimate

If the average daily flow discharged to the POTW is unknown, determine the population served by the system and multiply by 120 gallons per capita per day (gpcd) to determine an average daily flow. For example, a satellite system serving 84,000 people would generate an average daily wastewater flow of (84,000 people × 120 gpcd) = 10,080,000 gallons per day or 10.08 MGD.

Step B Determine the pollutant concentration reduction as the pollutant concentration in untreated SSO - the pollutant concentration after treatment

If the typical untreated and treated concentrations of SSO pollutants are known, use those values

If not, there are representative values that can be used to estimate untreated and treated concentrations, See Table 5-1 above. (This calculation does not apply to microbials)

Step C Determine the reduction in pollutant loading

Pollutant reduction (Pounds/yr) = Annual volume of SSO (MG/yr) x pollutant concentration reduction (mass/volume) x conversion factors

(Continued)

Step D Report the total pollutant reduction (for one year) in pounds in ICIS. Identify "Water (navigable/surface)" as the impacted media

5.6.3 Example Calculation and Input for ICIS

As an example, a small urban municipality with a POTW flow of 42 MGD will be implementing an SSO plan in response to an enforcement action. It is assumed that with full implementation of the plan, SSOs will be eliminated and all wastewater in the system will be treated through the POTW.

Step A Without case specific information on the SSO volumes, we will assume that 2% of the one day's worth of average daily POTW system flow is equivalent to the annual SSO volume.

Estimate of annual SSO volume = 42 MGD × 0.02 = 0.84 MGY

Step B The pollutant concentration reductions Using Table5-1 (for typical untreated and treated concentrations) will be:

TSS = 217 mg/l - 30 mg/l = 187 mg/l

BOD_5 = 209 mg/l - 30 mg/l = 179 mg/l

COD = 250 mg/l - 30 mg/l = 220 mg/l

Total N = 33 mg/l - 3.95 mg/l = 29.05 mg/l

Total P = 5.8 mg/l - 1.65 mg/l = 4.15 mg/l

Step C TSS reductions = 0.84 MGY × 187 mg/l × 3.785 l/gal × 1,000,000 gal/MG × g/1,000 mg × 1 lb/454 g = 1,310 lbs/year TSS

BOD_5 reductions = 0.84 MGY × 179 mg/l × 3.785 l/gal × 1,000,000 gal/MG × g/1,000 mg × 1 lb/454 g = 1,250 lbs/year BOD_5

COD reductions = 0.84 MGY × 220 mg/l × 3.785 l/gal × 1,000,000 gal/MG × g/1,000 mg × 1 lb/454 g = 1,540 lbs/year COD

Total N reductions = 0.84 MGY × 29.05 mg/l × 3.785 l/gal × 1,000,000 gal/MG × g/1,000 mg × 1 lb/454 g = 203 lbs/year Total N

Total P reductions = 0.84 MGY × 4.15 mg/l × 3.785 l/gal × 1,000,000 gal/MG × g/1,000 mg × 1 lb/454 g = 29 lbs/year Total P

Step D Input for ICIS is as follows:

- **Complying Action:** Industrial/Municipal Process Change
- **Pollutant:** and **Unit:** TSS and 1,310 pounds
- **Pollutant:** and **Unit:** BOD_5 and 1,250 pounds
- **Pollutant:** and **Unit:** COD and 1,540 pounds
- **Pollutant:** and **Unit:** Nitrogen and 203 pounds
- **Pollutant:** and **Unit:** Phosphorus and 29 pounds
- **Media:** Water (navigable/surface)

5.7 Wetlands

5.7.1 Background and Methodology

Section 404 of the CWA establishes a program to regulate the discharge of dredged fill material into waters of the U.S., including wetlands. The activities regulated under this program include fills for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry.

The purpose of the program is to ensure that alternatives, that are less damaging to the aquatic environment, are evaluated and implemented where possible. Permittees must show that they have taken steps to avoid wetland impacts where practicable, minimized potential impacts to wetlands, and provided compensation for any remaining, unavoidable impacts through activities to restore or create wetlands. The program is administered by the Army Corp of Engineers through individual or general permits and both the Army Corp of Engineers and EPA enforce the Section 404 provisions.

Enforcement actions related to CWA 404 wetland cases may include the following types of direct and FMIP complying actions:

Statute/Section Violated	Actions with Direct Environmental Benefits/Response or Corrective Action	Pollutant Name	Amount	Unit	Potential Impacted Media
CWA 404	Wetlands Mitigation (note that this includes restoration, creation, and preservation of wetlands)	Fill Material	Enter a value	Acres, or Linear feet of small stream (<10 ft. wide), Linear feet of medium stream (10-20 ft wide); Linear feet of large stream (<20 ft wide)	Water (wetlands)

Statute/Section Violated	Facility/Site Management and Information Practices (FMIP)	Pollutant Name	Amount	Unit	Potential Impacted Media
CWA 404	Permit Application	Fill Material	NA	NA	NA

Statute/Section Violated	Actions with Direct Environmental Benefits/Response or Corrective Action	Pollutant Name	Amount	Unit	Potential Impacted Media
CWA 404	SEP - Environmental Restoration	Fill Material	Enter a value	Acres	NA

For wetland mitigation efforts, you should report the acres of wetland or linear feet of stream subject to the restoration or planned for creation or preservation. Identify "**fill material**" as the pollutant and the media impacted will be "**Water (wetlands)**." Permit application actions are a facility management and information practice and should not have an environmental benefit measurement included in ICIS.

Supplemental Environmental Projects (SEPs) involving the restoration of wetlands may also occur. For these types of actions you should identify "**environmental restoration and protection**" as the category of SEP on Question 18. of the CCDS and input the acres of wetlands to be restored or mitigated under the SEP in Question 20. The pollutant to be identified in Question 20 is "**fill material**" and the media impacted will be "**Water (wetlands)**".

5.7.2 Examples and Input for ICIS

Example 1. Wetlands Restoration

For some CWA Section 404 restoration efforts, the wetland area impacted will be along a stream or river. For these types of cases you can report the environmental benefit as linear feet of stream or river restored. In the identification of units, you should indicate the size of the stream or river using the following options:

- Linear feet of small stream (defined as < 10 feet in width);
- Linear feet of medium stream (defined as 10-20 feet in width); or
- Linear feet of large stream (defined as > 20 feet in width).

For a case involving the restoration of 300 feet of wetlands along a stream bed (where the stream size is considered small) you would report in ICIS the following:

- **Complying action**: Wetlands Mitigation
- **Pollutant**: Fill Material
- **Unit**: 300 linear feet of small stream

- **Media**: Water (wetlands)

Example 2. Wetlands Creation/Preservation

For a case involving the preservation of a 10 acre wetlands area, the input to ICIS would be:

- **Complying action**: Wetlands Mitigation
- **Pollutant**: Fill Material
- **Unit**: 10 acres
- **Media**: Water (wetlands)

5.8 SDWA - PWSS

5.8.1 Background and Methodology

The Safe Drinking Water Act (SDWA) directs EPA to set requirements for the level of contaminants in drinking water, and standards by which water supply system operators must comply to meet these levels. Through the PWSS program, EPA implements and enforces drinking water standards to protect public health. EPA's Office of Ground Water and Drinking Water regulates contaminants that present health risks and can potentially occur in public drinking water supplies. EPA set National Primary Drinking Water Regulations (NPDWRs) which are legally enforceable standards that apply to public water systems. The NPDWRs set a Maximum Contaminant Level Goal (MCLG) and a Maximum Contaminant Level (MCL) for specific contaminants. MCLGs are defined as the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on health would occur and are not enforceable. MCLs are the maximum allowable concentration of the contaminant for each pollutant and are an enforceable standard. The NPDWRs contain limits for inorganic chemicals, organic chemicals, radionuclides, and microorganisms.

Contaminants listed under the microorganism section of the NPDWR include Giardia lamblia, heterotrophic plate count, Legionella, total coliforms, turbidity, and viruses. These contaminants cannot be expressed in the typical concentration units of mass per unit volume and their standards are set as a treatment technique, which is an enforceable level of technical performance which public water systems must follow to ensure control of the contaminant. Additional information on microbial pollutants and disinfection byproducts in drinking water can be found at www.epa.gov/OGWDW/mdbp/mdbp.html#regsch.

Because microbial contaminants are not measured in concentration terms, it is not possible to obtain microbial pollutant reductions in terms of pounds of pollutant reduced/eliminated or treated. Therefore, OECA is requesting that the measure of success for SDWA - PWSS cases be represented by the population impacted by the action that will receive cleaner drinking water. The unit of measure for SDWA cases is the number of people served by the system covered under the compliance action. Typical complying actions under SDWA - PWSS cases may include:

Actions with Direct Environmental Benefits/Response or Corrective Action	Implement Best Management Practices (BMPs)
Preventative Actions to Reduce Likelihood of Future Releases	Notification

Enforcement actions against public water systems that are found to have contamination and are brought back into compliance with a pollutant problem should be entered into ICIS as the direct complying action "Implement Best Management Practices (BMPs)". Enforcement actions that address public notification violations should be entered into ICIS as the preventative complying action "Notification". If an action involves both the direct and preventative complying actions, you should report into ICIS the direct complying action and indicate the population measurement only once per case. The impacted media should be identified as "Water (drinking)".

5.8.2 Example and Input for ICIS

For example, a SDWA case involving a public water utility serving a population of 20,000 people that has been cited for deficiencies in public notification and requiring implementation of BMPs to address exceedences in fecal coliform and lead would result in the following ICIS input:

- **Complying Actions**: Implementing Best Management Practices
- **Pollutant**: Lead, Fecal Coliform
- **Unit**: 20,000 People
- **Media**: Water (drinking)

5.9 SDWA - UIC

5.9.1 Background and Methodology

The SDWA (under SDWA Sections 1422/1423) established the Underground Injection Control (UIC) program to provide safeguards on underground injection operations in order to protect current and future underground sources of drinking water (USDW).

Underground injection is the technology of placing fluids underground into porous formations of rocks, through wells or other similar conveyance systems. The fluids injected may be water, wastewater, or water mixed with chemicals. Facilities across the U.S. discharge a variety of hazardous and nonhazardous fluids into more than 400,000 injection wells. Agribusiness and the chemical and petroleum industries all make use of underground injection for waste disposal.

EPA has grouped underground injection into five classes for regulatory control purposes. Each class includes wells with similar functions, and construction and operating features so that the technical requirements can be applied consistently to the class. These classes of wells include:

- **Class I** - injection or emplacement of hazardous and nonhazardous fluids (industrial and municipal wastes) into isolated formations beneath the lowermost USDW. Because they may inject hazardous waste, Class I wells are the most strictly regulated by both the CWA - UIC program and RCRA.

- **Class II** - injection of brines and other fluids associated with oil and gas production. Some Class II wells inject fluids for enhanced recovery of oil and natural gas while others inject liquid hydrocarbons that constitute our Nation's strategic fuel reserves in times of crisis.

- **Class III** - injection of superheated steam, water, or other fluids into formations to extract minerals.

- **Class IV** - injection of hazardous or radioactive wastes into or above a USDW. These wells are banned under the UIC program because they directly threaten public health.

- **Class V** - includes all other underground injection not covered under Classes I- IV. Some Class V wells my not be waste disposal wells, for example, injection of surface water to replenish depleted aquifers or to prevent salt water intrusion.

Injection wells have the potential to inject contaminants that may cause our underground sources of drinking water to become contaminated. The UIC program prevents this contamination by setting minium requirements. These requirements are designed to keep injected fluids within the well and the intended injection zone, or to require that injected fluids not cause a public water system to violate drinking water standards or otherwise adversely affect public health. These minimum requirements affect the siting of an injection well, and the construction, operation, maintenance, monitoring, testing, and ultimately closure of the well. All injection wells require authorization under general rules of specific permits.

Typical direct and FMIP complying actions under SDWA - UIC cases may include:

Statute/Section Violated	Preventative Actions to Reduce Likelihood of Future Releases	Pollutant Name	Amount	Unit	Potential Impacted Media
SDWA 1422/1423	Obtain Permit for Underground Injection (UIC)	Wastewater or see ICIS list	Number of wells	Wells	Water (Underground Source of Drinking Water (USDW))
SDWA 1422/1423	UIC Plug and Abandon	Wastewater or see ICIS list	Number of wells	Wells	Water (USDW)
SDWA 1422/1423	UIC Demonstrate Mechanical Integrity	Wastewater or see ICIS list	Number of wells	Wells	Water (USDW)

Statute/Section Violated	Facility/Site Management and Information Practices (FMIP)	Pollutant Name	Amount	Unit	Potential Impacted Media
SDWA 1422/1423	Recordkeeping	Wastewater or see ICIS list	NA	NA	NA
SDWA 1422/1423	Monitoring	Wastewater or see ICIS list	NA	NA	NA
SDWA 1422/1423	Reporting	Wastewater or see ICIS list	NA	NA	NA
SDWA 1422/1423	Financial Responsibility	Wastewater or see ICIS list	NA	NA	NA
SDWA 1422/1423	Permit Application	Wastewater or see ICIS list	NA	NA	NA

For preventive actions, you should report **the number of wells monitored or decommissioned**. For each of these types of cases the pollutant identified may be either "wastewater" or other pollutant(s) specific to the enforcement action. The media impacted will be "**Water (underground source of drinking water)**". For facility management and information practices you should identify the appropriate complying action in Question 20 but should not report an environmental benefit under Question 22 (you may identify wastewater or some other pollutant as appropriate).

5.9.2 Example and Input for ICIS:

For example, a UIC case requiring the plugging and abandonment of 10 injection wells at a mining facility with accompanying monitoring to ensure no aquifer contamination has occurred and a demonstration of financial responsibility would be reported in ICIS as follows:

- **Complying Actions**: UIC Plug and Abandon (Preventative), Financial Responsibility Requirements, Monitoring, and UST Release Detection
- **Pollutant**: Wastewater
- **Unit**: 10 wells
- **Media**: Water (underground source of drinking water)

5.10 References

U.S. EPA, February 2000. *Drinking Water: Past, Present, and Future,* EPA 816-F-00-002.

U.S. EPA, Office of Ground Water and Drinking Water, Underground Injection Control Program, www.epa.gov/safewater/uic

U.S. EPA, Office of Water, Office of Ground Water and Drinking Water, Public Drinking Water Systems Program, www.epa.gov/safewater/pws/pwss.html

U.S. EPA, Office of Water, Office of Ground Water and Drinking Water, Current Drinking Water Standards, www.epa.gov/OGWDW/mcl.html

U.S. EPA, Office of Water, Office of Science and Technology, Effluent Guidelines www.epa.gov/waterscience/guide

U.S. EPA, Office of Water, Storm Water, www.epa.gov/npdes/stormwater

U.S. EPA, Office of Wetlands, Oceans and Watersheds, Section 404 of the Clean Water Act, www.epa.gov/owow/wetlands/facts/fact10.html

U.S. EPA, Office Emergency and Remedial Response, RCRA, Superfund & EPCRA Call Center Program Areas, OPA/SPCC, www.epa.gov/epaoswer/hotline/spcc.htm

U.S. EPA, Report to Congress on the Impacts and Control of Combined Sewer Overflows (CSOs) and Sanitary Sewer Overflows (SSOs). 2003.

Letterman, Raymond D., ed., *Water Quality and Treatment: A Handbook of Community Water Supplies*, American Water Works Association, McGraw-Hill, Inc., Washington, D.C., 1999.

6.0 AIR EXAMPLES

Under the CAA the following types of enforcement cases are typical:

- 6.1 Enforcement actions against facilities that have triggered a Prevention of Significant Deterioration (PSD)/New Source Review (NSR) violation. (pg. 6-1)
- 6.2 Enforcement actions resulting from violations with a MACT/NESHAP standard. (pg. 6-9)
- 6.3 Enforcement actions impacting Leak Detection and Repair (LDAR) requirements. (pg. 6-17)

The sections below present methodologies for determining pollutant reductions and environmental benefit for typical cases involving an air media. Each section includes information on the following:

- Background;
- Calculation Methodology; and
- Example calculations and input for ICIS using specific scenarios.

Section 6.4 presents references and Websites used in developing these examples.

In addition, it should be noted that for CAA cases involving exceedences with existing air pollution standards, actual emission amounts should be used in the calculations and not potential to emit amounts.

6.1 NO_x Reductions at a Petroleum Refinery under PSD/NSR

6.1.1 Background

Emissions of NO_x at petroleum refineries are associated with refinery combustion units. Refinery boilers and process heaters are usually targeted for NO_x reductions under compliance actions. Fluidized catalytic cracking unit (FCCU) regenerators are also sources of NO_x emissions at petroleum refineries (NO_x is generated when coke is burned off of the catalyst); however, these units are typically not controlled for NO_x reductions and therefore will not be discussed further under this guidance. There are two primary types of fuel burned in the boilers and process heaters: fuel oil and gas. The gas can be either refinery fuel gas that is produced at the facility or natural gas. There are different options that facilities may use to reduce NO_x emissions depending on the unit and fuel type.

The primary reduction techniques for boilers and process heaters can be classified into one of three fundamentally different methods — combustion controls, post-combustion controls, and fuel switching. Combustion controls reduce NO_x by suppressing NO_x formation during the combustion process while post-combustion controls reduce NO_x emissions after their formation.

Combustion controls are the most widely used method of controlling NO_x formation in all types of boilers and process heaters and include:

- Low excess air;
- Burners out of service;
- Biased-burner firing;
- Flue gas recirculation;
- Overfire air; and
- Low-NO_x burners.

Post-combustion control methods include selective noncatalytic reduction (SNCR) and selective catalytic reduction (SCR). These controls can be used separately, or combined to achieve greater NO_x reduction. For enforcement actions where combustion control technologies will be implemented, the complying action is **"emission/discharge change"**. Fuel switching replaces one type of fuel with another and can also be combined with other controls to achieved greater NO_x reduction. For actions that will implement fuel switching you should identify the complying action **"source reduction"**. For each of these complying action types the typical units reported are "tons" or "pounds" and the media impacted is "air".

Combustion Techniques (FGR and Low NO_x Burners)

Currently, the two most prevalent combustion control techniques used to reduce NO_x emissions are flue gas recirculation (FGR) and low NO_x burners. In an FGR system, a portion of the flue gas is recycled from the stack to the burner windbox. Upon entering the windbox, the recirculated gas is mixed with combustion air prior to being fed to the burner. The recycled flue gas consists of combustion products which act as inerts during combustion of the fuel/air mixture. The FGR system reduces NO_x emissions by two mechanisms. Primarily, the recirculated gas acts as a diluent to reduce combustion temperatures, thus suppressing the thermal NO_x mechanism. To a lesser extent, FGR also reduces NO_x formation by lowering the oxygen concentration in the primary flame zone.

Low NO_x burners reduce NO_x by accomplishing the combustion process in stages. Staging partially delays the combustion process, resulting in a cooler flame which suppresses thermal NO_x formation. The two most common types of low NO_x burners being applied are staged air burners and staged fuel burners. NO_x emission reductions of 40 to 85 percent (relative to uncontrolled emission levels) have been observed with low NO_x burners. When low NO_x burners and FGR are used in combination, these techniques are capable of reducing NO_x emissions by 60 to 90 percent.

Post-Combustion Technologies

Two post-combustion technologies that may be applied to natural gas-fired boilers to reduce NO_x emissions are selective noncatalytic reduction (SNCR) and selective catalytic reduction (SCR). The SNCR system injects ammonia or urea into combustion flue gases (in a specific temperature zone) to reduce NO_x emission. In many situations, a boiler or process heater may have an SNCR system installed to trim NO_x emissions to meet permitted levels. In these cases, the SNCR system may not be operated to achieve maximum NO_x reduction. The SCR system involves injecting NH into the flue gas in the presence of a catalyst to reduce NO_x emissions.

Fuel Switching

Fuel switching may be used to reduce NO_x emissions. For certain boiler and process heater units, it may be possible for the facility to switch from fuel oil combustion to natural gas combustion. This switch in fuels can result in reduced NO_x emissions.

6.1.2 Calculation Methodology

There are essentially two methods to calculate NO_x reductions from process heaters and boilers:

1. Calculate emissions for the unit using emission factors representing the pre-compliance and post-compliance conditions (e.g., uncontrolled and controlled scenario; or, emissions from fuel oil burning versus emission from refinery fuel gas switching). Subtract the post-compliance estimate from the pre-compliance estimate to determine the reductions.

2. Calculate emissions for the pre-compliance condition (e.g., uncontrolled) using emission factors. Multiply a NO_x control efficiency to the pre-compliance emission estimate that represents the control strategy that is or will be used by the facility to come into compliance (e.g., the control efficiency for a low-NO_x burner). The estimated reduction is equal to the amount of NO_x emissions controlled.

Published emission factors and control efficiencies are available for process heaters and boilers by fuel type and size or rated heat input of the unit. It is important to note that there are no published emission factors or control efficiencies specific to the use of 'refinery fuel gas'. Factors are available for the combustion of natural gas. In situations where refinery gas is being used as a fuel, the emissions reductions should be calculated using the emission factors or control efficiencies that are published for natural gas combustion in boilers and process heaters. The exception to this case would be if the facility provides emission factors specific to the refinery fuel gas being used at that facility.

The following steps should be followed to calculate NO_x emission reductions for boilers and process heaters at petroleum refineries. **Note: The steps should be followed to calculate emission reductions for each unit that is affected by the compliance measures and total reductions should be summed for all affected units to estimate a total reduction quantity for the compliance action.** Table 6-1 (following the examples) presents a worksheet that shows how to compile the information in order to calculate emission reductions (the field names in Table 6-1 are coded to the items listed in the methodology below):

Calculation Methodology for NO_x Reductions from Boilers and Process Heaters

Step A Determine the operating conditions of the unit under non-compliance conditions

Step B Determine the reduction strategy for the affected unit.

Step C If the affected unit is a boiler, locate the emission factor in Table 1.3-1 or Table 1.4-1 of AP-42 (EPA, 1995) that best matches the pre-compliance condition (e.g., uncontrolled). If the affected unit is a process heater, locate the emission factor from Tables 5-11 to 5-15 of the *Alternative Control Techniques Document - NO_x Emissions from Process Heaters* (EPA, 1993) that best matches the pre-compliance condition. Table 6-1 shows examples for a boiler unit (B1) and process heaters (PH1, PH2) ***Note: Section 11.0 of this guidance provides selected tables from these references.***

Step D If the affected unit is a boiler, locate the emission factor in Table 1.3-1 or Table 1.4-1 of AP-42 that best matches the post-compliance condition (e.g., unit controlled with low NO_x burners) If the affected unit is a process heater, locate the emission factor from Tables 5-11 to 5-15 of the *Alternative Control Techniques Document - NO_x Emissions from Process Heaters* that best matches the post-compliance (i.e., controlled) condition Table 6-1 shows examples for a boiler unit (B1) and process heaters (PH1, PH2) ***NOTE: if an emission factor that represents the reduction strategy cannot be located in the referenced tables, then skip to step "E" below.***

Step E If emission factors representing emission reduction strategies are not available, it is also possible to calculate emission reductions based on estimated control efficiencies In these cases, refer to Table 12.3-1 of Volume II, Chapter 12 of the EIIP document series located at http://www.epa.gov/ttn/chief/eiip/techreport/volume02/ii12/pdf Locate the control efficiency that best matches the reduction strategy used for compliance and use the value in Table 6-1, Column E.

Step F If the unit is a process heater, enter the annual heat input for the affected unit for which emission reductions are being estimated
[Conversion factors to go from a volume basis to an energy basis are provided in Table 6-1]

Step G If the unit is a boiler, enter the annual quantity of fuel burned
[If the fuel burned is fuel oil use units of 1×10^3 gallons; if the fuel burned is natural gas use units of 1×10^6 scf Conversion factors to go from a volume basis to an energy basis are provided in Table 6-1]

Step H Multiply the emission factor (from Column C) for the pre-compliance scenario by either the heat input value (from Column F for process heaters) or the fuel burned (from Column G for boilers) and enter the emission estimate in Column H.

Step I Multiply the emission factor for the post-compliance scenario (Column D) by either the heat input value (Column F for process heaters) or the fuel burned (Column G for boilers) and enter the emission estimate in Column I. If an emission factor was not available for the control device adopted by the facility to come into compliance, then skip to step K below See example calculation below.

Step J Subtract Column I from Column H and enter the quantity of NO_x emissions reduced for the unit. *Note*

Step K Multiply the pre-compliance estimate in Column H by the control efficiency in Column E and enter the quantity of NO_x emissions reduced for the unit.

Step L Report the total pollutant reduction in pounds in ICIS. Identify "Air" as the impacted media.

6.1.3 Example Calculations and Input for ICIS

The following examples demonstrate how emission reductions can be calculated for a petroleum refining facility. The input data to perform the reduction calculation have been entered onto the worksheet in Table 6-1 to illustrate how the worksheet can be used.

Example 1.

ABC Oil Company has a facility that added a new gas-fired boiler and 2 gas-fired process heaters (both are natural draft [ND] heaters) in order to increase its production. The boiler and process heaters were installed with no controls. In operating the new units, the facility increased its NO_x emissions by more than 40 tons per year, and thus triggered PSD/NSR, falling out of compliance with Prevention of Significant Deterioration (PSD) requirements for their NO_x emissions cap. Following an administrative order, the facility agrees to add control devices to the new boiler and process heater units in order to reduce NO_x emissions. The facility agrees to use a low-NO_x burner (LNB) and flue-gas recirculation (FGR) on the boiler unit and to retrofit the two new process heaters with ultra low-NO_x burners (ULNB). The annual quantity of fuel burned in the boiler is 687×10^6 scf. The annual quantity of heat input into the process heaters is 1.0×10^6 MMBtu each.

The worksheet in Table 6-1 is used to calculate emissions for the boiler (B1) and the process heaters (PH1 and PH2) based on uncontrolled conditions (pre-compliance) and also with controls installed (post-compliance). The calculations of reductions follow the steps outlined in Section 6.1.2.

For Boiler 1:

Pre-compliance NO_x emissions (Column H)	=	annual quantity of fuel burned (Column G) × pre-compliance emission factor (Column C)
	=	687×10^6 scf/yr × 100 lb/10^6 scf
	=	68,700 lb/yr
	=	34 ton/yr
Post compliance NO_x emissions (Column I)	=	Annual quantity of fuel burned (Column G) × post-compliance emission factor (Column D)
	=	687×10^6 scf/yr × 32 lb/10^6 scf
	=	21,984 lb/yr
	=	11 ton/yr
Annual NO_x reduction (Column J)	=	Pre-compliance emissions - post-compliance emissions
	=	34 ton/yr - 11 ton/yr
	=	23 ton/yr

For Process Heaters 1 and 2:

Pre-compliance NO_x emissions (Column H)	=	Annual heat input (Column F) × pre-compliance emission factor (Column C)
	=	1.0×10^6 MMBtu/yr × 0.098 lb/MMBtu
	=	98,000 lb/yr
	=	49 ton/yr

Post-compliance NO_x emissions (Column I)	=	Annual heat input (Column F) × post-compliance emission factor (Column D)
	=	1.0×10^6 MMBtu/yr × 0.025 lb/ MMBtu
	=	25,000 lb/yr
	=	12.5 ton/yr

Annual NO_x reduction (Column J)	=	Pre-compliance emissions - post-compliance emissions
	=	49 ton/yr - 12.5 ton/yr
	=	36.5 ton/yr

The total reductions for the facility based on its compliance actions equals the sum of the reductions for all three units on which controls were installed. The total reductions for NO_x are equal to 192,000 pounds per year.

Total NO_x Reduction	=	B1 reduction + PH 1 reduction + PH 2 reduction
	=	23 ton/yr + 36.5 ton/yr + 36.5 ton/yr
	=	96 ton/yr or 192,000 pounds/yr

Input for ICIS:

- **Complying action:** Emissions/Discharge Change
- **Pollutant:** NO_x
- **Unit:** 192,000 pounds
- **Media:** Air

Example 2.

XYZ Refining Company has decided that to come into compliance with its PSD requirements it will switch from using No. 6 fuel oil in its utility boiler to using No. 2 fuel oil, and in addition, will install low-NO_x burners with flue gas recirculation. The utility boiler is rated at 250 MMbtu/hr heat input and has a normal firing configuration prior to compliance action. The annual quantity of fuel burned in the utility boiler is $11,680 \times 10^3$ gallons. The worksheet in Table 6-1 is used to calculate emissions for the utility boiler (UB1) based on uncontrolled conditions (pre-compliance) and after the fuel switch and control device additions are made (post-compliance). The NO_x reductions achieved represent the difference between the pre-compliance and post-compliance estimates, which in this case is estimated to be 216 tons.

Pre-compliance NO_x emissions (Column H) =	Annual fuel burned (Column G) × pre-compliance emission factor (Column C) = $11{,}680 \times 10^3$ gal/yr × 47 lb/ 10^3 gal = 548,960 lb/yr = 274 ton/yr
Post-compliance NO_x emissions (Column I) =	Annual fuel burned (Column G) × post-compliance emission factor (Column D) = $11{,}680 \times 10^3$ gal/yr × 10 lb/10^3 gal = 116,800 lb/yr = 58 ton/yr
Total annual NO_x reduction	= Pre-compliance emissions - post-compliance emissions = 274 ton/yr - 58 ton/yr = 216 ton/yr or 432,000 pounds/yr

Input for ICIS:

- **Complying action:** Source reduction and Emissions/Discharge Change
- **Pollutant:** NO_x
- **Unit:** 432,000 pounds
- **Media:** Air

Table 6-1. Worksheet to Calculate NO_x Emission Reductions from Process Heaters and Boilers

Unit ID	Pre-compliance condition (A)[a]	Reduction Strategy (B)[a]	Pre-compliance emission factor ©)	Post-compliance emission factor (D)	NO_x Control Efficiency (E)	Annual heat input (F)[a]	Annual fuel burned (G)[a]	Pre-compliance emission estimate (H)	Post-compliance emission estimate (I)	NO_x emissions reduced (factor based) (J)	NO_x emissions reduced (CE based) (K)
B 1	no control	LNB + FGR	100 lb/10^6 scf	32 lb/10^6 scf	NA		687 × 10^6 scf	34 tons NO_x	11 tons NO_x	23 tons NO_x	NA
PH 1	no control	ULNB	098 lb/MMBtu	025 lb/MMBtu	NA	1 0 x10^6 MMBtu		49 tons NO_x	12 5 tons NO_x	36 5 tons NO_x	NA
PH 2	no control	ULNB	098 lb/MMBtu	025 lb/MMBtu	NA	1 0 x10^6 MMBtu		49 tons NO_x	12 5 tons NO_x	36.5 tons NO_x	NA
UB1	no control	Fuel switch + LNB + FGR	47 lb/10^3 gal	10 lb/10^3 gal	NA		11680 × 10^3 gal	274 tons. NO_x	58 tons NO_x	216 tons NO_x	NA

a - Information known from the case file
2000 pounds = 1 ton

Conversion factors to convert energy values (Million BTU or MMBtu) to volume values for fuels used in process heaters and boilers

For gas, use the natural gas heating value of 1,020 MMBtu/10^6 scf
For fuel oil, use a heating value of 150 MMBtu/10^3 gal for Nos 4, 5, 6, and residual fuel oil. and 140 MMBtu/10^3 gal for No 2 and distillate fuel oil

B1 = boiler # 1 from example calculation 1
PH1 = process heater # 1 from example calculation 1
PH2 = process heater # 2 from example calculation 1
UB1 = utility boiler #1 from example calculation 2
LNB = low NO_x burner
FGR = flue-gas recirculation
ULNB = ultra low-NO_x burner

6.2 SO_2 and HAP Reductions at a Kraft Pulp and Paper Mill Under MACT

6.2.1 Background

In the kraft pulping process, wood is digested under elevated temperature and pressure using a cooking liquor of sodium hydroxide and sodium sulfide. The digester contents are separated by the pulp washing system into a pulp slurry and spent cooking liquor. The pulp slurry is sent to subsequent processing and conditioning equipment (e.g., screening, oxygen delignification, bleaching) and the spent cooking liquor is concentrated in the evaporator system and then fired in the chemical recovery boiler. The inorganic cooking chemicals, recovered as smelt from the boiler furnace floor, are sent to the recausticizing area to be used in preparing fresh cooking liquor. The kraft pulping process also produces several byproducts (tall oil, turpentine) that are usually recovered onsite.

Air toxics (hazardous air pollutants or HAPs) and total reduced sulfur (TRS) compounds are formed in the wood digestion process and pulp treatment processes (e.g., oxygen delignification, chemical bleaching) and are emitted from discrete process vents and open equipment throughout the process. The emission points at a typical kraft pulp and paper mill include vents from the following systems: digester, evaporator, turpentine recovery, pulp washing, screening, knotter, decker, oxygen delignification, and chemical bleaching. Most mills tend to reuse or recycle process condensates in an effort to reduce fresh water consumption. Process equipment that uses recycled condensates typically has higher emissions than the same piece of equipment using fresh water due to the volatilization of pollutants in the process condensates.

Sulfur dioxide (SO_2) emissions at kraft pulp and paper mills are generated by the combustion of sulfur-containing fuels (black liquor and fossil fuels) and by the combustion of pulping vent gases that contain TRS compounds. Lime kilns, which convert calcium carbonate to quick lime for use in liquor preparation, are generally not considered significant sources of SO_2 emission at kraft mills since the exhaust gases are usually passed through a wet scrubber to remove particulate matter, which in turn also reduces SO_2 emissions.

The recovery boiler is the heart of the kraft chemical pulping process. During normal operation, spent cooking liquor (black liquor) from the evaporator system is burned in the chemical recovery boiler (fuel oil or natural gas may be burned during periods of start-up and shutdown). The organic content of the black liquor is oxidized to generate process steam and the inorganic cooking chemicals are recovered as smelt from the furnace bed. Some of the sulfur contained in the black liquor is reduced in the furnace bed and exits the boiler with the smelt. The remaining sulfur is oxidized in the upper furnace. The SO_2 emissions from the recovery boiler are determined by the relative amounts of sodium and sulfur volatilized during black liquor combustion.

The generation of black liquor is directly related to pulp production, therefore, any increases in pulp production necessitates an increase in black liquor firing rate with an associated increase in SO_2 emissions. In some cases, the recovery boiler has sufficient excess capacity to handle pulp production increases. However, if the pulp production capacity is greater than the available recovery capacity, then the boiler must be modified to handle the increase in black liquor throughput.

Although the chemical recovery boiler is the primary source of process steam in the mill, fossil fuels and wood waste are fired in power boilers at pulp and paper mills to generate additional process steam and electricity. Sulfur dioxide emissions generated by burning a given fuel are proportional to the heat input rate of the boiler. An increase in heat input rate, either due to modification of an existing boiler or addition of a new boiler, translates to an increase in SO_2 emissions.

Control Techniques

Air Toxic Emissions

Air toxic emissions from regulated pulping process vents are almost exclusively controlled using mill combustion sources (e.g., power boilers, lime kilns) or using dedicated thermal oxidizers. Reductions in HAP emissions can also be achieved by replacing higher-emitting process equipment with lower-emitting ones. For example, HAP emissions from the pulp washing system could be reduced by replacing the rotary vacuum drum washers with diffusion washers.

Sulfur Dioxide Emissions

The strategy for reducing SO_2 emissions is dependent on the source of sulfur (i.e., fuel or pulping process vent gases). For sources of emissions associated with fuel combustion, emission reductions can be achieved through physical process modifications and fuel switching. However, for chemical recovery boilers, fuel switching is only an option during periods of start-up and shutdown. For sources of SO_2 emissions associated with pulping process vent gas combustion, emission reductions can be achieved by treating the inlet gas to remove TRS compounds prior to combustion or by treating the outlet gas to remove SO_2 directly. This type of gas treatment is typically accomplished using a gas scrubber with caustic scrubbing media (sodium hydroxide or fresh (white) cooking liquor).

Process Modifications

Process modifications are the most prevalent control techniques used to reduce SO_2 emissions from chemical recovery boilers. Sulfur dioxide emissions are influenced by the temperature in the lower furnace area and can be nearly zero for boilers that have been modified to operate with a hotter lower furnace. Sulfur dioxide emissions can also be reduced by using sulfur-free chemicals, such as caustic soda (NaOH) and soda ash (Na_2CO_3), instead of saltcake (Na_2SO_4) to makeup sodium lost in the chemical recovery process.

Fuel Switching

Fuel switching can reduce SO_2 emissions from power (and recovery boilers during start up/shutdown), if a fuel with a lower sulfur content can be used. For example, a boiler burning coal or distillate oil, natural gas would be a candidate for fuel switching. However, fuel switching would not be feasible for a boiler firing natural gas since a fuel with a lower sulfur content is not available.

Gas Treatment

At some mills, the pulping process vent gases are routed through a scrubber (typically using white cooking liquor or caustic solution as the scrubbing media) to absorb sulfur compounds prior to combustion. This type of pretreatment is usually limited to dedicated thermal oxidizers. Due to the large volume of gas associated with recovery and power boilers, treatment of inlet and outlet gases to remove TRS (or SO_2 after combustion) is usually cost prohibitive.

Based on these control technologies, the typical types of direct complying actions applicable to SO_2 and HAP reduction, elimination, and treatment would include, **"source reduction"**, **"industrial/municipal process change"**, and/or **"emission/discharge change"**.

6.2.2 Calculation Methodology

The preferred method for calculating emission reductions associated with an add-on control technology or with process modifications is to use approved test data for the period before and after the emission reduction was achieved. For some process modifications, such as modifications to the heat recovery sections of recovery boilers, test data may be the only method for calculating emission reductions since reliable emission factors are not generally available. However, if approved test data are not available, as in most cases, then emission factors and control technology/treatment device efficiencies must be used to estimate emission reductions.

As discussed in Section 6.2.1, emissions from noncombustion and combustion sources at kraft pulp mills are either directly or indirectly a function of the pulp production rate. Consequently, site-specific process data (e.g., pulp production rate, fuel firing rate, operating schedule) are necessary to estimate reductions using emission factors.

Emission factors for characterizing HAP and TRS emissions are typically in units of mass of pollutant per mass of pulp production and are available from EPA documents (AP-42, Pulp and Paper NESHAP emission factor document). Emission factors are also available from industry reports and publications. Sulfur dioxide emission factors for fuel combustion are typically given in mass of pollutant per unit of fuel usage. AP-42 contains emission factors for various boiler configurations and fuels firing combinations. Process data (e.g., pulp production rate, operating schedule) should be obtained from mill documents or mill personnel. The efficiencies of control technologies or devices can be found in the EPA's Emission Inventory Improvement Program (EIIP), Volume II, Chapter 12, *How To Incorporate the Effects of Air Pollution Control Device Efficiencies and Malfunctions into Emission Inventory Estimates* located at http://www.epa.gov/ttn/chief/eiip/techreport/volume02/ii12.pdf. ***Note: Section 11.0 of this guidance provides selected tables from the references mentioned in this section.***

To estimate the reduction in SO_2 emissions achieved by fuel switching, the following calculation steps should be used:

Step A	Gather process parameters for power boiler no 1.
Step B	Find appropriate SO_2 emission factors for no. 6 fuel oil and natural gas for power boiler no 1
Step C	Determine the maximum amount of no. 6 fuel oil burned per year in the boiler.
Step D	Determine the equivalent amount of natural gas burned per year in the boiler
Step E	Calculate the SO_2 emissions from firing no. 6 fuel oil for the boiler
Step F	Calculate the SO_2 emissions from firing natural gas for the boiler.
Step G	Subtract the SO_2 emissions from natural gas firing from the SO_2 emissions from no. 6 fuel oil firing to estimate emission reductions.
Step H	Report the total pollutant reduction in pounds in ICIS Identify "Air" as the impacted media.

To estimate the reduction in HAP emissions achieved by an add-on control device, the following calculation steps should be used:

Step A	Gather process parameters for the pulp washing system.
Step B	Find an appropriate HAP emission factor for the pulp washing system
Step C	Determine the uncontrolled HAP emissions from the pulp washing system.
Step D	Determine the control efficiency of the add-on control device
Step E	Calculate the HAP emission reduction by multiplying the control efficiency of the add-on device by the uncontrolled emissions from the pulp washing system.
Step F	Report the total pollutant reduction in pounds in ICIS. Identify "Air" as the impacted media

6.2.3 Example Calculations and Input for ICIS

The following examples demonstrate how HAP and SO_2 emission reductions can be calculated from emission sources at a kraft pulp and paper mill. In these examples, the data (emission factors, process parameter, and control device efficiencies) are arranged such that the specific units (MMBtu/hr, lb/ton, lb removed/100 pounds at inlet) in the numerator and denominator of the data can be canceled out. This approach is used to help ensure that conversion errors are not introduced into the emission reduction calculations.

Example 1. Sulfur Dioxide Emission Reductions Using Fuel Switching

Under a Prevention of Significant Deterioration (PSD) violation, ABC Paper Company was found to have significantly increased pulp production. The increase in pulp production resulted in an increase in SO_2 emissions from the recovery furnace due to increased firing of black liquor. Since the cost of an add-on control device for reducing SO_2 emissions was determined to be cost-prohibitive, the mill is planning to offset the SO_2 emissions increase from the recovery boiler by reducing SO_2 emissions from the mill's power boiler.

To achieve the required SO_2 emission reduction, the mill plans to switch from burning no. 6 oil to natural gas in the power boiler. The mill currently has one no. 6 fuel oil-fired power boiler with maximum heat input rate of 250 million British thermal units per hour (MMBtu/hr). The boiler uses low-NO_x burners and has a maximum operating schedule of 8,760 hours per year.

Step A In calculating emissions from the power boiler, the following process parameters are needed:

- Maximum heat input rate (MMBtu/hr);
- Fuels fired;
- Type of burners used; and
- Boiler operating hours.

From the information provided in Example 1, the following information is obtained:

- Maximum heat input rate of power boiler no. 1 = 250 MMBtu/hr;
- No. 6 fuel oil is fired;
- The boiler uses low-NO_x burners; and
- The boiler operates a maximum of 8,760 hours per year.

Step B Once the boiler process parameters have been identified, appropriate SO_2 emissions factors for no. 6 fuel oil and natural gas firing can be found in Sections 1.3 and 1.4, respectively, of EPA's AP-42. For the boiler and fuel type, the following emission factors were selected from Tables 1.3-1 and 1.4-1:

no. 6 fuel oil firing = 157(S) lb/1,000 gallons
where S = the percent sulfur in no. 6 fuel oil; and
natural gas firing = 0.6 lb/scf of natural gas

For the fuel oil emission factor, the percent sulfur content of the fuel oil is needed before the emission factor can be used. Appendix A of AP-42 (Miscellaneous Data and Conversion Factors) contains average fuel characteristics that can be used in lieu of more specific information (e.g., vendor specifications for percent sulfur). For this calculation, the percent sulfur in fuel oil was selected as 0.5 percent. Therefore, the SO_2 emission factor for fuel oil is calculated as follows:

$$157(0.5) = 78.5 \text{ lb/1,000 gallon fuel oil}$$

Step C The maximum amount of no. 6 fuel oil burned in the boiler is determined using the maximum heat input rate, the heat content of no. 6 fuel oil, and the operating schedule. Since the heat content of no. 6 fuel oil was not provided by the mill, an average value of 140,000 Btu/gallon (for distillate oil) was selected from Appendix A of AP-42.

To determine the maximum amount of no. 6 fuel oil burned in the boiler, the following unit conversion is used:

$$\frac{\text{MMBtu}}{\text{hr}} \times \frac{1{,}000{,}000 \text{ Btu}}{\text{MMBtu}} \times \frac{\text{hrs}}{\text{yr}} \times \frac{\text{gallon no.6 oil}}{140{,}000 \text{ Btu}}$$

For power boiler no. 1, the above unit conversion is calculated as follows:

$$\frac{250 \text{ MMBtu}}{\text{hr}} \times \frac{10^6 \text{ Btu}}{\text{MMBtu}} \times \frac{8760 \text{ hr}}{\text{yr}} \times \frac{1 \text{ gal}}{140{,}000 \text{ Btu}} = \frac{1.56 \times 10^7 \text{ gal}}{\text{yr}}$$

Step D Once the maximum amount of no. 6 fuel oil burned for the boiler is determined, an amount of natural gas that is equivalent to the quantity of no. 6 fuel oil is needed. To determine the equivalent amount of natural gas burned per year in the boiler, a unit conversion similar to that used in Step 3 is followed:

$$\frac{\text{MMBtu}}{\text{hr}} \times \frac{1{,}000{,}000 \text{ Btu}}{\text{MMBtu}} \times \frac{\text{hr}}{\text{yr}} \times \frac{\text{scf natural gal}}{1{,}050 \text{ Btu}}$$

For power boiler no. 1, the above unit conversion is calculated as follows:

$$\frac{250 \text{ MMBtu}}{\text{hr}} \times \frac{10^6 \text{ Btu}}{\text{MMBtu}} \times \frac{8{,}760 \text{ hr}}{\text{yr}} \times \frac{1 \text{ scf}}{1{,}050 \text{ Btu}} = \frac{2.09 \times 10^9 \text{ scf}}{\text{yr}}$$

Step E The SO_2 emissions from firing no. 6 fuel oil in power boiler no. 1 are calculated using the appropriate emission factor determined in Step 2 and the maximum amount of fuel oil burned, determined in Step 3, as follows:

$$\frac{78.5 \text{ lb } SO_2}{1{,}000 \text{ gal fuel oil}} \times \frac{1.56 \times 10^7 \text{ gal}}{\text{yr}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lb}} = 613.98 \text{ tons } SO_2/\text{yr}$$

Step F Similarly to the procedures in Step E, the SO_2 emissions from natural gas firing in power boiler no. 1 are calculated as follows:

$$\frac{0.6 \text{ lb}}{10^6 \text{ scf}} \times \frac{2.09 \times 10^9 \text{ scf}}{\text{yr}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lb}} = 0.63 \text{ tons } SO_2/\text{yr}$$

Step G The emission reduction achieved by switching from no. 6 fuel oil to natural gas for the power boiler is determined by subtracting the SO_2 emissions determined in Step 6 from the SO_2 emissions determined in Step 5.

Power boiler no. 1 emission reduction = 613.98 - 0.63 = 613.35 tons SO_2/yr or 1,226,700 pounds SO_2/yr.

Step H Input for ICIS

- **Complying Action:** Source Reduction
- **Pollutant:** SO_2
- **Unit:** 1,226,700 pounds
- **Media:** Air

Example 2. Air Toxic Emission Reduction Using an Add-on Control Device

As a result of an enforcement action, a kraft mill subject to the pulp and paper NESHAP must control their emissions from their brown stock washing system (all other subject vents at the mill are currently controlled). Because the distance between the pulp washing system and the existing power boilers is too great, the mill decides to control the pulp washing system emissions using a dedicated thermal oxidizer meeting the design parameters specified in the NESHAP.

The pulp production rate of the mill is 1,200 air-dried tons of pulp per day (ADTPD). The pulp washing system is a diffusion washer (i.e., low-air flow design) that uses fresh water as wash water.

Step A In calculating uncontrolled HAP emissions from a pulp washing system, the following process parameters are needed:

- Type of pulp washing system (e.g., rotary vacuum drum);
- HAP concentration of washed water used; and
- Pulp production rate.

From the information provided in Example 2, the following information is obtained:

- Type of pulp washing system = diffusion washer (low-air flow design);
- HAP concentration of washed water = negligible; and
- Pulp production rate = 1,200 ADTPD.

Step B The Chemical Pulping Emission Factor Development Document (Revised Draft) prepared by the EPA for the pulp and paper NESHAP (40 CFR part 63 subpart S) contains HAP emission factors for kraft pulp mills. In Table 1-1 of the emission factor document, HAP emissions are presented for an example (1,000 tons oven-dried pulp per day, ODTPD). For low air flow washers, the HAP emissions for the example mill in the emission factor document are given as 20 megagrams per year (Mg/yr). Dividing the HAP emissions by the example mill production yields (1,000 tons air-dried pulp per day) and an assumed operating schedule of 365 days per year, a HAP emission factor of 5.48E-05 Mg/ODT is obtained.

Step C Once an appropriate HAP emission factor for the pulp washing system has been obtained, uncontrolled emissions can be estimated by multiplying the mill pulp production rate by the HAP emission factor. However, in this example, the pulp production rate is given in terms of **air**-dried tons and the emission factor is in terms of **oven**-dried tons. To properly use the HAP emission factor, the pulp production rate must be converted to oven-dried tons using the following relationship:

1 air-dried ton of pulp = 0.9 oven-dried ton of pulp

This relationship is developed based on the industry standard that an air-dried ton of pulp contains 10 percent moisture. Using the above conversion, the ADTPD pulp production rate in this example is converted to ODTPD using the following calculation:

$$\frac{1{,}200 \text{ air-dried tons}}{\text{day}} \times \frac{0.9 \text{ oven-dried ton}}{1 \text{ air-dried ton}} = 1{,}080 \text{ ODTPD}$$

The uncontrolled HAP emissions from the pulp washing system can now be estimated by multiplying the mill pulp production rate by the HAP emission factor as follows:

$$\frac{5.48 \times 10^{-5} \text{ Mg HAP}}{\text{ODTP}} \times \frac{1{,}080 \text{ ODTP}}{\text{day}} \times \frac{365 \text{ days}}{\text{yr}} = \frac{21.60 \text{ Mg HAP}}{\text{yr}}$$

Step D The pulp and paper NESHAP provides several control options for reducing HAP emissions from pulping process vents. The control options, of which the design thermal oxidizer is an alternative, are intended to achieve at least 98 percent destruction of HAP emissions. Therefore, it is appropriate to assume that the control efficiency of the thermal oxidizer in this example is 98 percent.

Step E Once an appropriate efficiency for the add-on control device is obtained, the HAP emission reduction for the pulp washing system is calculated by multiplying the control device efficiency by the uncontrolled HAP emissions as follows:

$$\frac{21.6 \text{ Mg HAP at thermal oxidizer inlet}}{\text{yr}} \times \frac{98 \text{ Mg Reduced}}{100 \text{ Mg at thermal oxidizer inlet}} = \frac{21.17 \text{ Mg HAP reduced}}{\text{yr}}$$

This metric value can be converted to English units using the following conversion:

$$\frac{21.17 \text{ Mg HAP Reduced}}{\text{yr}} \times \frac{1000 \text{ kg}}{\text{Mg}} \times \frac{1 \text{ lb}}{0.454 \text{ kg}} = \frac{46{,}630 \text{ pounds HAP Reduced}}{\text{yr}}$$

Step F Input for ICIS

- **Complying Action:** Emissions/Discharge Change
- **Pollutant:** HAP
- **Unit:** 46,630 pounds
- **Media:** Air

6.3 Leak Detection and Repair

6.3.1 Background

Under the Clean Air Act, fugitive emissions from a variety of equipment, including pumps, valves, flanges, connectors, and compressors, are to be controlled through the implementation of a Leak Detection and Repair program (LDAR). Through this program, equipment must be routinely monitored for leaks and if a leak is found, it must be repaired. If equipment leaks go undetected, fugitive emissions of volatile organic compounds (VOCs) and other hazardous chemicals will be emitted continually into the atmosphere. These emissions have a number of adverse effects such as contributing to smog and human health problems. The types of complying actions that apply to LDAR cases include **"Leak Detection"** to address the monitoring and leak detection aspects of the enforcement action and **"Leak Repair"** to address the process piping repair.

Once a LDAR program has been implemented and a leak has been identified, emissions from a particular piece of equipment can be estimated using the EPA correlation equation approach. This method involves obtaining screening values (from a portable organic vapor analyzer) before and after the leak was repaired. Using these values, a calculation can be performed to determine the resulting reduction in emissions. If screening data is available, but as "greater than or equal to 10,000 ppmv" or "less than or equal to 10,000 ppmv," screening ranges should be used.

6.3.2 Calculation Methodology

To estimate LDAR pollutant reductions according to the EPA correlation equation method, you need:

- The equipment screening value (ppmv) before the repair;
- The equipment screening value (ppmv) after the repair;
- The hours of operation (hr/yr);
- The pollutant concentration (weight percent) within the equipment; and
- The Total Organic Carbon (TOC) concentration (weight percent) within the equipment.

The EPA correlation equation approach involves the use of a unit and site-specific correlation equation. These correlation equations have been developed for organic chemical manufacturing

(SOCMI) process units and for the petroleum industry and can be found in the document entitled, *Protocol for Equipment Leak Emission Estimates* (EPA, Nov. 95). Table 6-2 and 6-3 contain a few of these equations.

Table 6-2. SOCMI Leak Rate/Screening Value Correlations

Equipment Type	Correlation
Gas valves	leak rate (kg/hr) = $1.87 \text{ E-06} \times (SV)^{0.873}$
Light liquid valves	leak rate (kg/hr) = $6.41 \text{ E-06} \times (SV)^{0.797}$
Light liquid pumps	leak rate (kg/hr) = $1.90 \text{ E-05} \times (SV)^{0.824}$
Connectors	leak rate (kg/hr) = $3.05 \text{ E-06} \times (SV)^{0.885}$

Source Protocol for Equipment Leak Emission Estimates (EPA, Nov. 1995)
SV = screening value in ppmv

Table 6-3. Petroleum Industry Leak Rate/Screening Value Correlations

Equipment Type	Correlation
Valves (all)	leak rate (kg/hr) = $2.29 \text{ E-06} \times (SV)^{0.746}$
Pump seals (all)	leak rate (kg/hr) = $5.03 \text{ E-05} \times (SV)^{0.610}$
Open-ended lines (all)	leak rate (kg/hr) = $2.20 \text{ E-06} \times (SV)^{0.704}$
Connectors (all)	leak rate (kg/hr) = $1.53 \text{ E-06} \times (SV)^{0.735}$
Flanges (all)	leak rate (kg/hr) = $4.61 \text{ E-06} \times (SV)^{0.703}$
Others[a]	leak rate (kg/hr) = $1.36 \text{ E-05} \times (SV)^{0.589}$

Source Protocol for Equipment Leak Emission Estimates (EPA, Nov. 1995)
SV = screening value in ppmv
a - others shall be applied to any equipment type other than connectors, flanges, open-ended lines, pumps, or valves

If the available screening value is a "zero" screening value (the screening value that represents the minimum detection limit of the monitoring device) or a "pegged" screening value (the screening value that represents the upper detection limit of the monitoring device), the correlations in the above two tables cannot be used. Instead, the values displayed in Tables 6-4 and 6-5 should be used rather than a correlation.

Table 6-4. SOCMI Default Zero Leak Rates and Pegged Leak Rates

Equipment Type	Default Zero Emission Rate (kg/hr)	Pegged Emission Rate (10,000 ppmv) (kg//hr)	Pegged Emission Rate (100,00 ppmv) (kg/hr)
Gas Valves	6 6E-07	0 024	0.11
Light liquid valves	4 9E-07	0 036	0.15
Light liquid pumps	7 5E-06	0 14	0.62
Connectors	6.1E-07	0.044	0.22

Source Protocol for Equipment Leak Emission Estimates (EPA, Nov 1995)

Table 6-5. Petroleum Industry Default Zero Leak Rates and Pegged Leak Rates

Equipment Type	Default Zero Emission Rate (kg/hr)	Pegged Emission Rate (10,000 ppmv) (kg/hr)	Pegged Emission Rate (100,000 ppmv) (kg/hr)
Connector (all)	7.5E-06	0 028	0 030
Flange (all)	3.1E-07	0 085	0.084
Open-ended line (all)	2 0E-06	0 030	0 079
Pump (all)	2 4E-05	0 074	0 160
Valve (all)	7.8E-06	0 064	0.140
Other	4 0E-06	0 073	0 110

Source Protocol for Equipment Leak Emission Estimates (EPA, Nov 1995)

Calculation Methodology for Lead Detection and Repair

Step A For each leaking equipment type, choose the appropriate equation from Table 6-2 or 6-3 If the available screening value is a "zero" or "pegged" value, choose the appropriate value from Table 6-4 or 6-5 If a "zero" or "pegged" screening value exists before repair, skip Step B If a "zero" or "pegged" screening value exists after repair, skip Step D

Step B Enter the equipment screening value (ppmv) before the repair into the equation chosen in Step A in order to calculate the leak rate (kg/hr) before repair

Step C Calculate the pollutant emissions (kg/yr) before repair of the leak using the following equation

Pollutant emissions before repair (kg/yr) = [Leak rate (kg/hr) calculated in Step B or picked in Step A × pollutant concentration (weight percent) within the equipment × hours of operation (hr/yr)] / TOC concentration (weight percent) within the equipment

Step D Now, enter the screening value (ppmv) after the repair into the equation chosen in Step A in order to calculated the leak rate after repair

Step E Calculate the pollutant emissions (kg/yr) after repair of the leak using the following equation

Pollutant emissions after repair (kg/yr) = [Leak rate (kg/hr) calculated in Step D or picked in Step A × pollutant concentration (weight percent) within the equipment × hours of operation (hr/yr)] / TOC concentration (weight percent) within the equipment

Step F The emission reduction achieved by the repair is determined by subtracting the emissions after repair from the emissions before the repair and converting to a total load reduction for one year

Step G Report the total pollutant reduction in pounds in ICIS. Identify "Air" as the impacted media

6.3.3 Example Calculations and Input for ICIS

Example 1. SOCMI with Non-Zero, Non-Pegged Screening Values

An EPA inspection of a chemical manufacturing facility identified a leak at a pump that pumps light liquid. The monitoring device signaled that the VOC concentration was 5,000 ppmv. Upon repair of the leak, the inspector went back to the equipment location with his monitoring device. This time the device registered a VOC concentration of 50 ppmv. Records show that the pump is run for approximately 8760 hr/yr and that the light liquid that is pumped contains 20% wt. VOC and 40% wt. TOC.

Step A The following equation is chosen from the SOCMI table (Table 6-2) and corresponds to the light liquid pump: leak rate (kg/hr) = 1.90 E-05 × $(SV)^{0.824}$ where SV = screening value in ppmv

Step B Leak rate (kg/hr) before repair = 1.90E-05 × $(5000)^{0.824}$ = 0.0212 kg/hr

Step C VOC emission (kg/yr) = 0.0212 (kg/hr) × 20 (wt. %) × 8760 (hr/yr) / 40 (wt. %)
VOC emission (kg/yr) before repair = 92.8 kg/yr

Step D Leak rate (kg/hr) after repair = 1.90E-05 × $(50)^{0.824}$ = 0.000477 (kg/hr)

Step E VOC emission (kg/yr) = 0.000477 (kg/hr) × 20 (wt. %) × 8760 (hr/yr) / 40 (wt. %)
VOC emission (kg/yr) after repair = 2.09 kg/yr

Step F VOC emission reduction = (92.8 (kg/yr) - 2.09 (kg/yr)) × 1 lb/454 kg × 1000g/kg × 1 year = 200 lbs of VOC

Step G Input for ICIS

- **Complying Actions:** Leak Repair and Leak Detection
- **Pollutant:** VOC
- **Unit:** 200 pounds
- **Media:** Air

Example 2. Petroleum Industry with Zero and Pegged Screening Values

A LDAR inspection of a petroleum refining facility resulted in the discovery of leaks at 4 connectors. During the inspection, the monitoring device signaled that the VOC concentrations were greater than 10,000 ppmv, the upper detection limit of the monitoring device. An administrative order requires repair of the connectors to a monitoring concentration of less than 1,000 ppmv, the lower detection limit of the monitoring device. Facility records show that the facility operates continuously (approximately 8760 hr/yr) and that the light liquid that is pumped through the connectors contains 20% wt. VOC and 40% wt. TOC.

Step A Since the screening values before the repair are "pegged" and after the repair will be "zero," respectively, the values are chosen off of Table 6-5.
Leak rate before repair = 0.028 kg/hr.
Leak rate after repair = 7.5E-06 kg/hr

Step B Skipped

Step C VOC emission (kg/yr) = 0.028 (kg/hr) × 20 (wt. %) × 8760 (hr/yr) / 40 (wt. %)
VOC emission (kg/yr) before repair = 122.6 kg/yr per connector

Step D Skipped

Step E VOC emission (kg/yr) = 7.5E-06 (kg/hr) × 20 (wt. %) × 8760 (hr/yr) / 40 (wt. %)
VOC emission (kg/yr) after repair = 0.03 kg/yr per connector

Step F VOC emission reductions = (122.6 (kg/yr) - 0.03 (kg/yr)) × 4 connectors × 1 lb/454g × 1000g/kg × 1 year = 1,080 lbs VOC

Step G Input for ICIS

- **Complying Actions:** Leak Repair and Leak Detection
- **Pollutant:** VOC
- **Unit:** 1,080 pounds
- **Media:** Air

6.4 References

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http://www.epa.gov/reg5foia/asbestos/ban.html (information on the ABPO rule)

http://www.epa.gov/reg5foia/asbestos/legislat.html (information on various Asbestos-related legislation)

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"Enforcement and Compliance Assurance Accomplishments Report", FY 1997, OECA, EPA-300-R-98-003, July 1998.

7.0 HAZARDOUS WASTE EXAMPLES

Solid and hazardous wastes are regulated by the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response and Liability Act (CERCLA), also referred to as Superfund. In response to RCRA and Superfund enforcement actions, the following types of cases are typical:

- 7.1 RCRA Subtitle C enforcement actions that are geared toward the proper management of solid and hazardous wastes. These include implementation of the used oil regulations developed under RCRA. (pg. 7-1)
- 7.2 RCRA enforcement actions resulting from the Underground Storage Tank (UST) regulations. (pg. 7-5)
- 7.3 RCRA corrective actions and Superfund response actions that result in environmental cleanups. (pg. 7-7)

The sections below present various pollutant reduction, waste management, and prevention examples for solid/hazardous waste media. Each section includes information on the following:

- Background;
- Calculation methodology; and
- Example calculations and input for ICIS using specific scenarios.

Section 7.4 presents references and websites used in developing these examples.

7.1 RCRA Subtitle C

7.1.1 Background

The Resource Conservation and Recovery Act (RCRA), an amendment to the Solid Waste Disposal Act, was enacted in 1976 to address the huge volumes of industrial solid waste generated nationwide. RCRA has three primary goals: 1) to protect the environment and human health, 2) to conserve energy and natural resources, and 3) to reduce or eliminate the generation of hazardous waste. RCRA created the framework for EPA to regulate solid waste, hazardous waste, medical waste, and underground storage tanks (USTs).

RCRA is comprised of three major programs: Subtitle C (the hazardous waste management program), Subtitle D (the solid waste program), and Subtitle I (the UST program).

Under Subtitle C, the EPA has developed a comprehensive program to ensure that all hazardous waste is safely managed from the moment it is generated until its' final disposition at a Treatment, Storage or Disposal (TSD) Facility. The objective of this "cradle-to-grave" management system is to ensure that hazardous waste is handled in a manner that protects human health and the environment. To this end, there are Subtitle C regulations for the generation, transportation, and treatment, storage, or disposal of hazardous wastes. The regulations first identify the criteria to determine which solid wastes are hazardous, and then establish various requirements for the three categories of hazardous waste handlers: generators, transporters, and TSDFs. These standards, which primarily involve proper identification, management, and handling safeguards, are designed to minimize the likelihood of an unintended release of hazardous waste into the environment.

EPA's used oil regulations are included under the RCRA regulatory umbrella. In an effort to encourage the recycling of used oil, and in recognition of the unique properties and potential hazards posed by used oil, Congress passed the Used Oil Recycling Act in 1980. This Act amended RCRA by requiring EPA to study used oil and to develop used oil management standards. Used oil mixed with hazardous waste is subject to all applicable hazardous waste standards. Examples of common used oil generators include car repair shops, service stations, and metalworking industries. Individuals who generate used oil through the maintenance of their own vehicles and equipment are not considered used oil generators.

RCRA Subtitle C enforcement actions may include the following types of Direct, Preventative and FMIP complying actions:

Statute/Section Violated	Complying Actions with Direct Env. Benefits	Unit	Potential Impacted Media
RCRA 3002, 3003, 3004	Waste Treatment Waste Minimization	Pounds	Land Soil Water (ground) Water (navigable/surface) Air

Statute/Section Violated	Preventative Actions to Reduce Likelihood of Future Releases	Unit	Potential Impacted Media
RCRA 3002, 3003, 3004	Disposal Change Storage Change RCRA Labeling/Manifesting RCRA Waste Identification RCRA Secondary Containment	Gallons Cubic Yards	Land Soil Water (ground) Water (navigable/surface) Air

Statute/Section Violated	Facility/Site Management and Information Practices (FMIP)	Unit	Potential Impacted Media
RCRA all sections	Testing/Sampling Record-keeping Reporting Notification Financial Responsibility Requirements Training Permit Application	N/A	N/A

7.1.2 Example Calculations and Input for ICIS

All Subtitle C non-corrective enforcement actions that include physical complying actions will be categorized as direct reduction only when waste minimization or waste treatment occurs. All other actions, such as storage change or disposal change, will be classified as prevention or proper management of waste. For all of these cases, you will report in ICIS the amount of pollutant or characteristic waste that is impacted by the enforcement action. So that they may be included in our GPRA measure for "Lbs of pollutants estimated to be reduced, eliminated or treated", the unit for **direct** reductions in the RCRA program must be **pounds**. Common densities to convert gallons to pounds can be found in Chapter Ten. If not included or if unknown, you should use the density of water.

For Subtitle C enforcement actions that include only Facility Management and Information Practices (FMIP) complying actions, identify in ICIS the applicable complying action(s) only. For these situations you do not need to identify a pollutant, amount, unit, or media.

Examples of some RCRA Subtitle C cases and the appropriate input for ICIS are provided below.

Example 1. Hazardous Waste Treatment (Direct)

ABC Chemical Company is subject to a RCRA Subtitle C order requiring treatment of an F001 solvent waste (containing methylene chloride) that is currently stored at the facility. The facility will send out ten 55-gallon drums of the material for incineration treatment. Using the density of methlyene chloride (From Table 10-1 in Section 10) the amount of material in pounds sent to treatment can be estimated as follows:

$$10 \text{ drums F001} \times 55 \text{ gallons/drum} \times 11.149 \text{ lbs./gallon} = 6{,}132 \text{ pounds of F001}$$

Input for ICIS:

- **Complying Action:** Waste Treatment
- **Pollutant:** F001 Solvent Waste
- **Unit:** 6,132 pounds
- **Media:** Land

Example 2. Hazardous Waste Use Reduction (Direct)

ABC Chemical Company is currently generating a waste ash in their process which contains dioxins formed during a process combustion step. The facility has been sited for improper storage and disposal of this material. In response to an enforcement order, the facility is proposing to eliminate this waste by incorporating a change in their production process and the pre-curser chemicals used, thereby, eliminating the possible formation of dioxin in the waste ash. Currently, the facility generates one ton of ash per month. To determine the environmental benefit from this use reduction activity use the current waste ash production rate and scale the amount of hazardous material eliminated by the action to one year's worth of benefits.

1 ton waste ash/month × 12 months/yr × 2000 lbs/ton = 24,000 lbs waste ash

Input for ICIS:

- **Complying Action:** Use Reduction
- **Pollutant:** Dioxin contaminated waste ash
- **Unit:** 24,000 pounds
- **Media:** Land

Example 3. Hazardous Waste Disposal Change (Prevention)

ABC Chemical Company is subject to a RCRA Subtitle C order identifying a solid waste stream that is currently mis-characterized as non-hazardous. The material has recently been classified as hazardous become of its characteristic for ignitability. The facility is planning to collect and properly dispose of this waste. The quantity of waste generated over the past 12 months totals 5,000 pounds of material.

Input for ICIS:

- **Complying Actions:** Disposal Change (Preventative), RCRA Waste Identification (FMIP)
- **Pollutant:** Ignitable Waste
- **Unit:** 5,000 pounds
- **Media:** Land

Example 4. Used Oil (Prevention)

Metal Works Company is a metal machining shop which uses lubricating oil in their process. After use, the oil is stored on site. During an on-site inspection the used oil from the shop was found to be stored in a concrete pit (which is 4 ft. by 6 ft. and contains oil at a 12 inch depth) along the back of the shop. The Agency inspector issued an administrative order requiring the facility to install a used oil tank for storage, relocate the used oil in the pit at the back of the facility to the new storage tank, properly label the tank as "Used Oil", and arrange for periodic pick up by a used oil transporter. The quantity of used oil generated at the facility is approximately 10 gallons per month.

An estimate of the amount of used oil coming under proper management is calculated as:

Used oil in the outdoor pit + used oil generated during the reporting year.

<u>Volume of Used oil in the outdoor pit is calculated as:</u>

4 ft. × 6 ft. × 1 ft. = 24 cubic feet × 1 cubic yard/ 27 cubic feet = 0.89 cubic yards

<u>Used oil generated per year is calculated as:</u>

10 gallons/mo. × 12 mo./year × 1 cubic yard/202 gallons = 0.59 cubic yards

Total Used Oil Brought into Proper Management is:

0.89 cubic yards + 0.59 cubic yards = 1.48 cubic yards

Input for ICIS:

- **Complying Actions:** Disposal Change, Storage Change, and RCRA Labeling/Manifesting
- **Pollutant:** Used oil
- **Unit:** 1.48 cubic yards
- **Media:** Land

Note: When there are several preventative and direct complying actions applicable to one waste stream you only report the benefit once.

7.2 RCRA UST

7.2.1 Background

Subtitle I of RCRA provides EPA with regulatory authority for Underground Storage Tanks (USTs) and is an important component of the act because it allows EPA to regulate products as well as wastes. An underground storage tank is defined as a tank with at least 10 percent of its volume underground, including piping, ancillary equipment, and containment systems. In order to be regulated by Subtitle I, the tank must store petroleum or a hazardous substance. Certain tanks are excluded from this definition. For a complete list of exempt USTs, please see 40 CFR, Part 280. **(http://www.epa.gov/docs/epacfr40/chapt-I.info/subch-I/40P0280.pdf)**

For all non-exempt USTs, performance standards for tank design, construction, and installation have been developed. Additionally, requirements concerning leak detection, record keeping, reporting, corrective action, and closure have also been promulgated.

The regulation of USTs is vital because leaks from an UST can cause fires and explosions, as well as contamination of the ground water. In order to protect both people and the environment, several key regulations have been developed for the safe operation of USTs. As of December, 1993, all new and existing USTs had to be equipped with a leak detection system, and by December,1998, new and existing USTs had to be equipped with spill, overfill, and corrosion protection. To ensure spill protection, USTs are required to be equipped with catch basins to contain spills. For overfill protection, USTs are required to be equipped with automatic shut off devices, overfill alarms, or ball float valves. Finally, for corrosion protection, the tank and piping had to be made completely of non-corrodible material, or of steel having a corrosion-resistant coating and having cathodic protection, or of steel clad with a thick layer of non-corrodible material.

To deal with non-compliance or illegal UST operation, EPA or the state regulatory agency may take enforcement actions to ensure that the substandard UST is temporarily closed until it can be permanently closed, replaced, or upgraded. These pollution prevention actions may include monetary penalties and administrative or judicial enforcement actions. However, if an UST pollutant release is detected, the result is a corrective action scenario and pollutant reductions can be calculated.

Enforcement actions related to RCRA UST cases may include the following types of Direct, Preventive, and FMIP complying actions:

Statute/Section Violated	Actions with Direct Environmental Benefits/Response or Corrective Action	Pollutant Name	Amount	Unit	Potential Impacted Media
RCRA UST	Removal of Contaminated Medium	Specific pollutant name	Volume of contaminated medium removed	Cubic Yards	Soil

Statute/Section Violated	Preventative Actions to Reduce Likelihood of Future Releases	Pollutant Name	Amount	Unit	Potential Impacted Media
RCRA UST	UST Secondary Containment	Specific pollutant name	Amount impacted by action	Gallons	Land
RCRA UST	UST Tank Closure	Specific pollutant name	Amount impacted by action	Gallons	Land
RCRA UST	UST Corrosion or Overfill Protection	Specific pollutant name	Amount impacted by action	Gallons	Land

Statute/Section Violated	Complying Actions with Facility/Site Management and Information Practices (FMIP)	Pollutant Name	Amount	Unit	Potential Impacted Media
RCRA UST	UST Release Detection	NA	NA	NA	NA
RCRA UST	Testing/Sampling	NA	NA	NA	NA
RCRA UST	Record-keeping	NA	NA	NA	NA
RCRA UST	Reporting	NA	NA	NA	NA
RCRA UST	Financial Responsibility Requirements	NA	NA	NA	NA

7.2.2 Examples and Input for ICIS

Example 1. UST Spill Clean-up (Direct)

An enforcement action has been lodged against Ajax Service Station for release of gasoline from their underground storage tanks into the surrounding soil. The station will be required to decommission the existing three tanks (which were non-compliant with the UST regulations) and remediate the site. The amount of gasoline leaked is estimated at 900 gallons from the three tanks and it is estimated that 1,000 cubic yards of soil will be removed from the site.

Input for ICIS:

- **Complying Action:** Removal of Contaminated Medium
- **Pollutant:** Gasoline
- **Unit:** 1,000 cubic yards
- **Media:** Soil

Example 2. UST Prevention

Under an APO, Barker Chemical Company has been cited for non-compliance with requirements under the UST regulations. Six underground storage tanks at the facility were found to be lacking leak detection controls and secondary containment. The APO requires the facility to add leak detection and spill prevention controls onto the six tanks and they must also conduct soil vapor sampling to determine whether any leaks have occurred from the tanks. The facility must also supply proof of financial responsibility in case of a spill event. The tanks contain manufactured solvents including toluene (in 4 - 5,000 gallon tanks) and benzene (in 2 - 500 gallon tanks).

Input for ICIS:

- **Complying actions:** UST Secondary Containment (Preventative), Testing/Sampling, Financial Responsibility Requirements, and Release Detection (FMIP)
- **Pollutants** Toluene
- **Unit:** 20,000 gallons
- **Media:** Land

  AND
- **Pollutant:** Benzene
- **Unit:** 1,000 gallons
- **Media:** Land

7.3 RCRA/Superfund Corrective Actions

For RCRA corrective actions and Superfund response actions, the following types of media-specific response actions may be encountered:

- Soil response actions (including mine tailings);

- Groundwater hydraulic response actions;
- Landfill response actions;
- Soil vapor extraction response actions;
- Vapor intrusion (point of entry control) response actions;
- Non-aqueous phase liquid (NAPL) recovery response actions;
- Sediment response actions;
- Surface water response actions;
- Mine drainage diversion and treatment (point of entry control) response actions; and
- Container (e.g., drum) and large debris removal actions.

7.3.1 Background

Past and present activities at RCRA facilities may result in releases of hazardous waste and hazardous constituents to soil, groundwater, surface water, and air. Through the RCRA Corrective Action Program, EPA requires the investigation and cleanup, or in-situ or ex-situ treatment of hazardous releases at RCRA facilities. EPA enforces the Corrective Action Program primarily through the statutory authorities established by the Hazardous and Solid Waste Amendments (HSWA) of 1984.

The corrective action program is structured around elements common to most cleanups under other EPA programs: an initial site assessment, an extensive characterization of the contamination, and the evaluation and implementation of cleanup alternatives, both immediate and long-term. To facilitate investigations, EPA uses the concept of action levels in some cases. Action levels are risk-based concentrations of hazardous constituents in ground water, soil, or sediment, and the presence of hazardous constituents above these action levels suggests that there has been a release requiring corrective measures. Under this approach, contamination below appropriate action levels would not generally be subject to cleanup or further study.

For more information on corrective actions to clean up hazardous waste contamination see: **http://www.epa.gov/epaoswer/general/orientat/**

Several complying actions are applicable to corrective action cases. These include:

Statute/Section Violated	Actions with Direct Environmental Benefits and/or Direct Response/Corrective Action	Pollutant Name	Amount	Unit	Potential Impacted Media
RCRA 3004VU, 3008H, 3023, 7003, 9003, 9003C(3-4), 9005	In-situ and Ex-situ treatment Removal of Contaminated Medium Containment	Top 3 pollutants in the contaminated medium	Volume of contaminated medium (0 for addtl pollutants)	Cubic Yards	Soil

The CERCLA complying actions above are being categorized as actions with Direct Environmental Benefits because they require immediate response in order to avoid imminent and/or substantial endangerment to human health and the environment. Environmental benefits that accrue from these CERCLA actions are to be reported in ICIS in terms of the volume of contaminated media addressed by the action. These types of cases will be quantified based on the physical state of the medium that is addressed by the response action. For example, for soil remedies, the volume of contaminated media measured will be the volume of soil subject to removal or treatment. For groundwater remedies, the volume of contaminated media is the volume of physical aquifer (not water, but entire formation) that will be addressed by the response action.

Statute/Section Violated	Facility/Site Management and Information Practices	Pollutant Name	Amount	Unit	Potential Impacted Media
RCRA 3004VU, 3008H, 3023, 7003, 9003, 9003C(3-4), 9005	Remedial Investigation/Feasibility Study (RI/FS) Site Assessment/Site Characterization Provide Site Access	Top 3 pollutants in the contaminated medium	N/A	N/A	N/A

For cases with FMIP complying actions only, you may identify the pollutant/waste subject to the action but should not identify any amount, unit, or media.

As mentioned in Section 7.0 above, RCRA corrective actions and Superfund response actions may encompass several types of media-specific response actions. The following table identifies the volume of media that should be estimated for each type of response action and the typical reporting units that apply. More than one type of medium may be addressed and thus reported for a given response action.

Type of Response Action	Volume of Media to be Estimated	Unit to Report in ICIS
Soil (including mine tailings)	Volume of soil, fine debris, or tailings that are being addressed (treated, removed, capped, stabilized) by the response action.	Cubic Yards
Groundwater/NAPL hydraulic containment	Volume of aquifer formation (not just the water) that is contaminated above Record of Decision (ROD) cleanup standards and will be subject to the response action.	Cubic Yards
Landfill/Dump/ Waste Pile/Impoundment	Volume of soil, waste, or debris that is being addressed (treated, removed, capped, stabilized) by the response action.	Cubic Yards
Soil vapor extraction (SVE)	Total volume of soil that will be subject to a concentration reduction from SVE or volume of soil subject to vacuum to achieve vapor recovery with SVE.	Cubic Yards
Vapor intrusion (point of entry control)/Landfill gas collection	Volume of air/vapor which will be diverted or treated by the vapor intrusion control system over its expected lifetime	Cubic Yards

Type of Response Action	Volume of Media to be Estimated	Unit to Report in ICIS
Non-aqueous phase liquid (NAPL) recovery	Volume of formation impacted with NAPL that will be subject to the recovery technology This volume may also be the zone in which NAPL is known to occur and in which a remedy will be applied to address it	Cubic Yards
Sediment	Volume of sediment to be addressed by the response action	Cubic Yards
Surface water	Volume of water, in-situ, within the surface water body that is contaminated and that will be addressed by the response action	Cubic Yards
Mine drainage diversion and/or treatment (point of entry control)	Volume of drainage water that will be diverted or treated by the mine drainage diversion and/or treatment system over its expected lifetime.	Cubic Yards
Container (e.g., drum) and large debris removal	Volume of material removed in containers or volume of large-scale material removed, stabilized, or disposed.	Cubic Yards

For each of these media-specific response actions, Section 7.3.2 below discusses the case data or calculation steps that can be used to determine the volume of media impacted by the action.

7.3.2 Calculation Methodology by Media Response Type

The following calculation methodologies apply to the media-specific response actions identified above:

Soil, Landfill, and Soil Vapor Extraction Methodology

Step A Identify the area and depth of soil (or landfill waste) within which contamination resides. Convert to volume by multiplying the area by the depth

Step B Determine the subset of this volume that will be addressed by the response action.

Step C Convert to units of cubic yards and report that volume in ICIS.

Notes:
1 Depending on the nature of the contaminated site, you may want/need to determine multiple sub-volumes and will then sum these to make a total volume.
2 For landfill capping, calculate the volume of waste beneath the cap based on best available information
3 You can use either in-situ or after excavation volumes - which ever data is more readily available.

Groundwater Methodology

Step A Compile plume maps for each aquifer layer and collect information on the thickness of each aquifer unit

Step B For each aquifer layer, calculate the area that will be addressed by the response action remedy

Step C For each aquifer layer, multiply the area by the average thickness of the aquifer unit to determine a volume.

Step D Add up the volume(s) calculated in Step C to determine a total volume.

Step E Convert the total volume to cubic yards and divide by 1,000 to get into the units of 1000 cubic yards.

Notes·

1 If the thickness of an aquifer layer varies by more than 50% across the area, do not use the average thickness Instead, divide the area up into smaller areas with similar thicknesses

Vapor Intrusion and Mine Drainage Diversion/Treatment Methodology

Step A Determine the expected average volumetric flowrate of the system over the duration it will run (usually represented as cubic feet per second (cfs)).

Step B Estimate the amount of time the system is expected to run (maybe in months or years)

Step C Multiply the flowrate by time and convert to units of cubic feet of air/vapor or cubic feet of mine drainage to be diverted or treated

Notes

1 Best professional judgement may need to be used to determine/estimate the volumetric flowrate of the system and the expected system running time.

NAPL Recovery Methodology

Step A Determine the volume within which the NAPL recovery technology will be applied (area × depth).

Notes.

1 The remedial action will be applied to an overall area within which it is known that the NAPL occurs This is NOT the volume of NAPL itself.

2 For disjointed NAPL areas on a large scale. you can sum smaller distinct volumes.

3. If a hydraulic groundwater remedy is also subject to the response action, then the NAPL volume should be counted and reported separately from the groundwater volume This is because NAPL recovery and groundwater pump and treat are focused on two different phases of contaminant and usually require entirely separate feasibility study analysis and response. It is appropriate to report both volumes, even though one lies within the other in physical space.

Sediment Methodology (for Rivers, Streams, Shoreline, Drainage, and Drainage Conveyances)

Step A Determine the average downstream cross-sectional area of sediment subject to the response action

Step B Determine the length of the overall reach of sediment subject to the response action

Step C Multiply the cross-sectional area by length of reach to determine sediment volume and convert to units of cubic yards

Notes:
1 For multiple reaches, calculate a volume of sediment for each and sum the volumes
2. For lake bottoms or wetlands not along a reach, use best professional judgement to determine the area and depth of sediment to be subject to the response action.

Surface Water Methodology

Due to the wide variety of surface water bodies, there is no single calculation that will address all of them. The volume of surface water that is contaminated and will be addressed by the enforcement action will therefore need to be determined using best professional judgement. If soil or sediment lying under the water is contaminated and will also be subject to the response action, a separate volume estimate for the soil or sediment should be made using the methodologies above.

Container/Large Debris Methodology

Step A Determine the volume of each container addressed by the action.

Step B Sum all volumes.

Notes:
1. If the number of containers impacted by the action is numerous, you may be able to use volumes from manifests or billing records from bulk shipments to determine the volume of material that will be impacted by the response action

7.3.3 Examples and Input for ICIS

Example 1. Corrective Action for Contaminated Groundwater and Soil

XYZ Industrial Company is a hazardous waste storage facility with a RCRA permit. During a routine EPA inspection, the Agency discovered contamination in XYZ Industrial's tank storage area. Soils under the area were contaminated by wastes spilled during pumping and by leaking tanks. The soil exhibited high levels of trichloroethylene, benzene, and toluene, which are volatile organic compounds that can migrate through the soil into the groundwater. Additionally, the investigation of the site discovered that a municipal drinking water well located within a mile of the facility was also contaminated with trichloroethylene and toluene. None of this contamination was detected in the initial permitting process.

EPA conducted a RCRA facility assessment (RFA) to compile information on the types of hazardous wastes managed at the facility in the past, areas where these wastes were managed, and possible exposure pathways.

The owner and operator of XYZ Industrial then conducted a RCRA facility investigation (RFI), with EPA oversight, to estimate the health and environmental problems that could result if the contamination was not cleaned up, and to determine the extent of the contamination. These investigations showed the VOC plume extending from the facility in the direction of the drinking water well for a distance of 4,000 feet with a plume width of approximately 100 feet. The aquifer of the impacted area is located 20 to 25 feet below the ground surface and has an average aquifer thickness of 20 feet. To protect human health and the environment while the assessment and investigation were taking place, the owner and operator established an alternative drinking water source for the households served by the municipal well as interim measures.

A corrective measures study (CMS) determined that the company should clean up the groundwater contamination via a pump and treat process and excavate the soil for disposal off-site at a permitted landfill. The area of soil to be remediated by the response action includes selected sections underneath the surface area where outdoor chemical storage occurred which is equal to 2,400 sq.ft. Two 20 ft. by 20 ft. sections of soil will be removed to a depth of 10 feet. The recommendations of the CMS were incorporated into an administrative order imposed on the facility by the Agency in its enforcement action.

The total remediation volumes of trichloroethylene and benzene for the facility based on the adopted corrective action will include the volume of aquifer impacted by the groundwater pump and treat system and the volume of contaminated soil removed.

The determination of these volumes is shown below:

For Groundwater:

Step A The average thickness of the aquifer impacted by this response action is 20 feet.

Step B The area to be impacted by the action includes the VOC plume area which is estimated to be 4,000 feet by 100 feet = 400,000 sq.ft.

Step C The volume of aquifer impacted by the action will be 400,000 sq. ft. × 20 feet = 8,000,000 cu.ft.

Step E Convert to cu.yds. as follows:

8,000,000 cu. ft. × 1 cu. yd./27 cu.ft. = 296,296 cu. yd.

For Soil:

Step A The area of contamination is equivalent to the soil storage area of 2,400 sq. ft. to 10 feet of soil depth = 24,000 cu. ft.

Step B The remediation effort will impact one third of this area or 8,000 cu. ft.

Step C 8,000 cu. ft. × 1 cu. yd./27 cu. ft. = 296 cu. yds. of soil removed.

Input for ICIS:

For groundwater

- **Complying Actions:** In-situ and ex-situ treatment, Removal
- **Pollutant:** Trichloroethylene
- **Unit:** 296,296 cubic yards
- **Media:** Water (ground)

  AND

- **Pollutant:** Benzene
- **Unit:**0
- **Media:** Water (ground)

  AND

- **Pollutant:** Toluene
- **Unit:**0
- **Media:** Water (ground)

For soil

- **Complying Actions:** In-situ and ex-situ treatment, Removal
- **Pollutant:** Trichloroethylene
- **Unit:** 296 cubic yards
- **Media:** Soil

  AND

- **Pollutant:** Benzene
- **Unit:**0
- **Media:** Soil

  AND

- **Pollutant:** Toluene
- **Unit:**0
- **Media:** Soil

Example 2. Mine Drainage Diversion

An abandoned mine land Superfund site is currently undergoing clean up. Activities at the site have resulted in a release of highly acidic mine drainage to a stream on the site. As part of a Superfund response action, the mine drainage stream will be diverted and treated prior to discharge to the stream. The amount of drainage for diversion is estimated to have a volumetric flow rate of 0.5 cfs. The diversion of the stream is expected to occur throughout the duration of the Superfund clean up action, i.e., 2 years.

Step A The estimate of the volumetric flow rate is 0.5 cfs.

Step B The estimate of running time for the diversion and treatment system is 2 years.

Step C The total volume of mine drainage impacted by the response action is:

0.5 cu. ft./sec. × 60 sec./1 min. × 60 min./1 hr. × 24 hr./1 day × 365 days/yr. × 2 years x 1 cu.yd./27 cu.ft.= 1,168,000 cu. yd.

Input for ICIS:

- **Complying Action:** In-situ and ex-situ treatment
- **Pollutant:** Mine Drainage
- **Unit:** 1,168,000 cu. yd.
- **Media:** Water (navigable/surface)

7.4 References

U.S. EPA, 2000. Office of Solid Waste, *RCRA Orientation Manual Section III*. See **http://www.epa.gov/epaoswer/general/orientat**

40 CFR Part 268, Subpart D - Land Disposal Restrictions Treatment Standards

U.S. EPA. *RCRA Statutory Overview.*
See http://www.epa.gov/epaoswer/hotline/training/statov.txt

U.S. EPA. July 1995. Office of Solid Waste and Emergency Response. *Musts for USTs: A Summary of Federal Regulations for Underground Storage Tank Systems*. See http://www.epa.gov/swerust1/pubs/musts.pdf

U.S. EPA. Office of Underground Storage Tanks. *1998 Deadline for Upgrading, Replacing, or Closing Substandard UST Systems.* See http://www.epa.gov/swerust1/1998/index.htm

8.0 TSCA VIOLATIONS

The Toxic Substances Control Act (TSCA) of 1976 was enacted by Congress to give EPA the ability to track the 75,000 industrial chemicals currently produced or imported into the U.S. EPA repeatedly screens these chemicals and can require reporting or testing of those that may pose an environmental or human-health hazard. EPA can ban the manufacture and import of those chemicals that pose an unreasonable risk.

Many of the enforcement actions under TSCA address reporting and recordkeeping activities and result in facility management and information practice (FMIP) complying actions. These actions do not require you to report environmental benefit in ICIS. Enforcement cases under TSCA that result in the prevention of future human health risk or environmental impact generally include those related to lead-based paint, PCBs, and asbestos. In addition, asbestos is also regulated under the CAA NESHAP regulations.

This section discusses the following types of cases:

- 8.1 TSCA Lead-Based Paint;
- 8.2 TSCA Section 6 (PCBS); and
- 8.3 Asbestos under TSCA/AHERA and CAA NESHAP.

The sections below present various waste management and prevention examples for lead-based paint, PCB wastes, and asbestos wastes. Each section includes background information and example calculations and input for ICIS using specific scenarios. Section 8.4 presents references and websites used in developing these examples. This chapter does not include examples for core TSCA because it was assumed that instances of quantifiable direct or preventative benefits from core TSCA would be rare and that the majority of cases would have facility management and information practices benefits that do not require quantification.

8.1 TSCA Lead-based Paint

Deteriorated lead-based paint is a significant concern for older schools, houses, and buildings. Buildings constructed prior to 1978 may contain lead-based paint, which, if not properly maintained, can peel and become dust. This dust can then pose an inhalation and ingestion hazard to children. Exposures can also occur during renovation, remodeling, or demolition work. Children are susceptible to adverse health effects from extremely low exposures to environmental lead.

EPA adopted final lead hazard standards on January 5, 2001 that identify dangerous levels of lead in paint, dust and soil. These standards (at TSCA Section 403) can be found at: http://www.epa.gov/lead/leadhaz.htm.

Under TSCA Section 402, training/certification and work practice standards are required. Under these regulations, all persons (including school employees) that perform lead-based paint activities in "child-occupied facilities" must be trained and certified to conduct this work. They must also adhere to certain work practice requirements. This applies to persons inspecting for lead-based paint, and also to those involved in abating lead-based paint hazards.

Enforcement actions related to TSCA lead-based paint cases include the following types of preventive actions:

Statute/Section Violated	Preventative Actions to Reduce Likelihood of Future Releases	Pollutant Name	Amount	Unit	Potential Impacted Media
TSCA 406/1018	Lead-Based Paint Disclosure	Lead-based paint	Number of units	Single Family Housing Units Multi-Family Housing Units Building Units	Schools/ Housing/ Buildings
TSCA 206/402/1018	Lead-Based Paint Removal, Training, and Certification	Lead-based paint	Number of units	Single Family Housing Units Multi-Family Housing Units Building Units	Schools/ Housing/ Buildings

When reporting environmental benefit from these cases the unit of measurement will be the number of Single Family or Multi-Family housing or building units impacted by the enforcement action. The pollutant to report is **"lead-based paint"** and the media impacted should be identified as **"schools/housing/ buildings"**.

Example and Input for ICIS:

For example, a lead-based paint inspection of a pre-1978 public housing project (composed of 20 housing units) identified chipped and deteriorating lead-based paint on all buildings. A subsequent enforcement action requires disclosure of information to the housing residents and applicable authorities, and removal and replacement of the old paint by certified personnel. Input for ICIS would include the following:

- **Complying Actions:** Lead Based Paint Disclosure and Lead Based Paint Removal Training/Certification (Preventative)
- **Pollutant**: Lead-based Paint
- **Unit**: 20 multi-family housing units
- **Media**: Schools/Housing/Buildings

Note: Where multiple complying actions apply, only calculate preventative benefits once.

8.2 TSCA Section 6

TSCA Section 6 regulates certain hazardous chemical substances and mixtures and authorizes EPA to take regulatory action to protect against unreasonable risk to human health or the environment. EPA has promulgated regulations under Section 6 of TSCA applicable to polychlorinated biphenyls (PCBs). The final rules applicable to the disposal of PCBs were published on June 29, 1998. This rule provided the following:

- Flexibility in selecting disposal technologies for PCB wastes and expansion of the list of available decontamination procedures;
- Less burdensome mechanisms for obtaining EPA approval for a variety of activities;
- Clarification and modification of implementation requirements;
- Modification of the requirements regarding the use and disposal of PCB equipment; and
- Discussion of issues associated with the notification and manifesting of PCB wastes and changes in the operation of commercial storage facilities.

PCB Rules fall into two broad categories: non-disposal violations and disposal violations. Enforcement actions related to TSCA Section 6 cases include the following types of direct, preventive, and FMIP complying actions. Generally, disposal violations will result in direct or preventative complying actions while non-disposal violations will result in FMIP complying actions.

Statute/Section Violated	Actions with Direct Environmental Benefits/Response or Corrective Action	Pollutant Name	Amount	Unit	Potential Impacted Media
TSCA 6-PCBs	Removal of contaminated material	PCBS	Volume of material properly managed	Cubic yards	Soil or Land
	Waste Treatment	PCBS	#	Pounds	

Statute/Section Violated	Preventative Actions to Reduce Likelihood of Future Releases	Pollutant Name	Amount	Unit	Potential Impacted Media
TSCA 6-PCBs	Disposal Change	PCBS	Volume of material properly managed	Cubic yards	Soil or Land
			#	Pounds	

Statute/Section Violated	Facility/Site Management and Information Practices (FMIP)	Pollutant Name	Amount	Unit	Potential Impacted Media
TSCA 6-PCBs	Labeling/Manifesting Record-keeping Reporting Permit Application Notification	NA	NA	NA	NA

If the case is a labeling violation only, you should check "Labeling/Manifesting" as the complying action and omit entering a pollutant amount.

If the case includes removal of PCB contaminated material and/or proper disposal of PCB contaminated material, a calculation of the volume of contaminated material properly managed by the action should be reported in cubic yards. The pollutant should be identified as **"PCBS"** and the media should be identified as **"soil"** or **"land"**.

Example and Input for ICIS:

For example, Clean Harbors of Braintree, RI was sited for shipping dredged sediments with a >50 ppm concentration of PCBs without identification of PCBs on the manifest. The enforcement action will require proper labeling/manifesting of the waste and proper disposal of 20 cubic yards of PCB containing sediment.

- **Complying Action**: Disposal Change (Preventative)
- **Pollutant**: PCBS
- **Unit**: 20 cubic yards
- **Media**: land

8.3 Asbestos under TSCA/AHERA and CAA NESHAP

The EPA is one of six agencies with the authority to regulate asbestos. The EPA's authority to do so is provided under both the Toxic Substances Control Act (TSCA) and the Clean Air Act (CAA). Under TSCA, EPA is authorized to enforce the requirements of the Asbestos Ban and Phase Out Rule (ABPO) and the Asbestos Hazard Emergency Response Act (AHERA). The Asbestos Ban and Phase Out Rule phases out and bans production of five specific types of asbestos-containing products including corrugated paper, rollboard, and flooring paper, as well as new uses of asbestos. AHERA prescribes asbestos management practices and abatement standards for public schools and private, not-for-profit schools. Finally, the EPA is authorized under the CAA at 40 CFR Part 61 Subpart M to enforce the requirements of the National Emissions Standards for Hazardous Air Pollutants regulations dealing with asbestos (Asbestos NESHAP). ***Note: asbestos was delisted under 40 CFR Part 63 as a source category but is still regulated by 40 CFR Part 61 Subpart M.***

TSCA/AHERA

AHERA required EPA to develop regulations creating a comprehensive framework for addressing asbestos hazards in schools. The Act also required EPA to develop an accreditation program for individuals who conduct inspections for asbestos, develop management plans, and perform asbestos abatement work. Other provisions of AHERA require all public and private elementary and secondary schools to conduct inspections for asbestos-containing building materials, develop management plans, and implement response actions in a timely fashion. The provisions of AHERA required management plans to be submitted to State agencies on or before May 9, 1989 and local education agencies (LEAs) were required to begin implementation of their management plans by July 9, 1989.

Enforcement actions related to TSCA/AHERA cases include the following types of preventive and FMIP complying actions:

Statute/Section Violated	Preventative Actions to Reduce Likelihood of Future Releases	Pollutant Name	Amount	Unit	Potential Impacted Media
TSCA 203 (AHERA)	Asbestos Training, Certification, and Accreditation	Asbestos	Number of units	Schools, building units	Schools/ Housing/ Buildings
TSCA 203 (AHERA)	Develop/Implement Asbestos Management Plan	Asbestos	Number of units	Schools, building units	Schools/ Housing/ Buildings

Statute/Section Violated	Facility/Site Management and Information Practices (FMIP)	Pollutant Name	Amount	Unit	Potential Impacted Media
TSCA 203 (AHERA)	Asbestos Inspection	NA	NA	NA	NA

When reporting environmental benefit from these cases the unit of measurement will be the number of schools or building units impacted by the enforcement action. The pollutant to report is **"asbestos"** and the media impacted should be identified as **"schools/housing/buildings"**.

Example and Input for ICIS:

For example, under an AHERA enforcement action, the Monroe County School District has been cited for a failure to conduct asbestos inspections at their 4 elementary/secondary schools and have not complied with the management plan requirement for the managing and exposure control of asbestos in each school. The school district will need to designate and train a person to oversee asbestos-related activities in the LEA, will need to utilize a properly accredited person to conduct the asbestos inspections and to help them develop their asbestos management plans.

They will also need to provide custodial and maintenance staff with awareness and proper work practices training. Input for ICIS would include the following:

- **Complying Actions**: Develop/Implement Asbestos Management Plan (Preventative), Training (Preventative), and Asbestos Inspections (FMIP)
- **Pollutant**: Asbestos
- **Unit**: 4 Schools*
- **Media**: schools/housing/buildings

*** Note: Schools refers to the individual schools as opposed to school districts.**

Asbestos NESHAP

The Asbestos NESHAP provides regulatory standards that are applicable to asbestos disposal and asbestos removal from buildings as part of renovation and demolition projects. With the goal of minimizing asbestos emissions during the processing, transport, or disposal of asbestos containing material, the Asbestos NESHAP requires that building owners and/or renovation/demolition contractors follow specific work practices to minimize asbestos releases. Furthermore, the regulation requires that the proper regulatory authorities be notified prior to all demolitions and any renovation involving certain threshold levels of asbestos containing material.

Unlike other NESHAP regulations, the Asbestos NESHAP does not specify a numeric emission limitation for the release of asbestos fiber during renovation/demolition, nor does it require any air monitoring or sampling during renovation or removal activities. Instead of a numeric emissions limitations, the Asbestos NESHAP specifies that zero visible emissions from the outside air are allowed during the removal, transport, or disposal of asbestos containing waste. Towards this end, the asbestos NESHAP requires specific work practices be followed including a requirement that any asbestos containing materials be sufficiently wetted to a level which would prevent release of particulates prior to, during, and after renovation/demolition activities until the point of disposal. In addition, the regulation requires that asbestos containing material be transported in leak-tight containers or wrapped and disposed of at an acceptable disposal site.

For cases triggered by CAA 112(B) (the Asbestos NESHAP) the complying action that will apply is **"Asbestos Abatement"**. When reporting environmental benefit from these cases the unit of measurement will be the number of schools or building units impacted by the enforcement action. The pollutant to report is **"Asbestos"** and the media impacted should be identified as **"schools/housing/buildings"**.

Example Calculation and Input for ICIS:

The environmental benefit measurement of Asbestos NESHAP cases be represented by the number of schools, housing units, or building units impacted by the action.

For example, an inspection of Monroe County's local elementary schools identified loose and decaying asbestos roof tiles. A corresponding enforcement action will result in the removal and disposal of these tiles on 10 schools.

Input for ICIS:

- **Complying Action:** Asbestos Abatement (Preventative)
- **Pollutant:** Asbestos
- **Unit**: 10 schools
- **Media**: schools/housing/buildings

8.4 References

U.S. EPA Region 5, Major Environmental Laws - Toxic Substances Control Act, www.epa.gov/region5/defs/html/tsca.htm

U.S. EPA, Lead in Buildings, www.epa.gov/seahome/child/lead/lbu_m.htm

U.S. EPA, Asbestos - What are the Current Asbestos Requirements, www.epa.gov/seahome/child/asbes/asbes_req.htm

ChemAlliance, Regulatory Handbook, Background: TSCA, www.chemalliance.org/Handbook/background/back-tsca.asp

U.S. EPA, Disposal of Polychlorinated Biphenyls (PCBs); Final Rule, Federal Register Notice. 63 FR 35383, June 29, 1998.

9.0 ENVIRONMENTAL BENEFITS FROM FIFRA ENFORCEMENT CASES

The primary focus of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) is to provide federal control of pesticide distribution, sale, and use. Important FIFRA requirements include the registration of pesticides prior to their sale, distribution, or use (unless the pesticide meets specific exemptions as described in the regulations). Registration includes acceptance by the EPA of the pesticide's label, which gives detailed instructions for its proper use. In addition, EPA must classify each pesticide as either "general use", "restricted use", or both. "General use" pesticides may be applied by anyone, but "restricted use" pesticides may only be applied by certified applicators or persons working under the direct supervision of a certified applicator. Applicators are state-certified if the state operates an EPA approved certification program.

The EPA may issue a civil administrative compliant to any person or company who violates FIFRA. The complaint may impose a civil penalty, and may also require correction of the violation. EPA may also issue a Stop Sale, Use or Removal Order (SSURO) prohibiting the person who owns, controls, or has custody of a violative pesticide or device from selling, using, or removing that product except in accordance with the provisions of the SSURO.

FIFRA enforcement actions can produce Direct Environmental Benefit complying actions, Preventative complying actions, and Facility/Site Management and Information Practice (FMIP) complying actions. Direct environmental benefits should be calculated when a pesticide has been removed from commerce and destroyed or when an import has been denied. Preventative benefits should be calculated when an enforcement action is taken because the pesticide was mislabeled or not properly registered. For both Direct and Preventive complying actions the quantity of pesticide should be calculated and the pollutant reported should be the predominant pesticide active ingredient in the product: e.g., malathion or simazine.

Example of ICIS input where Direct Environmental Benefit Complying Action is taken:

Applicable Section	Actions with Direct Environmental Benefits/Response or Corrective Action	Pollutant Name	Amount	Unit	Potentially Impacted Media
FIFRA 12 FIFRA 13	Pesticide Destroyed Import Denied	Pesticide Active Ingredient	One year's worth of production of pesticide destroyed or denied import	Pounds (convert gallons to lbs using instructions in Section 10.0)	Land Plants

Example of ICIS input where Preventative Actions Occur:

Applicable Section	Preventative Actions to Reduce Likelihood of Future Releases	Pollutant Name	Amount	Unit	Potential Impacted Media
FIFRA 12	Pesticide Registered Pesticide Certified Pesticide Claim Removed Pesticide Label Revision	Pesticide Active Ingredient	One year's worth of production of pesticide	Pounds (convert gallons to lbs using instructions in Section 10.0)	Land Plants
FIFRA 12A2G	Worker Protection Notification .	Pesticide Active Ingredient	Number of Ag Workers on-site the day the Inspector visited the facility.	People	Humans

9.1 Examples and Input for ICIS

Example 1. SSURO (Direct Environmental Benefit Example)

Under a stop sale order, you know that a pesticide identified as *Product X* and containing malathion as its active ingredient will be taken off the shelf and destroyed. One hundred pounds of the material will be impacted by the action. The FIFRA Section Violated is FIFRA 12.

Input for ICIS:

- **Complying Action:** Pesticide Destroyed
- **Pollutant:** Malathion
- **Unit:** 100 pounds
- **Media:** Land, Plants

Example 2. FIFRA Prevention Example

ABC Greenhouse is selling a homemade herbicide containing bromacil called "ABC's Choice". The case reveals that ABC Greenhouse was selling 100 lbs of ABC Choice a year and the herbicide was not registered with the EPA. The FIFRA Section Violated is FIFRA 12A1A (Unregistered Pesticide).

Input for ICIS:

- **Complying Action:** Pesticide Registration
- **Pollutant:** Bromacil
- **Unit:** 100 pounds
- **Media:** Land, Plants

Example 3. FIFRA Misuse Example

Farmer X has sprayed his sweet corn crop with the herbicide simazine and did not post any sort of notification in the field to inform his five agricultural workers that the chemicals had recently been applied. During an EPA inspection of the farm, the inspector notes the lack of notification and issues an administrative penalty order. As a result of the EPA action, we know that the farmer has posted the appropriate notification. The FIFRA Section Violated is FIFRA 12A2G (Misuse).

Input for ICIS:

- **Complying Action:** Notification
- **Pollutant:** Simazine
- **Unit:** 5 People
- **Media:** Humans

9.2 References

U.S. EPA Region 5, Major Environmental Laws - Federal Insecticide, Fungicide, and Rodenticide Act, www.epa.gov/region5/defs/html/fifra.htm

10.0 DENSITIES, UNITS AND UNIT CONVERSIONS

Unit conversion is a simple tool which allows you to describe a quantity in other terms that are of interest. In its most basic form, unit conversion may contain only one step involving multiplication of a given quantity by a known conversion factor. More complex conversions may involve handling multiple sets of given information and conversion factors all within the same calculation. However, the steps for both simple and more complex unit conversions are the same as illustrated by the following examples.

Example 1. Simple Unit Conversion

To convert a pollutant loading discharged to a stream from 1.5 kilograms (kg) per day to pounds (lbs) per day requires the following information: 1.5 kg per day, represents the given information and 2.2 lbs per 1 kg, represents the required conversion factor.

A unit conversion will return an answer in the units of interest. This is accomplished by canceling out identical units that are opposite to each other in separate entries (i.e., one must be in the denominator and one must be in the numerator of the respective entries). In this example, the units for kilograms have been canceled out to return an answer in lbs per day:

$$\frac{1.5\ \text{kg}}{\text{day}} \times \frac{2.2\ \text{lbs}}{1\ \text{kg}} = \frac{3.3\ \text{lbs}}{\text{day}}$$

Example 2. Complex Unit Conversion

An example of a complex unit conversion would be calculating the pounds of particulate matter (PM) emitted per year when given an actual pollutant concentration of 0.15 grains (gr) of PM per dry standard cubic feet (dscf) of exhaust and an exhaust flow rate of 75,000 dscf per minute. For this calculation, the following conversion factors are used.

- 7,000 grains per pound
- 8,760 hours per year
- 60 minutes per hour

As with the previous example, all units except pounds and year will cancel each other out thus returning an answer in the units of interest, pounds per year:

$$\frac{0.15\ \text{grains}}{1\ \text{dscf}} \times \frac{75{,}000\ \text{dscf}}{1\ \text{minute}} \times \frac{1\ \text{pound}}{7{,}000\ \text{grains}} \times \frac{60\ \text{minutes}}{1\ \text{hour}} \times \frac{8{,}760\ \text{hours}}{\text{year}} = \frac{844{,}714\ \text{pounds}}{\text{year}}$$

Example 3. Conversion Requiring Density Information

When dealing with liquid wastes, conversion from a unit of volume to a unit of mass may be required. This can be done using information on the density of the liquid waste/material. An example would be to convert 100 gallons of toluene waste into its equivalent mass (in pounds) using the density of toluene:

100 gallons toluene x 7.227 lbs/gallon = 722.6 lbs. of toluene

Table 10-1 below includes common density factors to use in converting a volume of liquid waste to mass. Chemical densities can also be identified from Material Data Safety Sheets (MSDS) which are accessible via online databases. Table 10-2 below contains common conversion factors encountered in calculations to determine pollutant loading. Table 10-3 contains various examples of unit conversions commonly used to calculate pollutant loadings in air, solid waste, and water media, respectively.

Table 10-1. Common Densities

Pollutant	Density Conversion (lbs/gallon)	Pollutant	Density Conversion (lbs/gallon)
Triethylamine	6.054	Spent Hydrochloric Acid	9.163
Gasoline/Petroleum hydrocarbons/PAHs	6.092	Acrylic Polymer	9.2
Acetone	6.609	Spent Nitric Acid	9.305
Methyl Ethyl Ketone (MEK)	6.718	Antifreeze	9.346
Toluene	7.227	Hydrogen Peroxide	9.597
Fuel Blend/Xylene	7.260	Sodium Hypochlorite	9.722
Benzene	7.335	Dodecylbenzene Sulfonic Acid (DDBSA)	10.014
Ammonium Hydroxide	7.489	1,1,1-Trichloroethane	11.057
Styrene Resin	7.536	Methylene Chloride	11.149
Waste oil/Diesel fuel/Crude oil/Asphaltic oil	7.594	Sodium Hydroxide	11.683
Water	8.345	PCBs	12*
o-Toluidine	8.412	Tetrachloroethylene/ Perchloroethylene	13.552
Salt water/Brine	8.762	Sulfuric Acid	15.021

* As per the PCB penalty policy.

Sources: CRC Handbook of Chemistry and Physics, Perry and Chilton's Chemical Engineers' Handbook, and selected Material Data Safety Sheets.

Note. Densities will vary based on the concentration of the solution and its temperature. The values included in this table are approximate.

Table 10-2. Common Conversion Factors

Mass		Volume	
1 microgram (ug) =	1000 picograms (pg)	1 cubic foot (ft^3) =	7.481 gallons (gal)
1 milligram (mg) =	1000 micrograms (ug)	1 cubic yard (yd^3) =	0 764 cubic meters (m^3)
1 gram (g) =	1000 milligrams (mg)	1 gallon (gal) =	3.785 liters (l)
1 kilogram (kg) =	1000 grams (g)	**Time**	
1 kilogram (kg) =	2.2 pounds (lbs)	1 day =	24 hours
1 megagram (Mg) =	1,000 kilograms (kg)	1 hour =	60 minutes
1 pound (lb) =	7,000 grains (gr)	1 year =	365 days
1 pound (lb) =	454 grams (g)	1 year =	8,760 hours
1 ton (short) =	0.907 metric tons	**Area**	
1 ton (short) =	2,000 pounds (lbs)	1 Acre =	43,560 square feet (sq. ft.)

Table 10-3. Examples of Common Pollutant Loading Conversions for Different Media

Air

$$\frac{0.15\text{ gr PM}}{1\text{ dscf}} \times \frac{75,000\text{ dscf}}{1\text{ minute}} \times \frac{1\text{ pound}}{7,000\text{ gr}} \times \frac{60\text{ minutes}}{1\text{ hour}} \times \frac{8,760\text{ hours}}{1\text{ year}} = \frac{844,714\text{ pounds PM}}{\text{year}}$$

$$\frac{0.07\text{ lbs }NO_x}{1\text{ million Btu}} \times \frac{100\text{ million Btu}}{1\text{ hour}} \times \frac{8,760\text{ hours}}{1\text{ year}} = \frac{61,320\text{ lbs }NO_x}{\text{year}}$$

$$\frac{0.13\text{ pounds VOC}}{\text{thousand lbs steam}} \times \frac{110\text{ thousand lbs steam}}{1\text{ hour}} \times \frac{8,760\text{ hours}}{1\text{ year}} = \frac{125,268\text{ pounds VOC}}{\text{year}}$$

Solid Waste

$$\frac{00\text{ mg benzene}}{1\text{ kg soil}} \times \frac{500\text{ yd}^3\text{ soil}}{1} \times \frac{1.4\text{ Mg soil}}{1\text{ m}^3\text{ soil}} \times \frac{0.764\text{ m}^3}{1\text{ yd}^3} \times \frac{1,000\text{ kg}}{1\text{ Mg}} \times \frac{1\text{ lb}}{454\text{ g}} \times \frac{1\text{ g}}{1,000\text{ mg}} = 118\text{ lt benzer}$$

Water

$$\frac{4.95\text{ mg benzene removed}}{1\ \ell\text{ treated}} \times \frac{1,000\text{ gal}}{1\text{ day}} \times \frac{3.785\ \ell}{1\text{ gal}} \times \frac{365\text{ days}}{1\text{ year}} \times \frac{1\text{ g}}{1,000\text{ mg}} \times \frac{1\text{ lb}}{454\text{ g}} = \frac{15\text{ lbs benzene}}{\text{year}}$$

$$\frac{80\text{ mg BOD}}{1\ \ell} \times \frac{9,000,000\text{ gal}}{1\text{ day}} \times \frac{3.785\ \ell}{1\text{ gal}} \times \frac{\text{g}}{1,000\text{ mg}} \times \frac{1\text{ lb}}{454\text{ g}} = \frac{6,002\text{ lbs BOD}}{\text{day}}$$

11.0 LOOK-UP TABLES

Table 11-1. Typical Pollutant Concentrations (lb/d/1000# of animal) in As Excreted Manure for Beef and Dairy Cattle

Pollutant	Lactating Dairy Cow	Dry Cow	Heifer	Beef Cow
Manure	80.00	82.00	85.00	63 00
TS	10.00	9.50	9 14	7.30
COD	8 90	8.50	8.30	6.00
BOD_5	1.60	1.20	1.30	1.20
N	0 45	0.35	0 31	0.33
P	0 07	0.05	0.04	0 12
K	0 26	0.23	0 24	0.26

Source. USDA's Agricultural Waste Management Field Handbook, Chapter 4.

Table 11-2. Typical Pollutant Concentrations (lb/d/1000# of animal) in As Excreted Manure for Swine

Pollutant	Grower Pig (40-220 lb)	Replacement Gilt	Sow Gestation	Sow Lactation	Boar	Nursery Pig (0-40 lb)
Manure	63 4	32.8	27 2	60.0	20.5	106 0
TS	6.34	3.28	2.50	6 00	1.90	10.60
COD	6.06	3.12	2.37	5 73	1.37	9 80
BOD_5	2 08	1.08	0 83	2 00	0 65	3 40
N	0.42	0.24	0.19	0.47	0 15	0.60
P	0.16	0.08	0 06	0.15	0.05	0.25
K	0.22	0 13	0.12	0.30	0.10	0 35

Source USDA's Agricultural Waste Management Field Handbook, Chapter 4.

Table 11-3. Typical Supernate Pollutant Concentrations (lbs/1000 gal) in Lagoons and Runoff Ponds[a]

Pollutant	Dairy Anaerobic Lagoon	Dairy Aerobic Lagoon	Beef Feedlot Runoff Pond	Swine Anaerobic Lagoon
TS*	20.82	4.17	25.00	20.83
COD	12 50	1.25	11 67	10.00
BOD_5	2.92	0.29	-	3.33
N	1 67	0.17	1.67	2 91
P	0.48	0 08	-	0.63
K	4.17	-	7.50	3 16

a - Source. USDA's Agricultural Waste Management Field Book, Chapter 4,
the TS value is calculated as the sum of the volatile solids + fixed solids concentrations

Table 11-4. Typical Manure Recoverability Factors and Nitrogen/Phosphorus Losses by Animal Type

Animal Type	Recoverability Factor	Nitrogen Losses (percent loss)	Phosphorus Losses (percent loss)
Beef Cows	0 98	60.0	15 1
Milk Cows	0 98	59.8	14 1
Heifers	0 98	70 0	15 4
Breeding Hogs	0 95	75 0	15 4
Hogs for Slaughter	0.95	75 0	14 9

Source· USDA's Manure Nutrients Relative to the Capacity of Cropland and Pastureland to Assimilate Nutrients. Spatial and Temporal Trends for the United States, December 2000.

Table 11-5. Typical Animal Weight and Manure Density for Beef and Dairy Cattle

Animal Type	Animal Weight (lbs)	Manure Density (lb/cu. ft.)
Beef Cattle	877	62
Mature Dairy Cattle	1,350	62
Heifers	550	62

Source· Cost Methodology Report for Beef and Dairy Animal Feeding Operations, EPA-821-R-01-019, January 2001.

Table 11-6. Typical Crop Uptake Values

Crop Type	Nitrogen (lbs N/yield unit)	Phosphorus (lbs P/yield unit)
Corn for grain	0 80 lbs/bushel	0.15 lbs/bushel
Corn for silage	7.09 lbs/ton	1.05 lbs/ton
Soybeans	3 55 lbs/bushel	0.36 lbs/bushel
Sorghum for grain	0 98 lbs/bushel	0.18 lbs/bushel
Sorghum for silage	14 76 lbs/ton	2 44 lbs/ton
Cotton (lint and seed)	15 19 lbs/bale	1.89 lbs/bale
Barley	0.90 lbs/bushel	0.18 lbs/bushel
Winter wheat	1 02 lbs/bushel	0 20 lbs/bushel
Durum wheat	1.29 lbs/bushel	0.22 lbs/bushel
Other spring wheat	1 39 lbs/bushel	0.23 lbs/bushel
Oats	0 59 lbs/bushel	0 11 lbs/bushel
Rye for grain	1 07 lbs/bushel	0.18 lbs/bushel
Rice	1.25 lbs/bag	0.29 lbs/bag
Peanuts for nuts (w/pods)	0.04 lbs/lb	0 003 lbs/lb
Sugar beets for sugar	4 76 lbs/ton	0 94 lbs/ton
Tobacco (IN, MO, OH, and WV)	0 0298 lbs/lb	0.0024 lbs/lb
Tobacco (KY)	0 0299 lbs/lb	0.0024 lbs/lb
Tobacco (NC)	0.0329 lbs/lb	0.0020 lbs/lb
Tobacco (TN)	0.0302 lbs/lb	0.0023 lbs/lb
Tobacco (VA)	0 0322 lbs/lb	0.0021 lbs/lb
Tobacco (all other states)	0 0330 lbs/lb	0.0020 lbs/lb
Potatoes	0.36 lbs/bag	0.06 lbs/bag
Sweet Potatoes	0.13 lbs/bushel	0.02 lbs/bushel
Alfalfa hay	50 40 lbs/ton	4 72 lbs/ton
Small grain hay	25.60 lbs/ton	4.48 lbs/ton
Other tame hay/Wild hay	19.80 lbs/ton	15.30 lbs/ton
Grass silage	13.60 lbs/ton	1 60 lbs/ton
Sorghum hay	2.39 lbs/ton	1.01 lbs/ton

Source: USDA's Manure Nutrients Relative to the Capacity of Cropland and Pastureland to Assimilate Nutrients. Spatial and Temporal Trends for the United States, December 2000.

Table 11-7. NO_x and SO_2 Emission Factors for Boiler Fuel Oil Combustion

Firing Configuration (SCC)[a]	NO_x Emission Factor ($lb/10^3$ gal)[b]	SO_2 Emission Factor ($lb/lb/10^3$ gal)[c]
Boilers > 100 Million Btu/hr		
No. 6 oil fired, normal firing (1-01-004-01), (1-02-004-01), (1-03-004-01)	47	157S
No. 6 oil fired, normal firing, low NO_x burner, (1-01-004-01), (1-02-004-01)	40	157S
No. 6 oil fired, tangential firing, (1-01-004-04)	32	157S
No 6 oil fired, tangential firing, low NO_x burner, (1-01-004-04)	26	157S
No 5 oil fired, normal firing (1-01-004-05), (1-02-004-04)	47	157S
No. 5 oil fired, tangential firing, (1-01-004-06)	32	157S
No. 4 oil fired, normal firing (1-01-005-04), (1-02-005-04)	47	150S
No. 4 oil fired, tangential firing, (1-01-005-05)	32	150S
No 2 oil fired (1-01-005-01), (1-02-005-01), (1-03-005-01)	24	157S
No. 2 oil fired, LNB/FGR, (1-01-005-01), (1-02-005-01), (1-03-005-01)	10	157S
Boilers < 100 Million Btu/hr		
No 6 oil fired, (1-02-004-02/03), (1-03-004-02/03)	55	157S
No 5 oil fired, (1-03-004-04)	55	157S
No 4 oil fired, (1-03-005-04)	20	150S
Distillate oil fired (1-02-005-02/03), (1-03-005-02/03)	20	142S
Residential furnace (A2104004/A2104011)	18	142S

a - SCC = Source Classification Code

b - Expressed as NO_2. Test results indicate that at least 95% by weight of NO_x is NO for all boiler types except residential furnaces, where about 75% is NO. For utility vertical fired boilers use 105 $lb/10^3$ gal at full load and normal (>15%) excess air Nitrogen oxides emissions from residual oil combustion in industrial and commercial boilers are related to fuel nitrogen content, estimated by the following empirical relationship: lb $NO2/10^3$ gal = 20.54 + 104 39(N), where N is the wight % of nitrogen in the oil. For example, if the fuel is 1% nitrogen, then N = 1.

c - S indicates that the weight % of sulfur in the oil should be multiplied by the value given. For example, if the fuel is 1% sulfur, then S = 1.

Source: Table 1.3-1 of AP-42 (EPA, 1995)

Table 11-8. NO_x Emission Factors for Boiler Natural Gas Combustion

Combustor Type (MMBtu/hr Heat Input [SCC]	NO_x Emission Factor (lb/10^6 scf)[a]
Large Wall-Fired Boilers (>100) [1-01-006-01, 1-02-066-01, 1-03-006-01]	
Uncontrolled (Pre-NSPS)[b]	280
Uncontrolled (Post-NSPS)[b]	190
Controlled - Low NO_x burners	140
Controlled - Flue gas recirculation	100
Small Boilers (<100) [1-01-006-02, 1-02-006-02, 1-03-006-02, 1-03-006-03]	
Uncontrolled	100
Controlled - Low NO_x burners	50
Controlled - Low NO_x burners/Flue gas recirculation	32
Tangential-Fired Boilers (All Sizes) [1-01-006-04]	
Uncontrolled	170
Controlled - Flue gas recirculation	76
Residential Furnaces (<0.3) [No SCC]	
Uncontrolled	94

a - Expressed as NO_2. For large and small wall fired boilers with SNCR control, apply a 24 percent reduction to the appropriate NO_x emission factor For tangential-fired boilers with SNCR control, apply a 13 percent reduction to the appropriate NO_x emission factor.
b - NSPS = New Source Performance Standard s defined in 40 CFR Subparts D and Dp. Post-NSPS units are boilers with greater than 250MMBtu/hr of heat input that commenced construction, modification, or reconstruction after August 17, 1971, and units with heat input capacities between 100 and 250 MMBtu/hr that commenced construction, modification, or reconstruction after June 19, 1984.
Source: Table 1.4-1 of AP-42 (EPA, 1995)

Table 11-9. SO_2 Emission Factors for Boiler Natural Gas Combustion

Pollutant	Emission Factor (lb/10^6 scf)
SO_2[a]	0 6

a - Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content is natural gas of 2,000 grains/10^6 scf. The SO_2 emission factor in this table can be converted to other natural gas sulfur contents by multiplying the SO_2 emission factor by the ratio of the site-specific sulfur content (grains/10^6 scf) to 2,000 grains/10^6 scf.
Source: Table 1.4-2 of AP-42 (EPA, 1995)
Note: This emission factor is to be used for all natural gas fired boilers

Table 11-10. NO_x Emission Factors for Process Heater Natural Gas Combustion

Type of Process Heater	Uncontrolled NO_x Emission Factor (lb/MMBtu)[a]	NO_x Control Technique	Controlled NO_x Emission Factor (lb/MMBtu)
ND	0.098	(ND) LNB	0.049
		(ND) ULNB	0.025
		(ND) SNCR	0 039
		(ND) LNB + (ND) SNCR	0.020
MD	0 197	(MD) LNB	0 099
		(MD) ULNB	0.049
		(MD) SNCR	0 079
		(MD) SCR	0.049
		(MD) LNB + FGR	0 089
		(MD) LNB + SNCR	0 039
		(MD) LNB + SCR	0 025

a - Uncontrolled emissions for natural gas-fired heaters are from thermal NO_x formation
ND = natural draft
MD = mechanical draft
Source. Table 5-11 and 5-12 of *Alternative Control Techniques Document - NO_x Emissions from Process Heaters* (EPA, 1993)

Table 11-11. NO_x Emission Factors for Process Heater Oil Combustion

Model Heater Capacity (MMBtu/hr)	Type of Process Heater	Fuel	Uncontrolled Emission Factor (lb/MMBtu)		NO_x Control Technique	Controlled NO_x Emission Factor (lb/MMBtu)
			Thermal NO_x[a]	Fuel NO_x[b]		
69	ND	Distillate Oil	0.14	0.06	(ND) LNB	0.121
					(ND) ULNB	0.048
					(ND) SNCR	0.080
					(ND) LNB + (ND) SNCR	0.048
69	ND	Residual Oil	0.14	0.28	(ND) LNB	0.308
					(ND) ULNB	0.097
					(ND) SNCR	0.168
					(ND) LNB + (ND) SNCR	0.123
135	MD	Distillate Oil	0.26	0.06	LNB	0.175
					ULNB	0.082
					SNCR	0.128
					SCR	0.080
					LNB + FGR	0.168
					LNB + SNCR	0.070
					LNB + SCR	0.026
135	MD	Residual Oil	0.26	0.28	LNB	0.340
					ULNB	0.143
					SNCR	0.216
					SCR	0.135
					LNB + FGR	0.355
					LNB + SNCR	0.136
					LNB + SCR	0.051

a - Uncontrolled emission factor for thermal NO_x represents the NO_x from thermal NO_x formation
b - Uncontrolled emission factor for fuel NO_x represents the NO_x from fuel NO_x formation
ND = natural draft
MD = mechanical draft
Source. Table 5-13 and 5-14 of *Alternative Control Techniques Document - NO_x Emissions from Process Heaters* (EPA, 1993)

Table 11-12. Estimated Control Efficiencies (%) for NO_x

Process	Operation	Control Device Type	Average Control Efficiency (%)	Control Efficiency Range (%)
Chemical Manufacturing	Acrylonitrile - Incinerator Stacks	Selective Non-catalytic Reduction	80	
Fuel Combustion - Coal	Boiler	Flue Gas Recirculation		5-45
Fuel Combustion - Coal	Boiler	Low Excess Air		5-30
Fuel Combustion - Coal	Boiler	Low NO_x Burners		35-55
Fuel Combustion - Coal	Boiler	Natural Gas Burners/Reburn		50-70
Fuel Combustion - Coal	Boiler	Overfire Air		5-30
Fuel Combustion - Coal	Boiler	Selective Catalytic Reduction		63-94
Fuel Combustion - Coal	Boiler	Selective Non-catalytic Reduction	90	
Fuel Combustion - Distillate Oil	Boiler	Flue Gas Recirculation		45-55[a]
Fuel Combustion - Distillate Oil	Boiler	Low Excess Air		2-19
Fuel Combustion - Distillate Oil	Boiler	Overfire Air		20-45
Fuel Combustion - Distillate Oil	Boiler	Selective Catalytic Reduction		90 (max)
Fuel Combustion - Coal		Low-NO_x Burner with Selective Non-catalytic Reduction		50-80
Fuel Combustion - Coal		Low-NO_x Burner with Overfire Air and Selective Catalytic Reduction		85-95
Fuel Combustion - Coal	Boiler	Low-NO_x Burner with Overfire Air		40-60
Fuel Combustion - Municipal Waste	Boiler	Selective Catalytic Reduction	69	80 (max)
Fuel Combustion - Municipal Waste	Incinerator	Selective Non-catalytic Reduction		30-65
Fuel Combustion - Natural Gas	Boiler	Flue Gas Recirculation		49-68
Fuel Combustion - Natural Gas	Boiler	Low Excess Air		0-31
Fuel Combustion - Natural Gas	Boiler	Low NO_x Burners		40-85
Fuel Combustion - Natural Gas	Boiler	Overfire Air	60	13-73

Table 11-12. Estimated Control Efficiencies (%) for NO_x (Continued)

Process	Operation	Control Device Type	Average Control Efficiency (%)	Control Efficiency Range (%)
Fuel Combustion - Natural Gas	Boiler	Selective Catalytic Reduction		80-90
Fuel Combustion - Natural Gas	Boiler	Selective Non-Catalytic Reduction		35-80
Fuel Combustion - Natural Gas	Gas Turbines	Selective Catalytic Reduction		60-96
Fuel Combustion - Natural Gas	Gas Turbines	Water or Steam Injection		60-94
Fuel Combustion - Natural Gas	Reciprocating Engines	Selective Non-catalytic Reduction		80-90
Fuel Combustion - Natural Gas	Gas Turbines	Staged Combustion		50-80
Fuel Combustion - Natural Boiler Gas	Boiler	Low-NO_x Burner with Overfire Air		40-50
Fuel Combustion - Residual Oil	Boiler	Flue Gas Recirculation	21	2-31
Fuel Combustion - Residual Oil	Boiler	Low Excess Air		5-31
Fuel Combustion - Residual Oil	Boiler	Overfire Air		24-47
Fuel Combustion - Residual Oil	Boiler	Selective Catalytic Reduction		70-80
Fuel Combustion - Residual Oil	Boiler	Selective Non-catalytic Reduction		35-70
Fuel Combustion - Utility Oil or Natural Gas	Boiler	Flue Gas Recirculation		40-65
Fuel Combustion - Wood	Boiler	Selective Non-catalytic Reduction		50-70
Mineral Products Industry	Glass Flue	Selective Non-catalytic Reduction		50-75
Petroleum Industry	Process Heater	Selective Catalytic Reduction	90	
Petroleum Industry	Process Heater	Selective Non-catalytic Reduction	-	35-70

a - Average of widely varying values
Source: Table 12.3-1 of EIIP, Vol II, Chapter 12