Miller

DRAFT MANUAL OF PRACTICE
IDENTIFICATION OF
ILLICIT CONNECTIONS

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Section 1

INTRODUCTION

The United States Environmental Protection Agency (EPA) is in the process of developing and implementing comprehensive national strategies to coordinate National Pollutant Discharge Elimination System (NPDES) permitting efforts for discharges from combined sewer overflows (CSOs) and discharges from separate storm sewers. An important component of these control strategies is the reduction of pollutants from industrial and commercial sites discharged to separate and combined drainage systems.

The impetus for this initiative was the 1987 amendments to the Clean Water Act (CWA). Among other things, the amendments included the control of discharges to separate storm water drainage systems from industrial and commercial sites. Storm water drainage systems can be in the form of open ditches, swales, channels, brooks, and subterranean routes, or closed pipes, as well as sewers. Storm sewers are designed to convey only storm water, surface runoff, street wash waters and drainage [40 CFR 35.2005(b)(47)].

However, recent research efforts have shown that industrial, commercial, and sanitary contamination of separate storm drainage systems has become a nationwide problem. The contamination can be attributed to illicit connections. Illicit connections are point source discharges of pollutants to separate storm drainage systems which are not composed entirely of storm water and are not identified in an NPDES permit. There are two categories of illicit connections - pronounced and subtle. Pronounced connections are from direct hook-ups to storm drainage systems. Subtle connections are indirect, intermittent, and usually do not involve piping.

Both pronounced and subtle illicit connections MAY adversely affect the quality of receiving waters. Therefore, the removal and prevention of such discharges ~~will~~ CAN result in improvements in the quality of receiving waters.

Nationwide studies have shown that illicit connections are most prominent in commercial and industrial sites. The type of materials that are illegally discharged into storm water sewers vary considerably. Therefore, distinct physical and chemical characteristics can be used to identify non-storm water from storm water discharge.

The purpose of this manual is to present a procedure for the identification of illicit connections into storm drainage systems. The goal is to ensure that storm drainage systems do not receive non-storm water or other non-permitted discharges. The methodology presented has been designed to be flexible so as to accommodate both industrial and commercial facilities. In an effort to simplify the text, the word "industrial" has been used to connote both industrial and commercial facilities.

The methodology of this manual has been organized as a step-by-step procedure to follow and implement. These procedures are guidelines for use with reasonable judgement on a case-by-case basis.

The intended use for this manual is by regulatory or industrial personnel. It is important to note that this document has been written for ~~a non-technical audience~~. Therefore, principles have been developed with the understanding that the reader has little or no knowledge in the area of industrial non-storm water discharges.

Section 2

MANUAL APPROACH

There are two phases in the approach of this manual. The first phase involves the screening of storm sewer outfalls for indications of possible industrial or commercial contamination. The second phase is the investigation of the industrial or commercial facility for identification of actual illicit connections into the storm drainage system.

Both of these phases are divided into a number of sub-sections as shown below which are described in more detail in the following sections.

<u>Outfall Evaluation</u>

- Mapping Effort
- Walking Tour
- Outfall Analysis

<u>On-Site Industrial Investigation</u>

- Data Collection
- Preliminary Evaluation of Water Use and Other Discharges
- On-Site Investigation
- Confirmatory Analysis

In addition, the final section is a discussion of the field survey techniques essential for both phases. This section provides organizational ideas for field testing procedures. General estimates regarding personnel and time requirements necessary to carry out field surveys as well as equipment cost data are also included in this section.

Section 3

OUTFALL EVALUATION

The investigative procedure begins with the identification of storm water outfalls suspected or known to be discharging contaminated non-storm water flows to receiving water bodies.

This initial phase consists of three steps. The first step is a mapping effort during which outfalls likely to exhibit industrial discharge contamination are identified. High potential storm water outfalls are selected based upon the proximity of industrial sites and the density of industrial activity within the drainage area. The second step involves conducting field surveys in order to screen selected outfalls for actual signs of industrial discharge contamination. In the third step, observations of storm water outfalls indicating signs of possible industrial contamination are documented; physical characteristics are observed, elementary chemical analyses are performed, flow patterns are established, and samples are collected for comprehensive laboratory analyses.

Actual field testing procedures are discussed in detail in Section 7 of this manual.

STEP 1 - MAPPING EFFORT

The purpose of the mapping effort is to identify all storm water outfalls that may exhibit signs of industrial discharge contamination, and to delineate the industrial zones that contribute to these outfalls. This process involves the acquisition and study of land-use, drainage (topographic), and sewer maps for the area under investigation.

Once the industrial outfalls have been located and the contributing area delineated, they can be classified as having either high or low potential for illicit connections. The purpose of this classification exercise is to organize the outfalls according to their potential for illicit connections. Those most likely to exhibit industrial discharge contamination are the first to be visited during the field survey.

Several factors can aid in the classification of outfalls into high or low potential for illicit connection categories. A few of these factors are briefly described below:

- Density of industrial activities within delineated areas. If several industries are confined to a relatively small area, then the potential for illicit or inadvertent cross-connections is greater.

- Type of industrial activity. The industrial activity in terms of principal products or services provided should be correlated with the nature of the water quality problems of the receiving water, if such information is known. Often a single industry may contribute significant levels of pollutants to a water body. For example, in one study, highly odorous and colored discharges at an outfall were attributed to a tannery.

- Proximity of industries. The proximity of an industry to an outfall should also be correlated with the water quality of the receiving water if such information is known.

Mapping and other available information required for outfall identification and classification are described in the following sections.

Land Use

Land use maps document the land surface according to generalized uses. This is valuable because the type of land use has been found to be highly correlated to the pollution characteristics of storm waters that originate from an area. Land use maps are usually maintained by local and/or regional governments. Generally, land use is categorized according to the following classifications:

- residential
- industrial
- commercial
- recreational
- agricultural
- open space

Drainage/Topography

These maps document the elevations and general relief of the land surface. The topography of a land surface determines the direction of overland flow of storm water runoff. For example, in an area drained by two streams, it is possible to identify the contributing areas to the flows of each stream by examination of topographic maps. Water will flow in the path of decreasing elevation. Therefore, using topographic maps, it is possible to construct the probable drainage path of surface runoff. These maps are generally maintained by local units of government within the study area.

Aerial Photographs

Aerial photographs are another means of determining features on the land surface. The aerial photographs should be of large enough scale so that industrial areas can be identified. Aerial photographs can also be used to identify storage areas at industrial sites that may contribute significant amounts of pollutants during wet weather. Finally, they can also be used to determine the proximity and density of industrial areas relative to outfall locations. Aerial photographs may be obtained from local land use planning committees as well as from state agencies.

Sewers

Developed areas in the United States have extensive networks of sewers. They can be classified as follows:

- Sanitary Sewer. These are conduits intended to carry liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions together with minor quantities of ground, storm, and surface water that are not admitted intentionally [40 CFR 35.2005(b)(37)].
- Storm Sewer. A sewer designed to carry only storm waters, surface runoff, street wash waters, and drainage [40 CFR 35.2005(b)(47)].
- Combined Sewer. A sewer that is designed as a sanitary sewer an a storm sewer [40 CFR 35.2005(b)(11)].

Of primary interest is storm sewers which have illicit or inadvertent industrial connections. Sewer maps may be obtained from state agencies, local engineering departments, or from other authorities such as publicly owned treatment works. Sewer maps can be used to identify which lines are connected to contaminated storm water outfalls. They are also used to determine where industrial manufacturing process and operational wastestreams are discharged.

Permits

Industrial activity within the study area should be classified according to the category and types of wastes generated. To accomplish this, environmental control permits for these industries should be obtained. The categorical standards pertaining to industrial wastewater discharges will provide information on the types of pollutants to be expected in discharges from an industry. For example, metal fabricating or processing industries are likely to discharge wastewaters with higher metallic ion concentrations than a food processing industry. Permits may be obtained either directly from a particular industry or from other authorities such as publicly owned treatment works, state agencies, or EPA regional offices.

Summary

Mapping and data obtained for the study area should be summarized as follows:

- Assign an identification number to each industrial storm sewer outfall with potential industrial sources
- Delineate a contributing industrial area to each outfall
- Identify industries within these areas

Based on the likelihood for illicit connections, the field surveys should be organized such that outfalls exhibiting the highest potential for illicit connections are the first to be surveyed.

STEP 2 - WALKING TOUR

The purpose of the walking tour is to identify storm water outfalls exhibiting characteristics of possible industrial discharge contamination for further analysis. In addition, other outfalls not identified during the mapping effort may be discovered. It is important to note that outfalls may be submerged below the water level or may be inaccessible for some other reason. Thus, the screening of both inaccessible and directly accessible storm water outfalls is addressed.

Inaccessible Outfalls

If a storm water outfall is submerged under water or inaccessible for some other reason, a modified screening approach will be necessary.

Since direct inspection will not be possible, the storm water manhole nearest to the outfall discharge point should be located. During a period of dry weather, the manhole cover should be removed and visual observations made to detect any non-storm water discharges. If a discharge is discovered, at least two grab samples should be collected for comprehensive laboratory analysis. Noticeable physical and elementary chemical properties of the discharge should also be recorded.

If a particular odor or residue exists in a storm water manhole, illicit discharges may exist but not be present. These signs indicate the need for additional observations in order to detect the potential discharge at the manhole.

Accessible Outfalls

If the outfall is accessible, the inspectors should visit each of the selected outfalls to perform initial visual inspections for signs of illicit discharges. When walking from one outfall to the next, inspectors should check for storm outfalls not indicated on maps. Visual observations should also be made at any newly-discovered outfalls as well. Identification data should be noted for unmarked outfalls so that current maps can be updated.

When performing a visual outfall inspection, the inspector should first check for discharges or the presence of discharges such as wet pavement or residue. Flows during dry weather, when it has not rained recently, are a definite sign of possible illicit connections.

After checking for the presence of discharges, the following physical characteristics of any detected flows, the outfall, and surrounding area should be observed.

<u>Physical Characteristics</u>

Odor

The odor of a discharge can vary widely and often directly reflects the source(s) of contamination. Thus, potential non-storm water discharge will often cause a flow to smell like a particular spoiled product, oil, gasoline, certain chemicals and solvents, or whatever else may be the cause or a component of the contamination. For example, in many facilities the decomposition of organic wastes will release sulfur into the atmosphere creating an intense smell of rotten eggs. In particular, industries involved in the production of meats, dairy products, and the preservation of vegetables or fruits, are commonly found to discharge organic materials into storm drains. As these organic products or byproducts spoil and decay, the sulfur production creates this readily apparent and unpleasant smell.

Color

Non-storm water discharge can be any color; however, it generally is a darker shade such as brown, gray or black. Outfall discharges may become highly colored from the direct discharge of industrial wastes. For instance, the color of industrial wastewaters from meat processing industries is usually a deep reddish-brown. Paper mill wastes are also brown. In contrast, textile wastes are varied, intense colors, while plating-mill wastes are often yellow. The waste from spray paint booths which may be washed down to floor drains may also result in varied colors. Field measurements of color can be performed using a colorimeter.

Turbidity

Turbidity determines the clarity of an outfall discharge. It is a measurement of the amount of suspended matter which interferes with the passage of light through water. Turbidity may be caused by both fine and coarse suspended materials. These materials may range from purely inorganic substances to those that are largely organic in nature. Turbidity values may range from essentially zero in pure water to several thousand in highly polluted conditions. Many industrial wastewaters are highly turbid. Thus, a dry weather discharge at an outfall with a high degree of turbidity is a strong sign of a possible industrial discharge contamination.

Floatables

A contaminated flow may also contain floatables. These are any floating solids or liquids derived from non-storm water discharge or storm water washoff. Evaluation of floatables often leads to the identity of the source of industrial pollution since these substances are usually direct products or byproducts of a manufacturing process. Floatables may include substances such as animal fats, spoiled food products, oils, plant parts, solvents, sawdust, foams, packing materials, or any type of fuel.

Three physical characteristics of the sewer outfall which can indicate whether or not there is a non-continual source of contamination are residue, vegetation, and structural damage.

Residue

Residue refers to any type of coating which remains after a non-storm water discharge has taken place. Residues tend to coat the area surrounding the outfall and are usually a dark color. They often will contain fragments of floatable substances and may take the form of a crystalline or amorphous powder. These situations are illustrated by the grayish-black residue, containing fragments of animal flesh and hair, which is often produced by leather tanneries or the white crystalline powder which commonly coats sewer outfalls at nitrogenous fertilizer plants.

Vegetation

Vegetation surrounding an outfall will also show the effects of intermittent or random non-storm water discharge. Pollutants will often cause a substantial alteration in the chemical composition and pH of the discharge stream. This alteration will affect plant growth even when the exposure is intermittent. For example, decaying organic materials coming from various food product wastes would cause an increase in plant life. Whereas the loss of chemical dye and inorganic pigments from textile mills could noticeably decrease vegetation as these non-storm water discharges often have a very acidic pH. In either case, even if the source of pollution is gone, the vegetation surrounding the outfall will continue to show the effects of the contamination.

In order to accurately judge if the vegetation surrounding an outfall is normal, the observer must take into account the climate as well as the time of year in the area. In addition, the vegetation of outfalls close in proximity to the one under investigation should also be noted as a means of comparison. Thus, inhibited plant growth as well as dead and decaying foliage can indicate the season or weather conditions in addition to being a sign of pollution.

Structural Damage

Structural damage is another highly visible indication of both continuous and intermittent non-storm water discharge contamination. This occurs when certain pollutants reside at an outfall and cause structural damage such as cracking, deterioration, and spauling of the concrete or peeling of surface paint. These contaminants are usually very acidic or basic in nature. For instance, primary metal industries have a strong potential for structural damage because their batch dumps are highly acidic.

STEP 3 - OUTFALL ANALYSIS

Closer analysis of an outfall is warranted if any flows are detected and/or any physical characteristics appear to indicate the potential for illicit connections during the initial inspection.

If a flow is occurring during dry weather, the time and day of the week should immediately be recorded. Next, documentation of the observed physical characteristics at the contaminated outfall should also be recorded.

Observation of basic chemical characteristics may reveal a great deal of information about the flow quality of a discharge as well. Once preliminary documentation has been completed, an elementary chemical analysis of any discharges should also be performed.

Testing for pH, total dissolved solids, and conductivity can be easily performed in the field with specialized meters. Further testing for specific elements, total phenol, free cyanide, and for many other chemicals can also be done in the field. This requires the aid of units such as field test kits. These tests may also be performed through laboratory analysis of samples taken from an outfall.

pH

Measurement of pH determines if a solution is in either an acidic or alkaline condition. Several kinds of pH meters are available which can be used to determine the presence and approximate intensity of an acidic or alkaline condition at an outfall. The possibility of direct discharge of industrial wastewater is often indicated by dry weather flows which are found to be acidic, alkaline, or which alternate between the two extremes.

The normal pH of storm water is usually between 5 and 9. However, the pH at an outfall affected by a source of contamination may vary in the range from 3 to 12. Acids and alkalies are commonly found in the wastewaters of those industries which use chemicals as part of various manufacturing processes. Illicit connections conveying discharges from such processes could lead to extreme pH levels.

Acidic, non-storm water discharges in the range of 3 to 5 are possible from textile mills, pharmaceutical manufacturers, metal fabricators as well as companies producing resins, fertilizers, pesticides, or other similar materials. Wastes containing sulfuric, hydrochloric, or nitric acids are the common cause of acidic contamination.

Alkalis may cause non-storm water discharges to become more basic and enter the higher pH range of 9 to 12. Many industrial alkaline wastes contain chemicals such as sodium cyanide, sodium sulfide, and sodium hydroxide. High concentrations of these contaminants are found in non-storm water discharges from soap manufacturers, textile mills, metal plating industries, steel mills, and producers of rubber or plastic. In addition, alkaline wash waters used by many industries to clean floors or manufacturing machinery are a typical source of illicit discharges.

Total Dissolved Solids

Total Dissolved Solids (TDS) refers to the amount of solid material completely dissolved in a water sample. Dissolved solids consist mainly of inorganic salts, small amounts of organic matter, and dissolved gases. A high amount of total dissolved solids is a strong indication that flows from sources other than storm water could be entering the storm water system.

Ranges of possible TDS readings are as follows:

Clear Water	100 - 200 ppm
Rainwater	150 - 500 ppm
Storm water Runoff	200 - 5,000 ppm
Non-Storm water Discharge	- greater than 2,000 ppm
Undiluted Industrial Wastes	- greater than 10,000 ppm

Conductivity

The conductivity of a solution is a measure of its ability to conduct an electrical current. Conductivity measurements may be taken with a special meter to provide a rapid estimate of the dissolved solids content of a water sample.

Only charged particles such as ions carry electrical current. Therefore, water samples with high proportions of uncharged organic molecules will have low specific conductivity values. It should be noted, however, that samples with very high or low pH values will show high specific conductivities due to the high concentrations of H^+ and OH^- ions. Conductivity measurements are also temperature dependent.

If a discharge is present at the time of the initial inspection, elementary chemical analysis for pH, total dissolved solids, and specific conductivity should immediately be performed. Results of the testing should always be recorded and at least two grab samples should be taken for comprehensive laboratory testing. (Parameters of concern for laboratory analysis are discussed in detail in the section on Field Survey Techniques.)

SUMMARY

If signs of an illicit discharge appear evident but there is no flow occurring, additional field surveys of the outfall will be necessary. Further inspections of the outfall should be scheduled for various times and days throughout the week in order to completely evaluate the discharge. Or, as an alternative, an automatic sampler may be installed and checked on a regular basis. Once the discharge has been discovered, the time and day of the week on which the flow occurred should be recorded. Elementary chemical analysis should be performed and grab samples should be collected as well.

Once the field surveys of all outfalls scheduled for the walking tour have been completed and initial inspections for illicit discharges have been fully documented, the identification of potential industrial sources may be pursued.

Section 4

IDENTIFICATION OF POTENTIAL INDUSTRIAL SOURCES

The purpose of this section is to define techniques which will serve as guidelines in selecting which industrial facilities may be responsible for an illicit discharge discovered at a storm water outfall. Support information is also presented which will aid in the correlation between an illicit discharge and the suspected industrial facility. However, since there is no clear-cut way to pinpoint the actual industrial source, it is important to keep in mind that the techniques presented are not infallible. Rather, this section should serve as a basis for organizing all collected data in a fashion which will allow the user of this manual to narrow the choices and select the industrial facility most likely responsible for the discovered illicit discharge.

In order to identify the potential sources of a non-storm water discharge when industrial contributors are suspected, the following questions should be considered:

- What is the flow pattern of the non-storm water discharge?
- What distinctive qualities of the non-storm water discharge are revealed by the observed physical and chemical properties?

Answering these questions will lead to a characterization of the discovered illicit discharge. The following text describes the evaluation process to determine which industrial facilities could be responsible according to non-storm water discharge characterization. Step 1 begins with establishing the flow pattern of the non-storm water discharge. In Step 2, documented data is analyzed to reveal any distinguishing characteristics. Step 3 involves making the correlation between an illicit discharge and the most likely industrial source.

STEP 1 - ESTABLISH FLOW PATTERN

The flow pattern of a potentially illicit discharge may be either continuous or intermittent, as described below.

Continuous Dry Weather Flow

A visible sign of non-storm water contamination is continuous flow in a storm water drainage system pipe or drainage ditch during dry weather. Flow in the absence of storm water runoff clearly indicates that a secondary source (or sources) is contributing unknown substances to the storm drain flow. Continuous discharges will release water or other liquids at a uniform and uninterrupted rate. Typical sources of continuous flows include leaks from manufacturing equipment, constant overflows from wet processes, and released non-contact cooling water which has been contaminated. Continuous dry weather flows are not always contaminated. They may also originate from either groundwater infiltration and/or permitted industrial discharges.

Intermittent Dry Weather Flow

Another strong indicator of non-storm water discharge is intermittent flow during dry weather. Intermittent discharges release flow periodically. This may be a fixed cycle, for example at every half hour, or at variable intervals. If the source is industrial, discharge may occur on a regular basis or randomly, depending on production schedules. The main sources are rinse waters, batch dumps, process dumps, process line discharge, or spills.

Intermittent discharges may result from non-industrial sources as well. Several examples of potential non-industrial sources are listed below:

Sewage Sources:
- raw sewage from leaking sanitary sewers
- septage from improperly operating septic tank systems

Household Automobile and Maintenance:
- car washing runoff
- radiator flushing
- improper oil disposal

Residential Watering Runoff

Roadway and Other Accidents:
- fuel spills
- spills of truck contents
- pipeline spills

Other:
- washing of ready-mix trucks
- laundry wastes
- improper disposal of other household toxic substances
- sump pump discharges
- contaminated surface and groundwater infiltration

Infiltration of groundwater into sewers in areas with high groundwater tables may result in flows observed in sewer systems as noted above. However, flows will typically not exhibit fluctuations, such as short-term, hourly variations which may be more typical for industrial discharges.

If the flow pattern was not established during the initial outfall inspection from the walking tour, additional field surveys will be necessary. These inspections should be scheduled for various times and days throughout the week or an automatic monitor may be used to determine the flow pattern.

STEP 2 - ANALYSIS OF RECORDED DATA

The purpose of this step is to review all recorded data for distinguishing characteristics of the potentially illicit discharge. This review typically includes an analysis of all physical observations and chemical parameters which appear as unusual.

Physical observations which work well for characterization include the odor and color of the discharge as well as any floating material or residues. Extremely high or low values for the various parameters as measured from the elementary chemical analysis or the comprehensive laboratory testing are also strong indicators. These factors can be used to identify possible industrial sources.

All distinguishing characteristics should be noted before proceeding to the next step.

STEP 3 - CORRELATION TO POSSIBLE INDUSTRIAL SOURCES

In this step, an answer to the following question is sought:

- Which industrial facilities could be responsible for this particular non-storm water discharge?

The following support data has been provided to simplify the task of selecting the most likely industrial source for an illicit discharge.

Sources of Non-Storm Water Discharge Related to Industry

Table 1 is provided to rank the most likely ways in which various facilities could produce non-storm water discharges. The categories considered included loading and unloading of dry bulk or liquids, water usage in reference to cooling and process waters, and illicit or inadvertent industrial connections. The likelihood of a facility producing a non-storm water discharge in each of these categories was rated on the basis of high, moderate, or low potential or not applicable if there was no evident correlation.

Chemical and Physical Properties

The information in Table 2 indicates possible chemical and physical characteristics of contaminated non-storm water discharge which could come from various facilities. The chemical properties considered are pH and Total Dissolved Solids. The physical properties included are odor, color, turbidity, floatable substances, vegetation, and structural damage. The descriptions in each of these categories explain the most likely test results for a contaminated non-storm water discharge coming from a particular industrial facility. It should be noted that any combination of these characteristics may occur at an outfall.

TABLE 1

SOURCES OF NON-STORMWATER DISCHARGE RELATED TO INDUSTRY

INDUSTRIAL CATEGORIES MAJOR CLASSIFICATIONS SIC GROUP NUMBERS		LOADING/UNLOADING DRY BULK	LIQUIDS	WATER USAGE COOLING	PROCESS	ILLICIT/ INADVERTANT CONNECTIONS
PRIMARY INDUSTRIES						
20	FOOD AND KINDRED PRODUCTS					
201	MEAT PRODUCTS	H	L	H	H	H
202	DAIRY PRODUCTS PROCESSING INDUSTRY	H	H	H	H	H
203	CANNED AND PRESERVED FRUITS AND VEGETABLES	H	H	H	H	H
204	GRAIN MILL PRODUCTS	H	H	H	H	H
205	BAKERY PRODUCTS	H	M	NA	H	L
206	SUGAR AND CONFECTIONARY PRODUCTS	H	M	L	M	L
207	FATS AND OILS	H	H	M	H	M
208	BEVERAGES	H	H	H	H	L
21	TOBACCO MANUFACTURES	H	M	NA	M	M
22	TEXTILE MILL PRODUCTS	H	L	H	H	H
23	APPAREL AND OTHER FINISHED PRODUCTS MADE FROM FABRICS AND SIMILAR MATERIALS	H	L	NA	M	L
MATERIAL MANUFACTURE						
24	LUMBER AND WOOD PRODUCTS	H	L	NA	M	L
25	FURNITURE AND FIXTURES	H	M	NA	L	L
26	PAPER AND ALLIED PRODUCTS	H	H	H	H	H
27	PRINTING, PUBLISHING, AND ALLIED INDUSTRIES	H	M	NA	M	L
31	LEATHER AND LEATHER PRODUCTS	H	H	L	H	H
32	STONE, CLAY, GLASS, AND CONCRETE PRODUCTS	H	M	L	H	L
33	PRIMARY METAL INDUSTRIES	H	M	H	H	H
34	FABRICATED METAL PRODUCTS	H	H	H	H	H
37	TRANSPORTATION EQUIPMENT	L	H	H	H	H
CHEMICAL MANUFACTURE						
28	CHEMICALS AND ALLIED PRODUCTS					
281	INDUSTRIAL INORGANIC CHEMICALS	H	H	H	H	H
282	PLASTIC MATERIALS AND SYNTHETICS	H	H	H	M	H
283	DRUGS	L	L	H	M	L

(H - HIGH, M - MODERATE, L - LOW, NA - NOT APPLICABLE)

TABLE 1

SOURCES OF NON-STORMWATER DISCHARGE RELATED TO INDUSTRY

INDUSTRIAL CATEGORIES MAJOR CLASSIFICATIONS SIC GROUP NUMBERS	LOADING/UNLOADING DRY BULK	LIQUIDS	WATER USAGE COOLING	PROCESS	ILLICIT/ INADVERTANT CONNECTIONS
CHEMICAL MANUFACTURE (continued)					
284 SOAP, DETERGENTS, AND CLEANING PREPARATIONS	H	H	H	H	H
285 PAINTS, VARNISHES, LACQUERS, ENAMELS, AND ALLIED PRODUCTS	H	H	L	H	L
286 INDUSTRIAL ORGANIC CHEMICALS	H	H	H	H	M
287 AGRICULTURAL CHEMICALS	L	L	H	L	L
29 PETROLEUM REFINING AND RELATED INDUSTRIES					
291 PETROLEUM REFINING	L	H	H	L	H
295 PAVING AND ROOFING MATERIALS	H	H	NA	M	L
30 RUBBER AND MISCELLANEOUS PLASTICS PRODUCTS	H	H	H	H	M
TRANSPORTATION AND CONSTRUCTION					
15 BUILDING CONSTRUCTION	M	L	NA	L	L
16 HEAVY CONSTRUCTION	M	L	NA	L	L
RETAIL					
52 BUILDING MATERIALS, HARDWARE, GARDEN SUPPLY, AND MOBILE HOME DEALERS	H	L	NA	L	L
53 GENERAL MERCHANDISE STORES	H	M	NA	L	L
54 FOOD STORES	H	H	NA	M	L
55 AUTOMOTIVE DEALERS AND GASOLINE SERVICE STATIONS	H	H	NA	M	M
56 APPAREL AND ACCESSORY STORES	H	L	NA	L	L
57 HOME FURNITURE, FURNISHINGS,	H	L	NA	L	L
AND EQUIPMENT STORES	H	L	NA	L	L
58 EATING AND DRINKING PLACES	H	M	NA	M	M
OTHER					
COAL STEAM ELECTRIC POWER	H	L	H	L	L
NUCLEAR STEAM ELECTRIC POWER	NA	L	H	L	NA

(H - HIGH, M - MODERATE, L - LOW, NA - NOT APPLICABLE)

TABLE 2
CHEMICAL AND PHYSICAL PROPERTIES

INDUSTRIAL CATEGORIES MAJOR CLASSIFICATIONS SIC GROUP NUMBERS		ODOR	COLOR	TURBIDITY	FLOATABLES	RESIDUE	STRUCTURAL	VEGETATION	pH	TDS
PRIMARY INDUSTRIES										
20	FOOD AND KINDRED PRODUCTS									
201	MEAT PRODUCTS	SPOILED MEATS ROTTEN EGGS AND FLESH	BROWN TO REDDISH-BROWN	HIGH	ANIMAL FATS, BYPRODUCTS PIECES OF PROCESSED MEATS	BROWN TO BLACK	HIGH	FLOURISH	NORMAL	HIGH
202	DAIRY PRODUCTS	SPOILED MILK RANCID BUTTER	GREY TO WHITE	HIGH	ANIMAL FATS SPOILED MILK PRODUCTS	GREY TO LIGHT-BROWN	HIGH	FLOURISH	ACIDIC	HIGH
203	CANNED AND PRESERVED FRUITS AND VEGETABLES	DECAYING PRODUCTS COMPOST PILE	VARIOUS	HIGH	VEGETABLE WAXES, SEEDS, SKINS, CORES, LEAVES	BROWN	LOW	NORMAL	WIDE RANGE	HIGH
204	GRAIN MILL PRODUCTS	SLIGHTLY SWEET AND MUSTY GRAINY	BROWN TO REDDISH-BROWN	HIGH	GRAIN HULLS AND SKINS STRAW AND PLANT FRAGMENTS	LIGHT BROWN	LOW	NORMAL	NORMAL	HIGH
205	BAKERY PRODUCTS	SWEET AND OR SPOILED	BROWN TO BLACK	HIGH	COOKING OILS, LARD FLOUR, SUGAR	GREY TO LIGHT BROWN	LOW	NORMAL	NORMAL	HIGH
206	SUGAR AND CONFECTIONARY PRODUCTS	NA	NA	LOW	LOW POTENTIAL	WHITE CRYSTALS	LOW	NORMAL	NORMAL	HIGH
207	FATS AND OILS	SPOILED MEATS LARD OR GREASE	BROWN TO BLACK	HIGH	ANIMAL FATS, LARD	GREY TO LIGHT-BROWN	LOW	NORMAL	NORMAL	HIGH
208	BEVERAGES	FLAT SODA, BEER, OR WINE ALCOHOL, YEAST	VARIOUS	MODERATE	GRAINS AND HOPS, BROKEN GLASS DISCARDED CANNING ITEMS	LIGHT BROWN	HIGH	INHIBITED	WIDE RANGE	HIGH
21	TOBACCO MANUFACTURES	DRIED TOBACCO CIGARS, CIGARETTES	BROWN TO BLACK	LOW	TOBACCO STEMS AND LEAVES PAPERS AND FILLERS	BROWN	LOW	NORMAL	NORMAL	LOW
22	TEXTILE MILL PRODUCTS	WET BURLAP, BLEACH SOAP, DETERGENTS	VARIOUS	HIGH	FIBERS, OILS, GREASE	GREY TO BLACK	LOW	INHIBITED	BASIC	HIGH
23	APPAREL AND OTHER FINISHED PRODUCTS	NA	VARIOUS	LOW	SOME FABRIC PARTICLES	NA	LOW	NORMAL	NORMAL	LOW

TABLE 2

CHEMICAL AND PHYSICAL PROPERTIES

INDUSTRIAL CATEGORIES MAJOR CLASSIFICATIONS SIC GROUP NUMBERS		ODOR	COLOR	TURBIDITY	FLOATABLES	RESIDUE	STRUCTURAL	VEGETATION	pH	TDS
MATERIAL MANUFACTURE										
24	LUMBER AND WOOD PRODUCTS	NA	NA	LOW	SOME SAWDUST	LIGHT-BROWN	LOW	NORMAL	NORMAL	LOW
25	FURNITURE AND FIXTURES	VARIOUS	VARIOUS	LOW	SOME SAWDUST, SOLVENTS	LIGHT BROWN	LOW	NORMAL	NORMAL	LOW
26	PAPER AND ALLIED PRODUCTS	BLEACH VARIOUS CHEMICALS	VARIOUS	MODERATE	SAWDUST, PULP PAPER WAXES, OILS	LIGHT BROWN	LOW	NORMAL	WIDE RANGE	LOW
27	PRINTING, PUBLISHING, AND ALLIED INDUSTRIES	INK, SOLVENTS	BROWN TO BLACK	MODERATE	PAPER DUST, SOLVENTS	GREY TO LIGHT-BROWN	LOW	INHIBITED	NORMAL	HIGH
31	LEATHER AND LEATHER PRODUCTS	LEATHER, BLEACH ROTTEN EGGS OR FLESH	VARIOUS	HIGH	ANIMAL FLESH AND HAIR OILS, GREASE	GREY TO BLACK SALT CRYSTALS	HIGH	HIGHLY INHIBITED	WIDE RANGE	HIGH
33	PRIMARY METAL INDUSTRIES	VARIOUS	BROWN TO BLACK	MODERATE	ORE, COKE, LIMESTONE MILLSCALE, OILS	GREY TO BLACK	HIGH	INHIBITED	ACIDIC	HIGH
34	FABRICATED METAL PRODUCTS	DETERGENTS ROTTEN EGGS	BROWN TO BLACK	HIGH	DIRT, GREASE, OILS SAND, CLAY DUST	GREY TO BLACK	LOW	INHIBITED	WIDE RANGE	HIGH
32	STONE, CLAY, GLASS, AND CONCRETE PRODUCTS	WET CLAY, MUD DETERGENTS	BROWN TO REDDISH-BROWN	MODERATE	GLASS PARTICLES DUST FROM CLAY OR STONE	GREY TO LIGHT-BROWN	LOW	NORMAL	BASIC	LOW
CHEMICAL MANUFACTURE										
28	CHEMICALS AND ALLIED PRODUCTS									
2812	ALKALIES AND CHLORINE	STRONG HALOGEN OR CHLORINE PUNGENT BURNING	ALKALIES - NA CHLORINE - YELLOW TO GREEN	LOW	NA	ALKALIES - WHITE CARBONATE SCALE CHLORINE - NA	HIGH	HIGHLY INHIBITED	BASIC	HIGH
2816	INORGANIC PIGMENTS	NA	VARIOUS	HIGH	LOW POTENTIAL	VARIOUS	LOW	HIGHLY	WIDE RANGE	HIGH
28	CHEMICALS AND ALLIED PRODUCTS									
282	PLASTIC MATERIALS AND SYNTHETICS	PUNGENT, FISHY	VARIOUS	HIGH	PLASTIC FRAGMENTS, PIECES OF SYNTHETIC PRODUCTS	VARIOUS	LOW	INHIBITED	WIDE RANGE	HIGH

TABLE 2
CHEMICAL AND PHYSICAL PROPERTIES

NDUSTRIAL CATEGORIES MAJOR CLASSIFICATIONS SIC GROUP NUMBERS		ODOR	COLOR	TURBIDITY	FLOATABLES	RESIDUE	STRUCTURAL	VEGETATION	pH	TDS
MICAL MANUFACTURE (Continued)										
283	DRUGS	NA	VARIOUS	HIGH	GELATIN BYPRODUCTS FOR CAPSILLATING DRUGS	VARIOUS	LOW	HIGHLY INHIBITED	NORMAL	HIGH
284	SOAP, DETERGENTS, AND CLEANING PREPARATIONS	SWEET OR FLOWERY	VARIOUS	HIGH	OILS, GREASE	GREY TO BLACK	LOW	INHIBITED	BASIC	HIGH
285	PAINTS, VARNISHES, LACOUERS, ENAMELS, AND ALLIED PRODUCTS (SB = SOLVENT BASE)	LATEX - AMMONIA SB - DEPENDANT UPON SOLVENT (PAINT THINNER, MINERAL SPIRITS)	VARIOUS	HIGH	LATEX - NA SB - ALL SOLVENTS	GREY TO BLACK	LOW	INHIBITED	LATEX - BAS SB - NORMAL	HIGH
286	INDUSTRIAL ORGANIC CHEMICALS									
2861	GUM AND WOOD CHEMICALS	PINE SPIRITS	BROWN TO BLACK	HIGH	ROSINS AND PINE TARS	GREY TO BLACK	LOW	INHIBITED	ACIDIC	HIGH
2865	CYCLIC CRUDES, AND CYCLIC INTERMEDIATES, DYES, AND ORGANIC PIGMENTS	SWEET ORGANIC SMELL	NA	LOW	TRANSLUCENT SHEEN	NA	LOW	HIGHLY INHIBITED	NORMAL	LOW
287	AGRICULTURAL CHEMICALS									
2873	NITROGENOUS FERTILIZERS	NA	NA	LOW	NA	WHITE CRYSTALLI	HIGH	INHIBITED	ACIDIC	HIGH
2874	PHOSPHATIC FERTILIZERS	PUNGENT SWEET	MILKY WHITE	HIGH	NA	WHITE AMORPHOUS POWDER	HIGH	INHIBITED	ACIDIC	HIGH
2875	FERTILIZERS, MIXING ONLY	VARIOUS	BROWN TO BLACK	HIGH	PELLETIZED FERTILIZERS	BROWN AMORPHOUS POWDER	LOW	NORMAL	NORMAL	HIGH
29	PETROLEUM REFINING AND RELATED INDUSTRIES									
291	PETROLEUM REFINING	ROTTEN EGGS KEROSENE, GASOLINE	BROWN TO BLACK	HIGH	ANY CRUDE OR PROCESSED FUEL	BLACK SALT CRYSTALS	LOW	INHIBITED	WIDE RANGE	HIGH
30	RUBBER AND MISCELLANEOUS PLASTICS PRODUCTS	ROTTEN EGGS CHLORINE, PEROXIDE	BROWN TO BLACK	MODERATE	SCHREDDED RUBBER PIECES OF FABRIC OR METAL	GREY TO BLACK	LOW	INHIBITED	WIDE RANGE	HIGH

TABLE 2

CHEMICAL AND PHYSICAL PROPERTIES

INDUSTRIAL CATEGORIES MAJOR CLASSIFICATIONS SIC GROUP NUMBERS	ODOR	COLOR	TURBIDITY	FLOATABLES	RESIDUE	STRUCTURAL	VEGETATION	pH	TDS
					POWDER				
TRANSPORTATION AND CONSTRUCTION									
15 BUILDING CONSTRUCTION	VARIOUS	BROWN TO BLACK	HIGH	OILS, GREASE, FUELS	GREY TO BLACK	LOW	NORMAL	NORMAL	HIGH
16 HEAVY CONSTRUCTION	VARIOUS	BROWN TO BLACK	HIGH	OILS, GREASE, FUELS DILUTED ASPHALT OR CEMENT	GREY TO BLACK	LOW	NORMAL	NORMAL	HIGH
RETAIL									
52 BUILDING MATERIALS, HARDWARE, GARDEN SUPPLY, AND MOBILE HOME DEALERS	NA	BROWN TO BLACK	LOW	SOME SEEDS, PLANT PARTS, DIRT, SAWDUST, OR OIL	LIGHT BROWN	LOW	NORMAL	NORMAL	LOW
53 GENERAL MERCHANDISE STORES	NA	NA	NA	NA	NA	LOW	NORMAL	NORMAL	LOW
54 FOOD STORES	SPOILED PRODUCE RANCID, SOUR	VARIOUS	LOW	FRAGMENTS OF FOOD DECAYING PRODUCE	LIGHT BROWN	LOW	FLOURISH	NORMAL	LOW
55 AUTOMOTIVE DEALERS AND GASOLINE SERVICE STATIONS	OIL OR GASOLINE	BROWN TO BLACK	MODERATE	OIL OR GASOLINE	BROWN	LOW	INHIBITED	NORMAL	LOW
56 APPAREL AND ACCESSORY STORES	NA	NA	LOW	NA	NA	LOW	NORMAL	NORMAL	LOW
57 HOME FURNITURE, FURNISHINGS, AND EQUIPMENT STORES	NA	NA	LOW	NA	NA	LOW	NORMAL	NORMAL	LOW
58 EATING AND DRINKING PLACES	SPOILED FOODS OIL AND GREASE	BROWN TO BLACK	LOW	SPOILED OR LEFTOVER FOODS OIL AND GREASE	BROWN	LOW	NORMAL	NORMAL	LOW
COAL STEAM ELECTRIC POWER	NA	BROWN TO BLACK	HIGH	COAL DUST	BLACK AMORPHOUS POWDER	LOW	NORMAL	SLIGHTLY ACIDIC	LOW
NUCLEAR STEAM ELECTRIC POWER	NA	LIGHT BROWN	LOW	OILS, LUBRICANTS	LIGHT BROWN	LOW	NORMAL	NORMAL	LOW

Waste Characterization

Appendix A provides detailed information regarding wastestream identification and characterization for various facilities listed under industrial SIC categories. The following data are included for each SIC code:

- SIC Subcategory Listing
- Typical Sources of Wastestream Flows
- Wastestream Characterization

Common sources of wastestream flows as well as typical values for conventional and toxic pollutants are presented to aid in the industrial identification process.

These tables and appendix were organized according to the SIC code. The intent of classifying by SIC code was that similar facilities should produce non-storm water discharges in basically the same manner with fairly identical characteristics. Furthermore, SIC codes give the best estimate of typical wastewater discharges by virtue of principal manufacturing operations. Thus, those facilities which are not individually listed should have qualities resembling those of other facilities with which they are classified in the SIC code.

Correlation Process

The correlation process begins by generating a list of all industries in the area which could have a connection to the drainage system pipe network leading to the contaminated storm water outfall. Once this list is completed, the selected industries should be organized according to their appropriate SIC classification and, if possible, by subcategory. Next, the outstanding characteristics which were determined in the previous steps should be compared - industry by industry - to the coded support data.

The flow pattern established in Step 1 should be compared to Table 1. High cooling and process water usage indicates a greater likelihood for a continual discharge or a very frequent intermittent discharge. While low water usage would generally indicate a random discharge of little volume or perhaps none at all.

The distinguishing characteristics as determined in Step 2 should be compared to Table 2. A particular industrial facility could be the actual source when there are several correlations between noted features and those listed in the table.

The results from the comprehensive laboratory testing of the grab samples should be compared to the typical conventional and toxic pollutant values listed in Appendix A. Strong similarities between the test results and typical listed values may indicate a particular facility as the possible industrial source of the non-storm water discharge.

Age of Facilities

A final factor of consideration is the age of an industrial facility. There is a high potential for unauthorized connections for industries that occupy older buildings. Sanitary sewers may not have been in existence, since storm sewers predate the development of sanitary sewers. During the time of an industry's development there may have been a lack of information regarding the location of sanitary and storm sewer lines which led to confusion as to the proper function of a storm sewer line. In addition, over time as the activities within an industry change or expand, there is a possibility for illicit or inadvertent connections as floor drains and other storm sewer connections may begin to process non-storm water discharges which require treatment.

Also, since pollution control requirements regarding storm water have been minimal or non-existent in the past, older industrial facilities possess a greater potential for having illicit connections to the storm water drainage system.

Upon the completion of this correlation process, it will become evident that many of the previously listed industrial facilities should be eliminated as possible sources of the illicit discharge. In most cases, either one particular industry may clearly appear to be the most likely source or several facilities may still seem to all be possible sources.

At this point, the only way of identifying the actual source of an illicit discharge is to perform an on-site industrial investigation for illicit connections to the storm water drainage system. On-site industrial investigations should proceed from the most to the least likely facility appearing to be the source of the illicit discharge. A priority listing of investigations should be generated based upon the findings of the correlation process.

A brief discussion of common types of industrial non-storm water discharges and illicit connections is presented in Section 5. This information is provided to serve as a basis for Section 6 which defines a methodology for performing an on-site industrial investigation for illicit connections.

Section 5

INDUSTRIAL WATER USE AND SPILL POTENTIAL

This section describes typical water use processes and sources of spills at industrial facilities and is intended to provide technical background for the investigative team. The descriptions provided are by no means exhaustive. Therefore, the investigative team is encouraged to consult with plant personnel for more complete descriptions of water use processes during actual on-site investigations.

NON-CONTACT COOLING WATER

Non-contact cooling water is water that decreases the temperature of a particular part or process without ever physically touching it. "Non-contact" is achieved by allowing cooling waters to circulate around the part or process in a contained jacket or external channel.

In order to discharge non-contact cooling water into a storm drain, an industry must obtain an NPDES permit. These discharges should not be contaminated as long as cooling waters remain fully separated from the part or process they are cooling and are not above permit temperature limits. However, when cooling systems are not functioning properly, they become potential sources for contamination as cooling waters may come in contact with various toxic substances and carry them into storm sewers.

Industries will use large amounts of non-contact cooling water for several reasons. Non-contact water is often used to cool raw materials, final products, and machinery such as compressors or rectifiers. For example, the turbines and boilers used in coal steam electric power generation are cooled by using non-contact waters. These cooling waters are also frequently used for temperature control of chemical reaction vats or metal plating baths. The temperature of reactor vessels used in the production of plastics and synthetics is controlled by non-contact cooling waters. These could become contaminated by leaks and spillovers in the primary process.

In some industrial facilities chemicals are added to cooling waters to prevent the deposition of scale on pipes and equipment, and also to prevent rust formation. They are also added to cooling waters to prevent biological growth. In situations where these chemicals may be toxic or harmful to animal, plant, or aquatic life, such cooling waters cannot be discharged to storm sewers. Such cooling water discharges are usually permitted for discharge into sanitary sewers, with appropriate pretreatment when applicable.

RINSE WATER

Rinse water is water which cleans or reduces the temperature of an object through actual physical contact with the object. Discharges resulting from rinse waters are often allowed to enter floor drains which may be inadvertently connected to storm sewers rather than to sanitary sewers. They can also enter storm sewers through direct connections by piping. A high potential for continuous or intermittent dry weather flow exists for those industries in which raw materials, final products, or production machinery must be sanitized or cooled by using rinse waters.

Rinse waters may originate from facilities that utilize regular washdown procedures. For instance, soft drink bottling plants use rinse waters for removal of waste liquids, debris, and labels from returned bottles. Rinse waters can also be used for temperature reduction by dipping, washing, or spraying objects with cool water. For example, rinse water is sometimes sprayed over the final products in the metal plating industry in order to cool them.

Rinse waters which are most likely to cause an intermittent flow are those used for clean-up at the end of a work shift, before product changeover, or after raw materials have been unloaded. One such case could be the flushing of a chemical delivery tank at an unloading dock. This would lead to contamination if toxic chemicals were washed down to floor drains connected to the storm water system.

PROCESS WATER

Process water may also be discharged into floor drains or could be piped directly into the storm water sewer system. Process water is used in a facility to perform a variety of functions or an actual product ingredient. Process waters which are likely to cause continual dry weather flows are those used for filtration, dilution, soaking, and conveyance.

PROCESS LINE DISCHARGE

Process line discharge refers to the disposal of anything used in or resulting from a manufacturing process including substances such as wastes, byproducts, chemicals, and fuels. This type of waste is often seen in the food processing industry. For instance, cannery procedures for vegetables often produce process line discharge. The process line wastes usually consist of solids from sorting, peeling, and coring operations as well as can spillage from filling and sealing procedures.

BATCH DUMPS

Batch dumps are the disposal of process batches which may be composed of a wide variety of substances. However, some of the more common batches include combinations of chemicals, solvents, dyes, paints, or may simply be rinse water baths. A common example of batch dump waste comes from the pickling process used in steel mills. To remove dirt and grease, steel is immersed in dilute batches or sulfuric acid. This process produces a waste known as "pickling liquor" which is mainly composed of iron sulfate. Batch dump disposal occurs when the iron sulfate concentration has increased enough to inhibit the pickling process. At this point the pickling liquor is replaced by a fresh batch of sulfuric acid.

In the cases of both batch dumps as well as process line discharge described above, these substances may be disposed of by allowing them to drain to the storm water sewer system.

BLOWDOWN

Blowdown represents a portion of water purposely wasted from a water system to help control buildup of solids or minerals. Two common examples are blowdown from boilers as well as that from cooling towers. In some cases the volume of blowdown generated by an individual plant is significant and it may require treatment before discharge. More frequently, however, contributions of blowdown are very small, and it is merely combined with other wastewater prior to discharge.

The water used in boilers or cooling towers is often subjected to treatment designed to control corrosion and scale formation. In most cases, chemical agents such as zinc or sodium chromate, caustics, and acids are used for these purposes. Therefore, the existence of these chemicals qualifies blowdown as an industrial process wastestream.

INDUSTRIAL SPILLS

The previous situations are most likely to cause continuous or intermittent dry weather flows on a fairly regular basis. In some cases, observed flows may exhibit random behavior. A primary cause of random flows is industrial spills, since they are accidental. After a spill has taken place, the spilled materials are often washed down to floor drains which may be connected to storm sewers. Unless there is some dilution (such as rainwater), this type of pollution will be very concentrated.

Spills result from many activities, but among the most common are:

Boil Overs: Boil overs principally result from bulk overheating, hot spots, uncontrolled exothermic reactions, and overloading.

Transfer To and From Storage: Inadequate personnel training, poor maintenance and irregular inspections may be causative factors for spills during transfer. In addition, inadvertent damage to facilities, i.e., valves, piping and storage tanks by vehicles or work crews may contribute to accidental discharge.

Transfer To and From Carriers: Spills during transfer to and from carriers generally result from improper or poorly maintained facilities and equipment, malfunctions of equipment, and operator error.

Storage Facility Leaks and Failures: Leaks in storage tanks that escape detection may result in large amounts of pollutants reaching separate storm sewers via illicit connections. These spills are typical for storage tanks and/or lagoons used for the temporary storage of concentrated wastes or reject materials.

Process Facilities and Failures: This type of spill may result from operator inattention, poor equipment up-keep, or faulty piping connections.

Storm Water Drainage: Storm water may discharge large quantities of pollutants from areas that include:

- Spilled dry materials,
- Dust collector accumulations,
- Small leaks which are impounded by topography,
- Rubbish piles, and
- Containers with residues.

The principal causes of such storm water runoff hazards are operator neglect, poor maintenance, and poor housekeeping. Loading and unloading areas as well as outdoor storage of raw or waste materials are where spills are most likely to occur.

Section 6

ON-SITE INDUSTRIAL INVESTIGATION

This section presents a methodology for the identification of illicit connections to the storm water drainage system at industrial sites. It is suggested that industry personnel participate as members of the investigative team since they are the most familiar with the processes and operations within a facility.

The methodology for the on-site industrial investigation is divided into four steps.

- Step 1 - Data Collection
- Step 2 - Preliminary Analysis of Water Use and Other Discharges
- Step 3 - On-Site Investigation
- Step 4 - Confirmatory Analysis

STEP 1 - DATA COLLECTION

The objective of this step of the methodology is to obtain and evaluate all mapping and spill history information pertaining to the industrial site under investigation. The information necessary to complete this step is discussed below.

Mapping Information

Mapping information is essential for identification of key features of the storm water drainage system relative to the industrial processes and operations at a site. Key features of the storm water drainage system may include swales, open ditches, channels, brooks, closed pipes, or sewer lines. Various industrial processes and operations are obviously determined on a site-by-site basis.

Pertinent mapping information, when available, should include:

- Plant Layout Drawings (Schematics)
- Sewer System Maps
- Topographic Maps

Available mapping usually reflects the intended design of the facility. Due to process modification these maps may not represent existing conditions and will need to be updated.

The following sections describe the various types of mapping information.

Plant Layout Drawings (Schematics)

These drawings will show the actual physical layout of an industrial plant. They may also indicate the locations of major industrial or commercial processes and equipment within the facility. Plant layout drawings will show the geographic orientation of the facility relative to local streets as well.

Additionally, plant layout drawings may show an overview of the in-facility piping and sewer locations. The piping and sewer plans show the location of floor drains and hard piping connections to plumbing fixtures, wet processes or other equipment. Plant layout drawings may also show the locations of both indoor and outdoor storage areas. Figure 1 shows a typical plant layout drawing.

Sewer System Maps

Most municipalities provide storm and sanitary sewer service to the property line. Facilities usually have complete drawings of sanitary and storm water sewers to which its wastewaters and storm water runoff drain. Sewer maps also show the junction points at which storm and sanitary laterals from a facility connect to the municipal sewer systems.

Figure 1
TYPICAL PLANT LAYOUT AND SEWER OVERVIEW

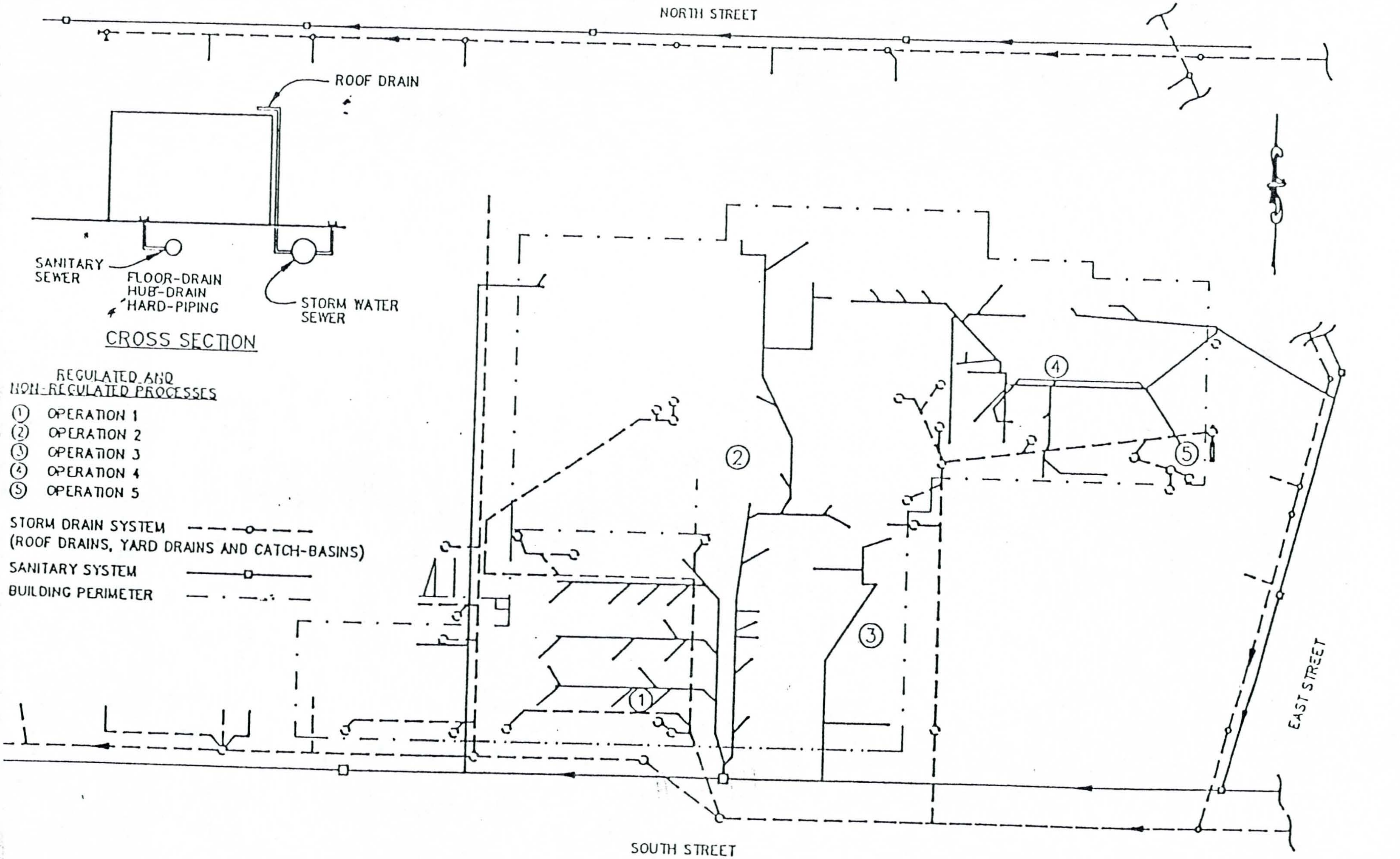


Figure 2 is a diagram showing storm and sanitary sewers in an industrial area.

Municipal sewer system schematics are generally shown on street maps. These maps will show connection locations to municipal sewer systems. During this initial mapping overview effort, it is important to note and distinguish between storm water and sanitary sewer lines. Manholes for each type of sewer (sanitary or storm) should be clearly labeled or numbered. This is necessary for manhole observations which are discussed in a later section.

Topographic Maps

Topographic maps, which show the ground elevations at a site, are useful when determining the direction of flow of storm water runoff. In situations where raw or waste materials at a facility are stored outdoors, storm water runoff may carry pollutants into separate storm water drainage systems. These discharges are also considered illicit and topographic maps can be used to determine the likely discharge points for contaminated storm water runoff.

Summary

The following check list summarizes the necessary actions for acquiring accurate mapping data.

Data Collection

- Make a listing of all available maps and schematics
- Note the dates when such maps and schematics were printed
- Obtain, if possible, older versions of the maps and schematics and determine if changes have occurred
- Note what changes were made

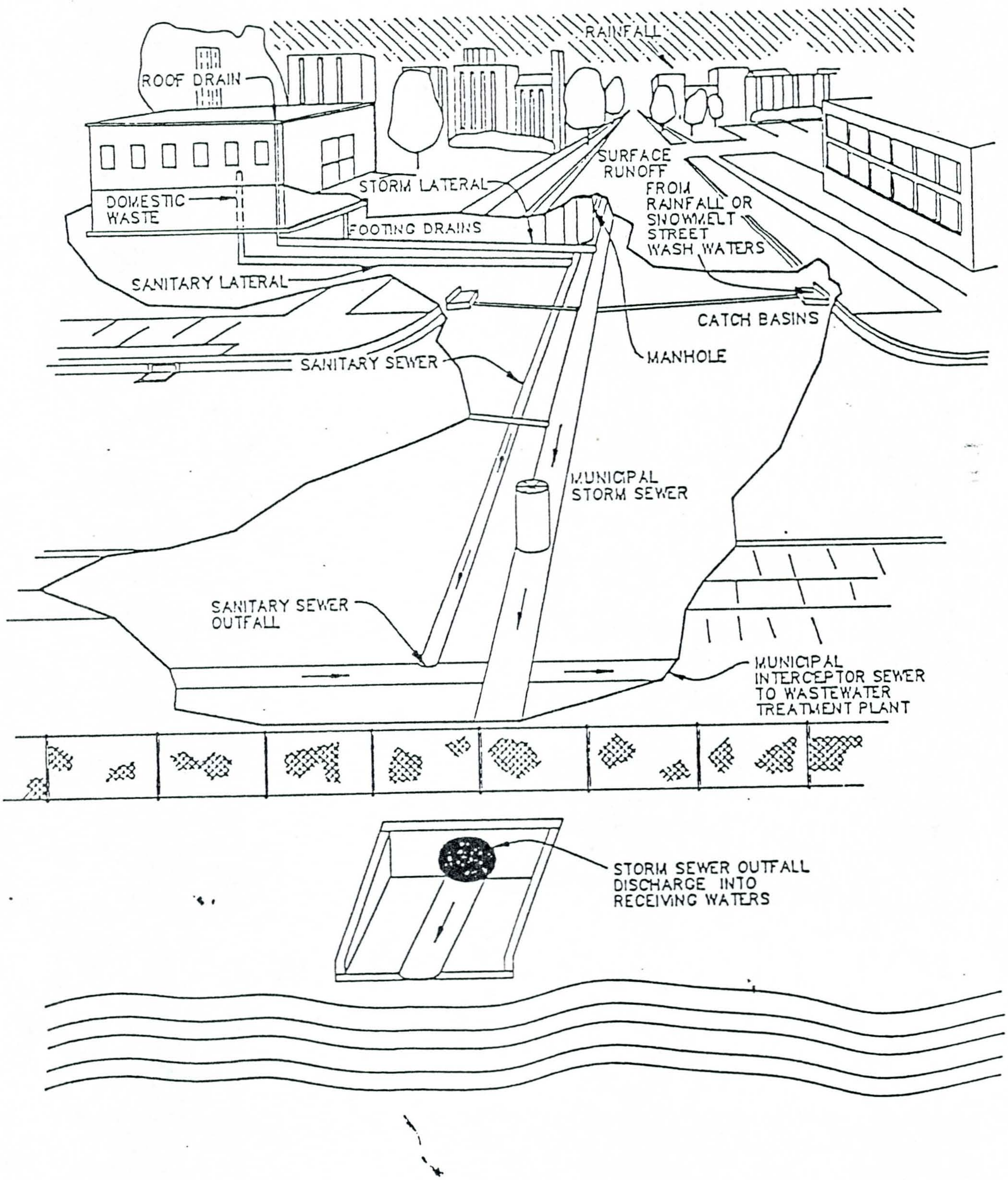
Plant Layout Drawings

- List all major processes and equipment at the facility from the most recent maps (schematics)
- Identify and label all indoor and outdoor material storage areas
- Note and label all floor drains within the facility

Sewer Maps

- Distinguish between sanitary and storm sewers
- Identify all manhole locations and label accordingly

Figure 2
STORM AND SANITARY SEWERS DIAGRAM



Spill History

Spill history records should be examined in order to determine the nature of materials which have been spilled as well as the frequency of occurrence of any spills. Typical sources of industrial spills were listed in the previous section. A correlation can be made between the nature of spilled materials and the characteristics of discharges observed at a storm water outfall. When such correlations are possible, the specific process or area in which the spill occurred should be investigated in greater detail.

Due to federal regulations, most industrial facilities are required to have a special document called the "Spill Prevention, Control, and Countermeasure (SPCC) Plan." If possible, this document should be obtained, as it should provide details regarding the spill potential at a facility. If this plan is not available, the necessary information will have to be determined from facility records and industry personnel.

In particular, if an industry has previously experienced a spill which resulted in the discharge of unacceptable material to a storm sewer, then that industry should be considered a candidate for illicit connections. In cases where there have been spills into storm sewers, information should be gathered so that the corrective actions taken to eliminate the illicit connection(s) can be evaluated.

The following check list summarizes the necessary actions for acquiring accurate spill history data.

- Obtain spill history records and prevention plan (SPCC Plan)
- Determine process and storage area(s) with high spill potential
- Determine frequency and nature of past spills
    - Note volumes and type of materials spilled
    - Note the recorded cause of any spills
    - Note corrective actions taken

STEP 2 - PRELIMINARY EVALUATION OF WATER USE AND OTHER DISCHARGES

The purpose of this step is to determine the water usage and other discharges at the industrial facility under consideration. This knowledge can serve as a useful aid in determining the probable source of an illicit connection.

Typical sources of industrial water use processes were listed in the previous section. These processes, as well as any other water-consuming operations, should be identified for the industrial site. Facilities may also use a wide array of solvents, oils, and other liquids for various applications in manufacturing. Processes utilizing these substances should be determined as well.

A preliminary step in listing these processes is the examination of all discharge permits. These permits are generally categorical standards pertaining to industrial wastewater discharges and provide information on the characteristics and quantities of all discharges allowed into the storm sewer system. Other processes not requiring a discharge permit may be identified through inquiry with industry personnel and/or from plant layout drawings.

The following check list summarizes the data which should be gathered during this step.

- List which processes use water, which use other liquids, and which use both.
- Note any distinctive physical or chemical characteristics of the other liquids used.
- Note the flow pattern of any discharges.
- Note the point of discharge as either connecting to the sanitary sewer, storm sewer, or as an unknown connection.

STEP 3 - ON-SITE INVESTIGATION

The previous steps described the collection and evaluation of available data and information at a given facility. It was noted that available information may not reflect existing conditions at a site. Therefore, the purpose of the third step is to:

- Confirm, modify and update available information
- Identify processes or areas that exhibit the potential for illicit connections

The on-site investigation procedure should add to the already existing information. For example, not all manholes may have been indicated on the sewer maps. Therefore, the actual on-site investigation may result in the identification of additional manholes.

The success of the on-site investigation depends upon careful visual inspections of both indoor and outdoor areas of the facility.

Outdoor Inspection

Depending upon the size of the facility, the outdoor inspection may be conducted by walking and/or driving. The specific objectives of the inspection are to locate all:

- Manholes
- Catch basins
- Storm water runoff directions and inlets
- Material storage areas

In addition, the general condition of the site grounds should be observed. These observations should focus on:

- Cleanliness of loading and unloading areas
- Spill control of outdoor material storage areas
- The nature and condition of waste storage facilities at the site
- The potential for contact of outdoor material storage with storm water runoff

Indoor Inspection

The indoor inspection should be conducted in a similar fashion to the outdoor inspection (i.e., careful visual observation). This step of the procedure can be expediently executed by using a list (as determined in Step 2) of manufacturing processes, equipment locations, and on-site storage facilities. The investigative team should query the plant personnel on the following issues:

Processes and Equipment

- Record name and brief description
- Identify nature of chemicals used
- Determine the nature of discharges (continuous, intermittent, or batch)
- Identify if the process wastes are regulated for discharge

Floor Drains/Other Discharge Points for the Process

- Identify the point of discharge for the process
- Locate nearest floor drain
- Identify the catch basin
- Determine the sump pump location

Inside Storage Locations

- Determine all storage areas
- Identify if spill control measures are in place

By the conclusion of the indoor inspection, all existing information should be updated. Processes or equipment whose discharge points are not known should be considered suspect (i.e., exhibiting illicit connections). Material storage areas that show any physical evidence of spills (e.g., powder, stains, or discolorations) should also be considered suspect. Additional guidance regarding typical sources of wastestream flows within various facilities as classified by SIC codes is provided in Appendix A of this manual.

By using the updated information from both the indoor and outdoor inspections, it is now possible to conduct the confirmatory analysis.

STEP 4 - CONFIRMATORY ANALYSIS

Upon conclusion of the on-site investigation, one or several sources from the industrial facility may appear to be the cause of the detected illicit discharge. Thus, the purpose of the fourth step is to determine the actual location of the illicit connection to the storm water drainage system.

This step of the procedure involves implementation of investigative strategies to pinpoint the source of the contaminated discharge. The confirmatory analysis begins with examination for dry weather storm sewer discharges from the industrial facility. This is followed by pipeline examination to verify the location of the illicit connection.

Dry Weather Discharge Examination

The examination for dry weather discharges to the storm sewerage system fulfills the following two objectives:

- Verification that the discharge from the particular industrial site under investigation is the same one as originally detected at the storm water outfall.
- Indication of the industrial source of the illicit discharge by virtue of relative site location as well as by discharge composition.

Procedure

This procedure involves determining the junction points at which a storm water sewer line from the facility connects to the municipal sewer line. Direct access to these junction points may be possible as manholes are often placed at private-municipal sewer line connections. When direct access is not possible, the nearest manhole located downstream of the junction point should be located.

Observation for dry weather discharges from the facility entails physically removing manhole covers at the selected locations and visually inspecting for the presence of flow. If the manholes are located along a street, proper precautions should be taken to ensure worker safety and minimize traffic disruption.

In addition, timing of the manhole observations is also a crucial factor. Inspection for dry weather discharges should coordinate with the flow pattern established for the detected illicit discharge - with an allowance made for the travel time from the industrial facility to the storm water outfall. Thus, all manhole observations should take place on those days that the illicit discharge occurred and at a time prior to the time that the flow was detected. How much earlier the inspection should take place is dependent upon the distance from the sewer line connection to the contaminated storm sewer outfall. In general, the farther apart these two locations are, the earlier the manhole inspection time should take place from the time of the recorded outfall discharge detection.

If a dry weather discharge is detected during a manhole observation, the flow should be characterized in the same manner as was performed for the storm water outfall analysis.

The following physical and chemical properties of the dry weather discharge should be observed and recorded:

<u>Physical Properties</u>

- Odor
- Color
- Temperature
- Turbidity
- Floatables
- Residue

<u>Chemical Properties</u>

- pH
- Total Dissolved Solids
- Specific Conductivity

Also, at least two grab samples of the dry weather discharge should be taken to a laboratory for detailed chemical analysis. This analysis should focus upon chemicals known to be used at the industry. Guidance regarding typical conventional and toxic pollutant concentrations is provided as part of the industrial wastestream characterization classified by SIC codes in Appendix A of this manual. Additional information regarding chemical parameters, which should be tested for, may also be obtained through reference to NPDES discharge limitations or consultation with industry personnel.

It should be noted, however, that the detected dry weather discharge may be a permitted discharge (such as non-contact cooling water) from the industrial facility to the storm sewerage system. This case may be confirmed by checking if a discharge permit exists for that particular sewer line connection as well as if the flow is uncontaminated.

If the observed dry weather discharge is determined as being non-permitted and/or contaminated, the results of the recorded analysis should be compared against the following:

- Characteristics recorded for the illicit discharge originally detected at the contaminated storm sewer outfall.
- Characteristics of discharges or of potential spill materials from those processes suspected of being possible sources within the section of the industrial facility nearest that sewer line connection.

Comparisons should seek to find common pollutant characteristics between the illicit outfall discharge, the observed manhole discharge, and the discharge resulting from a particular suspect industrial process or spill area.

If waste flows can be established as essentially identical, then it may be assumed that the industrial source responsible for the detected illicit discharge has been identified.

In some cases, more than one dry weather discharge may be observed at various manholes. It is possible that more than one illicit connection to the storm water drainage system may exist within the industrial facility and that the contaminated outfall discharge is the result of a culmination of several flows. Therefore, all suspect industrial sources of observed manhole discharges should be identified before proceeding on to the pipeline examination.

Summary

- Locate industrial-municipal sewer line connections
- Select manhole observation points
- Determine the presence of dry weather discharges
- Characterize observed dry weather discharges
- Determine if discharge is permitted or contaminated
- If discharge is not permitted, conduct a comparison of characteristics to identify the industrial source
- Identify all industrial sources of all dry weather discharges observed at selected manholes

Pipeline Examination

The major objective of the pipeline examination is to identify the specific point at which the illicit connection exists. Illicit connections may result from failing plumbing fixtures, direct connections, or in many cases inadvertent connections. The pipeline examination also serves to verify the industrial source responsible for an observed manhole discharge.

Inadvertent connections result when a storm sewer is mistaken for a sanitary sewer. In some cases, illicit connections were actually permitted at the time they were built. Regardless of the reason behind an illicit connection, a number of procedures have proven to be successful in identifying their actual locations. The main objective of these procedures is to trace the path taken by a discharge from a process to a downstream point. Two procedures recommended for use are:

- Dye tracer tests
- Internal pipe investigations
    - Manual visual inspections
    - Television (TV) inspections

Dye Tracer Tests

Dye tracer tests involve the introduction of a fluorescent dye such as fluorescein into the discharge point of the industrial or commercial process suspected of exhibiting illicit connections. The discharge points for all processes were determined during the indoor investigation of the facility.

The dye, once introduced, is flushed down with clear water. The outfall exhibiting illicit connections is then observed. If the fluorescent dye comes through, then the actual illicit connection location has been identified. In most cases, illicit connections can be identified by conducting dye tracer studies. However, situations may arise in which the dye tracing process fails to identify illicit connections. This may be the case when there is a break or crack in an adjacent sanitary sewer. In such cases, an internal investigation of the sewer lines may be necessary.

Internal Pipe Investigations

When sewer systems are large enough, they should be inspected by walking through them in order to locate the entry points of polluted discharges. In such cases, appropriate safety precautions as described under the OSHA confined space entry requirements should be employed.

This is an alternative to manual inspections and may be used when sewers are smaller or for safety reasons. The use of TV inspections is relatively expensive and should be used only when necessary.

Section 7

FIELD SURVEY TECHNIQUES

The objective of this section is to provide detailed information regarding the field survey techniques discussed in previous sections of this manual. The relative success of this methodology for identifying illicit industrial connections relies heavily upon careful field organization. Thus, this section focuses solely upon providing guidance in this area. Topics are addressed in the following order:

- Necessary Equipment and Materials
- Personnel Requirements
- Estimated Timeline
- Organizational Ideas

NECESSARY EQUIPMENT AND MATERIALS

Necessary equipment and materials must be gathered prior to conducting the field survey. A list of essential equipment and materials for both the outfall screening and the on-site investigation is provided in Table 3 and discussed below.

Field Test Kit

Elementary chemical analysis can be performed with a field test kit. These kits can be used to determine initial concentrations for discharges detected at storm water outfalls and during manhole observations. There are several brands of kits with features suited to the needs of this manual. Information regarding typical field test kits is presented in Appendix B. The data provided includes the manufacturer, model number, general capabilities, and cost.

pH and Conductivity Meters

The pH meter and conductivity meter are also used to determine initial values for discharges detected at storm water outfalls and during manhole observations. Highly sophisticated models will not be necessary for the purposes of this manual. Rather, a moderately priced meter should be selected. Buffer solutions are also essential and should always be brought along to calibrate the meters prior to taking readings. Information regarding typical pH and conductivity meters is presented in Appendix B. The data provided include the manufacturer, model number, general capabilities, and cost.

Automatic Sampler

The automatic sampler is used at the storm water outfall to detect illicit discharges, collect samples, and determine flow patterns. The use of an automatic sampler eliminates the need for inspectors to constantly monitor for intermittent discharges at outfalls exhibiting characteristics of industrial contamination. There are many brands of automatic samplers available with a diversity of characteristics. Table 4 presents a list of considerations for an automatic sampler suitable to the needs outlined in this manual. Additional information regarding typical automatic samplers is presented in Appendix B. The data provided include the manufacturer, model number, general capabilities, and cost.

Instant Camera and Film

An instant camera should be used to photograph all storm water outfalls exhibiting signs of contamination. This photo will serve as a visual aid for each outfall and also supplement the written documentation of the observed pollutant characteristics. Photographs may also be taken during the on-site investigation to log various suspect processes or potential spill areas. This may be especially helpful for large facilities with extensive manufacturing operations.

It is important to note that most facilities have strict policies concerning photographs taken by visitors. The inspector should always ask the plant manager about the plant's policy before carrying a camera into a manufacturing area. The inspector might need to obtain special permission or agree to have all photographs reviewed by the plant manager.

The instant camera selected for use should produce color photographs. A one-step model is generally the easiest to use as no waste paper is produced from the photographing.

Collecting Samples

Samples of discharges are collected at storm water outfalls, from manholes, and occasionally from industrial processes. Plastic bottles are preferred for a container since they will not break and are easily labeled. A waterproof marker should be used to label each sample immediately after it has been collected. Identification data should always include the date, time of day, inspector name, sample number, and the location from which the sample was taken. Once labeled, all samples should be tightly sealed and packed in ice.

Recordkeeping

Recordkeeping materials include a clipboard, pad of paper, and pen or pencil. Data Inventory Forms on which to summarize pertinent information should also be used to simplify documentation during field surveys. Typical forms are discussed under the topic of organizational ideas at the end of this section. In addition, any maps or plant layout drawings should be kept with the recordkeeping material. Maps and drawings brought along should be of manageable size, if possible, 8-1/2 by 11 inches. Finally, it is highly suggested that all documentation be organized into a three-ring binder. This will keep information readily available and ensure that little potential exists for losing or misplacing important data.

Outfall Identification

All contaminated and newly discovered storm water outfalls should be physically labeled with an identification number, in order to prevent confusion or mix-ups during additional field surveys. Visible outfall id numbers will also reduce unnecessary referencing to maps and thus save time as well. Outfall marking can be accomplished with wooden stakes. The stakes should be spray painted a fluorescent color with the id number of the outfall carefully marked in black. A thick waterproof marker should be used for stake labeling. Each stake should be placed next to its corresponding storm water outfall in an area away from trees or shrubbery for easy visibility. A hammer may be necessary to pound the stakes into the ground as it may be quite hard due to the fact that analysis is conducted during dry weather.

Manhole Observation Equipment

Manhole observation for illicit discharges requires several kinds of equipment. A crowbar will be necessary in order to remove the manhole lid. Also, a bright flashlight will be helpful for visual inspection inside of the manhole.

If a discharge is detected inside of a manhole but entry to obtain a sample is impossible or unsafe, an alternative sampling procedure must be employed. If the manhole is not too deep, one method of obtaining a sample is to tape the sampling bottle to a long stick which can reach the discharge. A fold-up tape measure is a compact way of carrying a long stick. Heavy duty tape should also be used to ensure that the sampling bottle remains affixed.

Finally, if the manholes are located along a street, precautionary measures should be taken to protect the inspectors and minimize traffic disruption. Orange safety cones and/or a flashing barricade should be used to segregate the necessary working area. Also, all inspectors should wear orange safety vests.

Pipeline Examination

Fluorescein dye tracer will be needed to conduct pipeline examinations. Ample dye should be brought along as several tests may be necessary to identify one or more illicit connections at an industrial site.

Inspector Safety

Attention to safety procedures is a must during all field surveys. This includes inspector apparel from head to toe. Work clothes should always be worn for all inspections. Rubber boots should be brought along in case of wet or muddy conditions during the screening of storm water outfalls. Essential materials for the industrial on-site investigation include safety shoes, safety glasses, a hard hat, and hearing protection. Protective gloves should always be worn when collecting samples of any potentially dangerous discharges. Finally, a complete first aid kit should always be kept on hand in case of an emergency.

TABLE 3

FIELD EQUIPMENT AND MATERIALS

Field Test Kit	Orange Safety Vest
pH Meter and Buffer Solution	Crowbar
Conductivity Meter and Buffer Solution	Flashlight and Batteries
Automatic Sampler	Fold-Up Tape Measure
Instant Camera and Film	Heavy Duty Tape
Sampling Bottles and Waterproof Marker	Fluorescein Dye Tracer
Cooler	Work Clothes
Clipboard, Pad, Pen or Pencil	Rubber Boots
Data Inventory Forms	Safety Shoes
Maps	Safety Glasses
Marked Stakes	Hard Hats
Hammer	Hearing Protection
Flashing Barricade	Protective Gloves
Orange Safety Cones	First Aid Kit

TABLE 4

CONSIDERATIONS FOR AUTOMATIC SAMPLER

-- Capability for AC/DC operation with adequate dry battery energy storage for 120-hour operation at 1-hour sampling intervals

-- Total weight including batteries

-- Sample collection interval (adjustability from 10 minutes to 4 hours)

-- Capability for:

  -- Flow proportional sample - constant time interval between samples, sample volume proportional to stream flow at time of sampling (variation in flow >15%)

  -- Time proportional sample - constant sample volume, time interval between samples proportional to stream flow

-- Capability for collecting discrete samples in 24 containers

-- Watertight exterior case to protect components in the event of rain or submersion

-- Exterior case capable of being locked to prevent tampering and provide security

-- No metal parts in contact with waste source or samples

-- An integral sample container compartment capable of maintaining samples at 4 to 6°C for a period of 24 hours at ambient temperatures ranging from -30 to 50°C

-- Operation capabilities in the temperature range from -30 to 50°C

-- Sampler exterior surface painted light color to reflect sunlight

PERSONNEL REQUIREMENTS

The objective of the following discussion is to provide general information regarding the personnel demand and training necessary to perform the methodology outlined in this manual.

Clearly, as the size of the industrial area to be investigated increases, so too does the demand for personnel. The following suggestions are based upon an optimum fixed number of inspectors per phase of the field survey. These suggestions were offered in order to set a standard as well as to simplify the overall procedure.

Phase I - Screening of Storm Water Outfalls

It is suggested that a minimum of two (2) investigators perform the observations and analyses at a storm water outfall. There are several reasons behind this selected minimum among which the most important are the following:

- Correspondence regarding visual observations and elementary chemical analyses
- Safety in numbers
- Load distribution for carried equipment

Thus, a coupled effort will result in greater efficiency as well as mobility. When very large numbers of storm water outfalls exist for screening in an industrial area, it is suggested that several pairs of investigators perform outfall surveys in order to expedite the process.

Phase II - Industrial On-Site Investigation

In order to perform the industrial on-site investigation, it is suggested that either three investigators be aided by one industry personnel or two investigators be aided by two industry personnel. The reasoning behind a total number of four being such that the on-site investigation may be divided into two tasks. Thus, one pair of investigators may perform the outside inspection while the other pair focuses their attention upon the inside inspection.

The selected industry personnel should have a thorough knowledge of the operations performed at the facility. In addition, it is beneficial if they also have a practical understanding of environmental management procedures as well.

Personnel Training

In addition to efficiency, the inspectors performing a field survey must also be accurate. High levels of accuracy may only be obtained through complete and proper training. Training should encompass a formal orientation of the methodology presented in this manual along with practical field techniques.

Therefore, inspectors should have an understanding of the various identification strategies presented in this text. They should also be knowledgeable of typical kinds and sources of industrial waste. If possible, training should include an actual field orientation of common industrial water use processes and types of spills. Factual information should also be provided summarizing the contacts and access details necessary for obtaining pertinent data such as sewer maps or environmental records.

Inspectors must be able to correctly operate all field equipment - in particular specialized meters and automatic samplers. Training should include the proper procedures for collecting samples as well as for performing manhole observations. Finally, steps must always be taken to make personnel aware of potential occupational hazards, precautionary measures to prevent them, and special plans to follow in the event of an emergency.

TIMELINE

There are several steps to be performed when following the methodology outlined in this manual. The following chart is intended to provide a generalized indication of the time required for each step.

It is important to note that the chart provided does not take into account unexpected problems such as poor weather or equipment failure. In addition, the time needed to conduct the on-site industrial investigation and confirmatory analysis is highly dependent upon the size of the facility. Thus, these estimates should be considered only as idealized guidelines.

Procedure and Step	Time Range (days)
Outfall Evaluation	
Step 1 - Mapping Effort	1-3
Step 2 - Walking Tour	2 outfalls surveyed/day*
Step 3 - Outfall Analysis	2 outfalls analyzed/day
Identification of Potential Industrial Sources	
Step 1 - Establish Flow Pattern	3-7
Step 2 - Analysis of Recorded Data	1-3
Step 3 - Correlation to Possible Industrial Sources	1-3
On-Site Industrial Investigation	
Step 1 - Data Collection	2-4
Step 2 - Preliminary Evaluation of Water Use and Other Discharges	2-4
Step 3 - On-Site Investigation	3-7
Step 4 - Confirmatory Analysis	3-7

*NOTE:
Inspectors should be able to complete the initial survey and analysis for two outfalls per day.

ORGANIZATIONAL IDEAS

The use of Data Inventory Forms can greatly simplify the process of recording information. A variety of Data Inventory Forms are provided in Appendix C of this manual. Thus, the objective of the following discussion is to briefly describe the function for each form.

Outfall Analysis Data

This three-page form should be used to record data collected from the screening of storm water outfalls. The form organizes information regarding the detected flow pattern, physical observations, and elementary chemical analysis results for a particular outfall.

Laboratory Analysis

This two-page form should be used to check off the parameters which should be tested for in a grab sample laboratory analysis. The form summarizes the grab sample identification details, laboratory information, and provides a listing for conventional as well as toxic pollutants. The toxic pollutants were determined according to the listing provided originally in the Clean Water Act.

Process Data: Direct Discharge

This form summarizes information regarding industrial processes which directly discharge into a receiving water body. Data regarding a particular industrial process as well as any permit details are to be recorded on this form.

Process Data: Indirect Discharge

This form summarizes information regarding industrial processes which discharge to the local POTW for treatment before entrance to a receiving water body. The information recorded includes details of the particular industrial process and any pretreatment for it discharges as well as general data for the local POTW.

Spill History

This form should be used to record information regarding any past spills which occurred at an industrial facility.

Spill Potential

This form should be used to summarize information regarding industrial processes which have spill potential.

Facility Runoff

This form should be used during the outside portion of the industrial on-site investigation. The form summarizes potential sources of illicit discharges due to storm water runoff contamination.

Correlation of Data

This form should be used during the correlation process to determine similarities between the detected illicit discharge and suspect industrial process discharges. Comparisons are drawn based upon the wastestream characterization of discharges from the contaminated outfall, manhole observations, and suspect industrial process discharges.

Section 8

SUMMARY

This manual has outlined a procedure which begins with the screening of stormwater outfalls for signs of industrial discharge contamination. The methodology then proceeds to the identification of likely sources for the detected non-stormwater discharge. Ultimately, the actual location of the industrial illicit connection to the storm drainage system is pinpointed. This manual concludes with a section focusing solely upon necessary field survey techniques as the success of this methodology depends largely upon the careful collection of data and analysis of pertinent information.

The actual strategy underlying this methodology involves a correlation process between the characteristics of discharges observed at outfalls and that of various industrial manufacturing or operational process discharges. It is possible that several options may appear to be viable solutions while at other times no alternatives may seem to be the correct choice. Therefore, more than one on-site industrial investigation may be necessary in order to identify the source of an illicit connection.

By applying common sense and professional judgement to the procedures outlined in this manual, successful assessments of a facility's illicit storm water connections can be accomplished.

APPENDIX A
WASTE CHARACTERIZATION

WASTE CHARACTERIZATION

The objective of the following section is to provide a general survey of information regarding wastestream identification and characterization for various facilities listed under industrial SIC categories. Listings of the subcategories falling under each industrial SIC category will be followed by potential sources of wastestream flows. In addition, a characterization of the potential wastewaters discharged from each of the defined subcategories will be presented. This characterization will define typical values for chemical and physical parameters as determined from laboratory wastestream analysis.

Some of the subcategories for listed classifications have been eliminated due to their insignificance in the industry. In addition, the parameters defined for the wastestream characterization vary according to the data available for a particular industrial category. Thus, the tables presented in this appendix list various combinations of conventional, toxic, and non-toxic pollutants. The values presented in each table may be typical wastestream concentrations or ranges of concentrations. In either case, these tables should provide the user of this manual with guidelines as to the types and general concentrations of pollutants likely to be identified for a specific industrial subcategory.

It is also important to note that each wastestream characterization presents values taken from raw wastewaters prior to discharge into a sewerage system. Thus, the concentrations actually detected at a storm sewer outfall are likely to be lower due to possible dilution from storm water or other wastewaters.

The source referenced to for all detailed information and tables provided in this section was Volume II of the 1980 USEPA Treatability Manual.

INDUSTRIAL LAUNDRIES

Facilities belonging to this category are linked by the fact that they provide cleaning services for their clients. The main subcategories falling under industrial laundries are as follows:

Subcategories

- Industrial Laundries
- Linen Laundries
- Power Laundries
- Coin-Operated Laundries
- Dry Cleaning Plants
- Car Washes

Sources of Wastestream Flows

The four basic process divisions in the industrial laundries category include water wash, dry cleaning, dual-phase processing, and car wash processes. Typical sources of wastestream flows for industrial laundries will be generated from the operations involved for these processes.

Facilities utilizing a water wash first sort soiled materials. Stains which may set are removed which generally involves the use of acids, bleaches, and/or various organic solvents. Wetting, sudsing with detergents, and rinsing of the materials then takes place to clean the fabric.

Primary cleaning for dry cleaning processes is accomplished through the use of an organic-based solvent along with detergent and a controlled amount of water. Solvents are generally filtered and recovered for further use.

In dual-phase processing, the water-detergent wash is followed by a separate solvent wash. This is used almost exclusively to clean items that contain large amounts of water-soluble soils as well as oil and grease, such as for work shirts and wiping rags.

Car washes are considered a variation of the water wash process. Facilities are designed for either automatic or self-service washing of vehicles. Operational processes generally include washing with various detergents, waxing, rinsing, and drying.

Wastestream Characterization

The chemical and physical characteristics of laundry wastewaters are influenced by three primary factors: the type of cleansing process utilized, the types and quantities of soil present, and the composition of the various chemical additives used in the process. Wastestream flows deriving from water wash operations may contain all of the soil removed from the materials as well as the chemical cleaning agents or detergents added to facilitate the laundering process. While wastestream flows from dry cleaning processes tend to contain removed soils along with appreciable quantities of organic-based solvent. The primary wastes present in car wash wastewater are suspended and dissolved solids, oil and grease, lead, and zinc.

An important factor to keep in mind when investigating facilities falling under this category is that the sources of wastes may originate from the cleaning processes as well as from the materials being cleaned. This in turn increases the potential number of pollutants to be found in wastestream flows from industrial laundries and car washes.

Table 1 presents subcategory wastewater descriptions for conventional and toxic pollutants found in this industry.

TABLE 1 (cont.)

WASTEWATER CHARACTERIZATION OF AUTO AND OTHER LAUNDRIES

	Coin-Operated Laundries		Dry Cleaning Plants		Car Washes	
	Number Analyzed	Mean	Number Analyzed	Mean	Number Analyzed	Mean
Pollutant (mg/l)						
BOD_5	31	140	1	---	45	58
COD	18	340	1	---	NA	---
TOC	1	---	1	---	NA	---
TSS	28	140	1	---	45	270
Total Phosphorus	2	9.8	1	---	NA	---
Total Phenols	3	0.10	2	<0.003	6	<0.006
Oil and Grease	13	26	1	---	45	26
pH, pH Units	29	7.9	1	---	7	7.1
Toxic Pollutant (mg/l)						
Antimony	3	10			7	7,9
Arsenic	3	<10			7	230
Beryllium					7	<5
Cadmium	3	8			7	17
Chromium	3	<5			7	34
Copper	3	67	2	25	7	340
Cyanide						
Lead	3	36	2	20	45[c]	890
Mercury	3	1			7	<1
Nickel					7	260
Selenium					7	<5
Silver					7	<5
Thallium					7	<2
Zinc	3	310			45[c]	750

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TABLE 1

WASTEWATER CHARACTERIZATION OF AUTO AND OTHER LAUNDRIES

	Industrial Laundries		Linen Laundries		Power Laundries	
	Number Analyzed	Mean	Number Analyzed	Mean	Number Analyzed	Mean
Pollutant (mg/l)						
BOD_5	51	1,300	50	620	8	340
COD	60	5,000	26	1,600	11	660
TOC	24	1,400	28	400	4	150
TSS	69	1,000	59	400	11	220
Total Phosphorus	12	12.2	5	18.7	6	7.3
Total Phenols	19	0.32	7	0.12	5	0.31
Oil and Grease	66	1,100	52	330	9	110
pH, pH Units	62	10.4	58	10.1	14	9.4
Toxic Pollutant (mg/l)						
Antimony	22	240	7	10	6	160
Arsenic	24	77	7	7	6	<15
Beryllium	14	<1				
Cadmium	36	88	36	9	5	11
Chromium	35	880	36	100	7	76
Copper	36	1,700	15	520	7	160
Cyanide	28	140	7	33	5	<28
Lead	36	4,500	36	460	7	110
Mercury	24	2	36	3	8	0.7
Nickel	36	290	36	61	7	14
Selenium	16	8	7	2		
Silver	26	26	7	8	7	<7
Thallium			7	5		
Zinc	36	3,000	37	900	6	37

ELECTROPLATING

Facilities which belong to the electroplating category are those that apply a metallic surface coating to a second material. This is generally done by electrodeposition but may also be accomplished through various coating processes or through electroless plating. The main subcategories falling under electroplating are as follows:

Subcategories

- Common Metals Plating
- Precious Metals Plating
- Anodizing
- Coating
- Chemical Milling and Etching
- Electroless Plating
- Printed Circuit Board Manufacture

Sources of Wastestream Flows

The three basic process divisions in electroplating include: surface preparation, plating, and posttreatment. These steps are common to all subcategories and are the sources from which wastewater flows will be generated.

Surface preparation of the basic material is necessary to ensure that the exterior is cleaned and descaled prior to plating. Cleaning removes oil, grease, and any other dirt which may interfere in the plating of the material. Several cleaning methods can be used for this step including solvent, alkaline, acid, emulsion with organic solvents, and salt bath descaling.

In the plating step, a surface coating is applied to a material for either functional or decorative purposes. The type of electroplating done at facilities can vary greatly in size as well as character. However, all tend to rely upon appreciable use of various acid and alkaline solutions. In addition, large quantities of rinse water are also generated often containing these solutions in a diluted form.

Posttreatment after the initial plating of a material is completed in order to provide an additional coating. This extra coating is applied for a variety of reasons such as corrosion protection or to prepare the surface for painting. Posttreatment processes include chromating, phosphating, and conversion coating operations.

Wastestream Characterization

Wastewater from electroplating processes is typically due to the processing and finishing solutions generated from alkaline and acid cleaning operations, plating processes, and posttreatment. While the quantities of wastewater generated are not excessive, they tend to be very strong in nature. Untreated wastestreams may contain appreciable amounts of acids, detergents, solvents, and metals in significant quantities.

Predominant wastewater constituents for the electroplating industry include various chemical cleaners and plating solutions as well as the following metals: copper, nickel, chromium, zinc, lead, tin, cadmium, gold, silver, and platinum.

Table 2 presents raw discharge pollutant concentration ranges for the subcategories of the electroplating industry.

TABLE 2
POLLUTANT CONCENTRATION RANGES
FOR THE SUBCATEFORIES OF THE
ELECTROPLATING INDUSTRY

Pollutant Parameter	Concentration Range			
	Common Metals Plating	Precious Metals Plating	Electroless	Anodizing
Conventional Pollutants, mg/l				
TSS	0.1 - 10,000	0.1 - 10,000	0.1 - 39.0	36.0 - 920
Toxic Inorganic Pollutants, mg/l				
Cadmium	7 - 21,6,000			
Chromium, Total	88 - 530,000			270 - 79,000
Chromium, VI	5 - 330,000			5 - 5,000
Copper	32 - 270,000		2 - 48,000	
Cyanide, Total	5 - 15,000	5 - 10,000	5 - 12,000	5 - 78,000
Cyanide, A	3 - 130,000	3 - 8,400	5 - 1,000	4 - 68,000
Lead	660 - 25,000			
Nickel	19 - 3,000,000		28 - 47,000	
Silver		50 - 180,000		
Zinc	110 - 250,000			
Non-Toxic Pollutants, mg/l				
Fluoride	22 - 140,000		110 - 18,000	
Gold		13 - 25,000		
Iron	250 - 1,500,000			
Palladium		27 - 630		
Phosphorus	20 - 140,000	20 - 140,000	30 - 109,000	180 - 33,000
Platinum		110 - 6,500		
Rhodium[a]		34		
Tin	60 - 100,000		60 - 90,000	

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TABLE 2 (cont.)

Pollutant Parameter	Concentration Range: Coating	Concentration Range: Chemical Milling & Etching	Concentration Range: Printed Circuit Boards
Conventional Pollutants, mg/l			
TSS	19.0 - 5,300	0.1 - 4,300	1.0 - 610
Toxic Inorganic Pollutants, mg/l			
Cadmium			
Chromium, Total	190 - 79,000	88 - 530,000	5 - 48,000
Chromium, VI	5 - 5,000	5 - 330,000	5 - 4,400
Copper		210 - 270,000	200 - 540,000
Cyanide, Total	5 - 130,000	5 - 130,000	5 - 11,000
Cyanide, A	4 - 68,000	5 - 100,000	5 - 9,400
Lead			10 - 10,000
Nickel			27 - 13,000
Silver			1 - 480
Zinc	140 - 200	110 - 200,000	
Non-Toxic Pollutants, mg/l			
Fluoride		22 - 140,000	280 - 680,000
Gold			6 - 110
Iron	410 - 170,000	75 - 260,000	
Palladium			5 - 230
Phosphorus	60 - 53,000	60 - 140,000	51 - 54,000
Platinum			
Rhodium[a]			
Tin	100 - 6,600	340 - 6,600	60 - 54,000

NOTE: Blanks indicate data not available.

[a] Only one plant had a measurable level of this pollutant.

INORGANIC CHEMICALS MANUFACTURING

Facilities belonging to this category are those which produce alkalies and chlorine, industrial gases, inorganic pigments, and those producing other inorganic chemicals. The main subcategories falling under inorganic chemicals manufacture are as follows:

Subcategories

- Aluminum- Fluoride
- Chlor-Alkali (Mercury Cell and Metal Anode)
- Chrome Pigments
- Copper Sulfate
- Hydrofluoric Acid
- Hydrogen Cyanide
- Nickel Sulfate
- Sodium Bisulfate
- Sodium Dichromate
- Sodium Hydrosulfite
- Titanium Dioxide (Chloride and Sulfate)

Sources of Wastestream Flows

The sources of wastestream flows for the inorganic chemicals industry can vary considerably. Each subcategory will have unique waste sources which would not be found in another type of inorganics facility. Descriptions of all these sources is beyond the scope of this manual. However, there are several wastestream flows which have a potential for being common to all of these subcategories. The following is a listing of typical wastestream sources:

- Noncontact Cooling Water
- Rinse Water
- Floor and Equipment Washings
- Scrubber Wastewater
- Spent Chemical Solutions and Solvents
- Condenser Drainage
- Boiler Blowdown

Wastestream Characterization

The pollutants which may be found in the wastewaters from the inorganic chemicals industry also vary widely for each of the subcategories listed. Toxic pollutants are generally metals. In addition, the concentrations of the wastewater flows may vary from insignificant to appreciable concentrations. Table 3 presents the maximum concentration of each toxic pollutant found in each subcategory for the inorganic chemicals industry.

TABLE 3 (cont.)
MAXIMUM RAW WASTEWATER CONCENTRATIONS
OF TOXIC POLLUTANTS FOUND AT
SAMPLED INORGANIC CHEMICAL PLANTS

Toxic Pollutant (ug/l)	Sodium Bisulfate	Sodium Dichromate	Sodium Hydrosulfite	Titanium Dioxide Chloride	Titanium Dioxide Sulfate
Antimony	30				20
Arsenic					11
Asbestos					
Beryllium					
Cadmium	6		43		338
Chromium	17	252,000	9,300	15,200	124,000
Copper	375	35	1,450		1,480
Cyanide			101		
Lead	8		1,290	5,150	3,730
Mercury	3		28		
Nickel	250	12,500	1,660	6,230	6,370
Selenium		<5	34		
Silver	2	<0.5	128		64
Thallium					19
Zinc	2,480	544	27,400	3,110	3,840

NOTE: Blanks indicate data not available.

TABLE 3
MAXIMUM RAW WASTEWATER CONCENTRATIONS
OF TOXIC POLLUTANTS FOUND AT
SAMPLED INORGANIC CHEMICAL PLANTS

Toxic Pollutant (ug/l)	Aluminum Fluoride	Chlor-Alkali Mercury Cell	Chlor-Alkali Metal Anode	Chrome Pigments
Antimony	200	<200	20	7,700
Arsenic		<10	10	
Asbestos				
Beryllium				
Cadmium	0,85	0,4	2	79
Chromium	77	7,7	940	55,000
Copper	120	350	525	7,500
Cyanide				360
Lead		1	255	36,000
Mercury	2	150	9	
Nickel	150	<100	54,400	160
Selenium	110			<10
Silver		0,6	<9	7
Thallium		<250	14	
Zinc		230	24	4,100

Toxic Pollutant (ug/l)	Copper Sulfate	Hydrofluoric Acid	Hydrogen Cyanide	Nickel Sulfate
Antimony	307	70		
Arsenic	3,500	10		
Asbestos				
Beryllium				
Cadmium	870	2		9
Chromium		73	1,300	
Copper	1,850,000	770		73,300
Cyanide			166	
Lead	175	5,190		55
Mercury		2		4
Nickel	112,000	150		175,500
Selenium		25		<235
Silver				
Thallium		5.5	25	21
Zinc	11,000	8,120		

Tables 5, 6, and 7 summarize conventional and toxic wastestream characteristics for these subcategories as they represent the largest portion of the leather tanning and finishing industry.

TABLE 5

WASTEWATER CHARACTERIZATION OF
LEATHER TANNING AND FINISHING

Hair Pulp/Chrome Tan/Retan-Wet Finish Subcategory			
		Concentration (mg/l)	
Pollutant	Number of Data Points	Range of Individual Data Points	Mean
BOD_5	205	210 - 4,300	1,600
COD	170	180 - 27,000	4,600
TSS	210	25 - 36,000	2,400
TKN	58	90.0 - 630	330
Total Phenols	15	0.140 - 110	1.0
Sulfides	170	0.800 - 200	64
Oil and Grease	75	15 - 10,000	400
Total Chromium	180	3.00 - 350	76
Ammonia	168	17.0 - 380	100

		Concentration (mg/l)	
Toxic Pollutant	Number of Data Points	Range of Individual Range	Mean
Metals and Inorganics			
Chromium	3	43,000 - 180,000	80,000
Copper	3	50 - 380	173
Cyanide	2	20 - 60	40
Lead	3	1,100 - 2,400	1,700
Nickel	3	20 - 60	40
Zinc	3	200 - 580	430

TABLE 6

WASTEWATER CHARACTERIZATION OF
LEATHER TANNING AND FINISHING

Hair Save/Chrome Tan/Retan-Wet Finish Subcategory

Pollutant	Number of Data Points	Concentration (mg/l) Range of Individual Data Points	Mean
BOD_5	101	140 - 2,800	980
COD	30	700 - 5,700	2,600
TSS	82	94.0 - 8,600	1,900
TKN	56	63.0 - 3,600	140
Total Phenols	24	0.440 - 6,80	2.2
Sulfides	70	0.030 - 300	20
Oil and Grease	30	49.0 - 620	240
Total Chromium	56	0.006 - 390	31
Ammonia	31	0.400 - 660	90

Toxic Pollutant	Number of Data Points	Concentration (mg/l) Range of Individual Data Points	Mean
Metals and Inorganics			
Chromium	2	31,000 - 150,000	90,500
Cyanide	2	20 - 50	35
Lead	2	100 - 1,300	700
Nickel	2	5 - 40	22
Zinc	2	240 - 400	315

TABLE 7

WASTEWATER CHARACTERIZATION OF
LEATHER TANNING AND FINISHING

Pollutant	Number of Data Points	Nonchrome Tan/Retan-Wet Finish Subcategory Concentration (mg/l) Range of Individual Data Points	Mean
BOD_5	48	1.00 - 7,800	1,200
COD	40	1,100 - 75,000	5,100
TSS	55	28.0 - 8,200	1,700
TKN	21	130 - 1,200	200
Total Phenols	16	0.280 - 100	1.2
Sulfides	29	1.100 - 330	68
Oil and Grease	32	2.00 - 1,300	340
Total Chromium	30	0.250 - 110	11
Ammonia	20	23 - 680	90

Toxic Pollutant	Number of Data Points	Concentration (mg/l) Range of Individual Data Points	Mean
Metals and Inorganics			
Chromium	4	430 - 10,000	5,100
Copper	4	100 - 740	380
Cyanide	3	60 - 100	80
Lead	4	100 - 200	140
Nickel	4	40 - 95	61
Zinc	4	300 - 700	490

10123TBL

APPENDIX B
COST ESTIMATES

INDIVIDUAL FIELD TEST KITS

HACH COMPANY

TEST	MODEL	METHOD/CHEMISTRY	PRICE
Acidity	AC-6 2223-01	Drop Count Titration/ Sodium Hydroxide	$25.75
	AC-DT 20640-00	Digital Titrator/ Sodium Hydroxide	$136.50
Alkalinity	AL-AP 1433-01	Drop Count Titration/ Sulfuric Acid	$20.75
	AL-DT 20637-00	Digital Titrator/ Sulfuric Acid	$136.50
Aluminum	DR 100 41101-01	Colorimeter/ Eriochrome Cyanine R	$215.00
Chloride	8-P 1440-01	Drop Count Titration/ Silver Nitrate	$25.00
	CD-DT 20635-00	Digital Titrator/ Mercuric Nitrate	$136.50
Chlorine, low range (Free and Total)	CN-80 21290-00	Color Disc/ DPD	$67.75
	DR 100 41100-02	Colorimeter/ DPD	$215.00
Chlorine, high range (Total)	CN-65 2254-01	Drop Count Titration/ Thiosulfate	$45.00
	CN-DT 0-1000	Digital Titrator/ Thiosulfate	$139.00

HACH COMPANY

TEST	MODEL	METHOD/CHEMISTRY	PRICE
Chromium, low range (hexavalent)	CH-8 1834-00	Color Disc/ Diphenylcarbazide	$35.00
	DR 100 41100-03	Colorimeter/ Diphenylcarbazide	$215.00
Chromium, high range (hexavalent)	CH-14 2227-02	Drop Count Titration/ Thiosulfate	$31.50
	CH-DT 20634-00	Digital Titrator/ Thiosulfate	$140.00
Copper (free)	CU-5 14213-00	Color Disc/ Bicinchoninate	$37.50
	DR 100 41100-06	Colorimeter/ Bicinchoninate	$215.00
Cyanide (free)	CYN-3 2010-02	Color Disc/ Pyridine-pyrazolone	$91.00
	DR 100 41100-07	Colorimeter/ Pyridine-pyrazolone	$215.00
Detergents	DE-2 1432-03	Color Disc/	$155.00
Dissolved Oxygen	OX-2P 1469-00	Drop Count Titration/ Modified Winkler	$39.95
	OX-DT 20631-00	Digital Titrator/ Modified Winkler	$160.00
Hydrogen Sulfide	HS-7 2239-00	Color Chart/ Effervescence of Pb_5	$16.75
Lead	DR 100 41100-48	Colorimeter/ Fast Column Extraction	$215.00

HACH COMPANY

TEST	MODEL	METHOD/CHEMISTRY	PRICE
Manganese	MN-5 1467-00	Color Disc/ Cold Periodate	$66.75
	DR 100 41100-11	Colorimeter/ Cold Periodate	$215.00
Nickel	DR 100 41100-41	Colorimeter PAN	$275.00
Phosphate (Total)	PO-24 2250-01	Color Disk/ Ascorbic Acid	$99.75
Silver	DR 100 41100-42	Colorimeter/ Colorimetric	$275.00
Sulfate	SF-1 2251-00	Extinction/ Turbidimetric	$33.00
	DR 100 41100-19	Colorimetric/ Turbidimetric	$215.00
Sulfite	SU-5 1480-02	Drop Count Titration/ Iodimetric	$45.00
	SU-DT 20633-00	Digital Titrator/ Iodimetric	$140.00
Zinc	DR 100 41100-20	Colorimeter Zincon	$215.00

NOTE: Listed analysis kits and prices are those available for 1990.

FIELD TEST KIT

VWR SCIENTIFIC

BASIC KIT	MODEL	FEATURES	PRICE
Complete Water Action Set	Milton Roy 33-10-41	- Mini 20 Spectophotometer - Portable, lightweight - Includes nephelometer module, DPD chlorine reagent system - Chlorine reagent system	$1,245.00

ADDITIONAL INDIVIDUAL TESTS	MODEL	METHOD/CHEMISTRY	PRICE
Alkalinity	3-09-01 66122-304	Titration drop count $CaCO_3$ alkalinity/liter	$56.00
Chloride	33-09-12 66122-406	Titration drop count Cl/liter	$80.00
Chloride (5-300)	EM-14401-1	Manual Test	$82.95
Chlorine (free and total	33-09-03 66122-428	Spectophotometric, DPD Cl_2/liter	$70.00
Chromium (hexavalent)	33-09-17 66122-461	Spectophotometric, alkaline hypobromite oxidation	$70.00
Copper	33-09-17 66122-508	Spectophotometric, cuprethol	$72.00
Copper (.05-.50)	EM-14414-1		$82.95
(.3-5.0)	EM-14417-1		$82.95
Cyanide (0.002-0.03 ppm)	EM-14417-1	Manual Test	$87.10
Cyanide (0.03-0.7 ppm)	EM-14429-1	Manual Test	$82.95

VWR SCIENTIFIC

ADDITIONAL INDIVIDUAL TESTS	MODEL	METHOD/CHEMISTRY	PRICE
Dissolved Oxygen	33-09-08 66123-034	Titration drop count Dissolved oxygen/liter	$80.00
Hydrogen Sulfide (0.02-0.25 ppm)	EM-14416-1	Manual Test	$82.95
Hydrogen Sulfide (0.2-5.0 ppm)	EM-14435-1	Manual Test	$82.95
Manganese	33-09-21 66122-756	Spectophotometric	$120.00
Nickel (0.25-8.0)	EM-14420-1	Manual Test	$82.95
Phosphate (Total)	33-09-23 66123-147	Spectophotometric acid hydrolysis and persulphate oxidation	$72.00
Phosphate (.1-.16)	EM-14409-1	Manual Test	$82.95
Phosphate (.1-2.5)	EM-14431-1	Manual Test	$82.95
Sulphate	33-09-14 66123-227	Spectophotometric, Turbidimetric, SO_4/liter	$70.00
Sulphate (25-300)	EM-14411-1	Manual Test	$82.95
Zinc (0.1-5)	EM-14412-1	Manual Test	$82.95

NOTE: Listed analysis kits and prices are those available for 1990.

pH METER

SUPPLIER	MODEL	CAPABILITIES	PRICE
Hach	Hach One System No. 43800-00	- Non-Clogging Reference Junction - mV Resolution of 0.1 Unit - Auto and Manual Mode for Calibration - One Year Warranty	$395.00
Cole-Parmer	pH Wand with Electrode Module N-05830-00	- Easy to Replace Electrode Module - Automatic Signal Amplification - Automatic Temp. Compensation - $\pm$ 0.01 pH Accuracy	$120.00
V.W.R Scientific	Beckman BK123132	- Auto Buffer Recognition/Standardization - Auto Read Stability Indicator - Simultaneous Temp. Display - Standardization Indicators - Error Messages - Auto Display Off	$310.00
McMaster Carr	Compact pH Meter (LCD) No. 8508T9	- 0 to 14 pH Range - LCD Display for Outdoor Use - $\pm$ 0.01 pH Accuracy	$217.00
Omega	Model PHH-43	-Combination pH, Milli Volt, And Temperature Meter -Easy pH Calibration -Microprocessor Based Temperature Compensation And pH Calibration	$255.00

INDIVIDUAL FIELD TEST KITS

COLE-PARMER INSTRUMENT COMPANY

TEST	MODEL	METHOD/CHEMISTRY	PRICE
Acidity (0-500 ppm)	L-02652-20	Titrimetric	$23.95
Alkalinity (0-300 ppm)	L-02652-02	Titrimetric	$21.95
Aluminum (0-.5 ppm)	L-05554-20	Titrimetric tablets	$37.50
Chloride (0-2.5 ppm)	L-02652-10	Mercurimetric titration	$23.95
Copper (0-1, 1-10 ppm) (total soluble)	95-00290-50	Colorimetric	$53.00
Cyanide	L-05542-09		$52.00
Dissolved Oxygen (0-10 ppm)	L-02652-00	Winkler titration	$37.95
Lead (0-50 ppb)	L-00291-50	Colorimetric	$64.50
Phosphate (0-5 ppm)	L-02652-38	Colorimetric	$23.95
Sulphate (0-750 mg/l)	L-05542-23		$58.50
Sulphite (0-200 ppm)	L-02652-24	Iodometric titration	$30.75
Zinc (0-10 mg/l)	L-05542021		$72.50

CONDUCTIVITY METER

SUPPLIER	MODEL	CAPABILITIES	PRICE
Cole-Parmer	Hand Held Model No. N-01481-40	- Adjustable Temp. Coefficient - Auto. Temp. Compensation - Wide Conductivity Range	$275.00
V.W.R. Scientific	NBS Digital Meter Cat. No. 23266-501	- Chemical Resistant ABS Housing - Fast Response Probe - Battery - NBS Certificate	$218.00
Hach	Digital Model 44600	- Digital Display - Conductivity, TDS, Temp. - Patented Probe - Carrying Case	$395.00
Omega	Portable Model CDH-70	- Chemical Resistant Case - Temp., Conductivity, Cell Constant - Built-in Temp. Compensation - Membrane Keyboard	$291.00
Extech Instruments	P341650	-3 1/2 Digit LCD Display -Adjustable Hinged Cover -Neckstrap For Hands Free Operation -9V or AC Adaptor -Measures Conductivity 0.1 to 200,000 $_{U}$s/cm -Automatic 0 to 100^{o}c Temperature Compensation	$229.00

PORTABLE AUTOSAMPLER

MANUFACTURER: American Sigma

MODEL: Model No. 800SL

CAPABILITIES:

- Compact design passes through 18" manhole opening.
- 24# dry wt.
- Accepts 8# ice in base.
- Corrosion resistant Delrin pump.
- Peristalic pump has no contact with media.
- Liquid sensing system.
- Serial interface for downloading to IBM P.C. or Hand Held Data Transfer Unit.
- Large 16 character display.
- Electronic isolation sealed in NEMA 4X, 6 housing.
- Vertical lift 27 ft.
- Transport velocity of 2.7 ft/sec.
- Temperature limits 32^{O}F - 120^{O}F.
- Time and flow proportional sampling capabilities

REQUIRED ACCESSORIES:

1 - Compact base part No. 1405.
1 - Gel electrolyte, 12 VDC, 6 AMP/HR battery No. 1414.
1 - Battery charger No. 913.
2 - 24-575 ml polypropylene bottles w/caps No. 1369.
1 - Retainer ring No. 1376.
1 - Distributor assembly for compact base No. 1375.
25'-3/8" I.D. Vinyl tubing No. 920.
1 - Teflon/S.S. weighted strainer No. 926.
1 - Silicone pump tubing insert No. 1358.

PRICE: $2,535.00

NOTE: Listed accessories included as part of total price.

PORTABLE AUTOSAMPLER

MANUFACTURER:	Manning
MODEL:	Model No. S-4040
CAPABILITIES:	- Max. sample lift 22 ft. - Time and flow proportional sampling capabilities. - Watertight, ABS plastic housing. - Superior sample transport velocity of 3 ft/sec minimum. - Precise equal volume samples. - Reliable operation w/discreet sampling and rotating spout assembly. - Purge pressure minimum 20 psi. - Temperature limits 32°F - 120°F. - Interface for Manning portable flowmeters. - 31 pound dry weight.
REQUIRED ACCESSORIES:	24 - 500 ml autoclave polypropylene bottles w/caps 1 - Battery charger. 1 - 12 VDC, 16 amp/hr wet cell battery. 1 - Composite base. 1 - (.375") I.D. nylon reinforced PVC tubing w/weighted PVC strainer, various lengths available.
PRICE:	$2,090.00

NOTE: Listed accessories not included as part of total price.

PORTABLE AUTOSAMPLER

MANUFACTURER: ISCO

MODEL: Model No. 3700

CAPABILITIES:

- Rugged corrosion resistant exterior.
- Exclusive LD90 liquid presence detector.
- Watertight, dust tight, corrosion resistant.
- Peristalic pump.
- No cross contamination.
- User friendly programming.
- 40 character LCD.
- Real time date clock.
- Sealed controller.
- Sequential 24 bottle sampling.
- Time and flow proportional sampling capabilities.
- Temperature limits $32^{\circ}F$ - $120^{\circ}F$.
- Pump rate 3500 ml/min. (3 ft. head)
- 37 pound dry weight.

REQUIRED ACCESSORIES:

1 - Nickel cadmium battery.
1 - AC-power converter/battery charger.
1 - 25'-3/8" I.D. vinyl suction line with strainer.

PRICE: $2,865.00

NOTE: Listed accessories included as part of total price.

ESTIMATED MISCELLANEOUS SURVEY COSTS

ITEM	AMOUNT	PRICE
Instant Camera	1 - Polaroid One-Step	45.00
Color Film	1 - 20 Exposure Film	18.00
Plastic Sampling Bottles	150 - 16 oz. Bottles	60.00
Storage Cooler	1 - 48 qt. Cooler	20.00
Wooden Stakes	20 - 2 in. x 4 in. x 3 ft.	15.00
Hammer	1 - One-Piece Steel	15.00
Flashing Barricade	1 - 36" Barricade	70.00
Orange Safety Cones	10 - Fluorescent 18" Cones	70.00
Orange SAfety Vests	2 - Nylon Vests	10.00
Crowbar	1 - Crowbar	20.00
Flashlight & Batteries	2 - Explosion Proof	15.00
Fold-Up Tape Measure	1 - 8 ft. Tape Measure	8.00
Heavy Duty Tape	1 - 60 yd. 2 in. Duct Tape	8.00
Fluorescein Dye Tracer	200 Tablets	18.00
pH Buffer Solution	1 Pint	5.00
Conductivity Buffer Solution	1 Pint	5.00
Gloves	2 Pair	5.00
Rubber Boots	1 Pair-10 in. Overshoe	35.00
Safety Shoes	2 Pair	100.00
Safety Glasses	2 Pair	8.00
Hard Hats	2 Hats	15.00
Work Coveralls	2 Coveralls	50.00
First Aid Kit	1 - Basic Unit	35.00
	TOTAL ESTIMATED COST	**$650.00**

APPENDIX C
DATA INVENTORY FORMS

OUTFALL ANALYSIS DATA

Outfall ID ______________________ Date ______________________

Inspector(s) ______________________ Time ______________________

____

Weather Conditions ____

____

Surrounding Industrial ____

Facilities ____

____

____

____

Flow Pattern ____

TIME(S) OF DETECTED DISCHARGE

Day of Week	Start Time	End Time
1)________	1)________	1)________
2)________	2)________	2)________
3)________	3)________	3)________
4)________	4)________	4)________
5)________	5)________	5)________

Other Comments ____

____

____

OUTFALL ANALYSIS DATA (cont.)

Outfall ID ______________________ Date ______________________

Inspector(s) ______________________ Time ______________________

____

PHYSICAL OBSERVATIONS

Odor ______________________

____

Color ______________________

____

Turbidity ______________________

____

Floatables ______________________

____

Residue ______________________

____

Vegetation ______________________

____

Structural Damage ______________________

____

Other Comments ______________________

____

____

OUTFALL ANALYSIS DATA (cont.)

Outfall ID ______________________ Date ______________________

Inspector(s) ______________________ Time ______________________

____

CHEMICAL ANALYSIS

pH

Type of Test ______________________ Reading 1)__________

Manufacturer ______________________ 2)__________

Model No. ______________________ 3)__________

Total Dissolved Solids

Type of Test ______________________ Reading 1)__________

Manufacturer ______________________ 2)__________

Model No. ______________________ 3)__________

Conductivity

Type of Test ______________________ Reading 1)__________

Manufacturer ______________________ 2)__________

Model No. ______________________ 3)__________

Grab Samples

Sample ID ______________________ ______________________

______________________ ______________________

Laboratory Address ______________________________________

____

____

Phone ______________________________________

LABORATORY ANALYSIS

Inspector(s) ______________________ Date ______________

______________________ Time ______________

Sample Location ______________________

____

Sample ID ______________________

Laboratory Address ______________________

____

____

Phone ______________________

Date Submitted ______________________

Date Completed ______________________

Parameters for Testing

CONVENTIONAL POLLUTANTS

- ____ pH
- ____ Conductivity
- ____ Total Solids
- ____ Total Suspended Solids
- ____ Total Dissolved Solids
- ____ BOD (5 day)
- ____ Organic Solids
- ____ Inorganic Solids
- ____ Oil and Grease

LABORATORY ANALYSIS (cont.)

Sample Location ______________________ Sample ID ____________________

TOXIC POLLUTANTS (As Listed by the Clean Water Act)

_____ Acenaphthene	_____ Endrin and metabolites
_____ Acrolein	_____ Ethylbenzene
_____ Acrylonitrile	_____ Fluoranthene
_____ Aldrin/Dieldrin	_____ Haloethers
_____ Antimony and compounds	_____ Halomethanes
_____ Arsenic and compounds	_____ Heptachlor and metabolites
_____ Asbestos	_____ Hexachlorobutadiene
_____ Benzene	_____ Hexachlorocyclohexane
_____ Benzidine	_____ Hexachlorocyclopentadiene
_____ Beryllium and compounds	_____ Isophorone
_____ Cadmium and compounds	_____ Lead and compounds
_____ Carbon tetrachloride	_____ Mercury and compounds
_____ Chlordane	_____ Naphthalene
_____ Chlorinated benzenes	_____ Nickel and compounds
_____ Chlorinated ethanes	_____ Nitrobenzene
_____ Chloroalkyl ethers	_____ Nitrophenols
_____ Chlorinated naphthalene	_____ Nitrosamines
_____ Chlorinated phenols	_____ Pentachlorophenol
_____ Chloroform	_____ Phenol
_____ Chlorophenol	_____ Phthalate esters
_____ Chromium and compounds	_____ Polychlorinated biphenyls
_____ Copper and compounds	_____ Polynuclear aromatic hydrocarbons
_____ Cyanides	_____ Selenium and compounds
_____ DDT and metabolites	_____ Silver and compounds
_____ Dichlorobenzenes	_____ 2,3,7,8-Tetrachlorodibenzo-*p*-dioxin
_____ Dichlorobenzidine	_____ Tetrachloroethylene
_____ Dichloroethylenes	_____ Thallium and compounds
_____ 2,4-Dichlorophenol	_____ Toluene
_____ Dichloropropane & dichloropropene	_____ Toxaphene
_____ 2,4-Dimethylphenol	_____ Trichloroethylene
_____ Dinitrotoluene	_____ Vinyl chloride
_____ Diphenylhydrazine	_____ Zinc and compounds
_____ Endosulfan and metabolites	

OTHER PARAMETERS

_____ ______________________________

_____ ______________________________

_____ ______________________________

_____ ______________________________

_____ ______________________________

PROCESS DATA: DIRECT DISCHARGE

Inspector(s) ______________________ Date ______________________

____

Industrial Facility ______________________

Industrial Address ______________________

____

____

Industrial Contact ______________________ Phone ______________________

Process Description ______________________

____

____

Discharge Point Location ______________________

____

Discharge Point ID ______________________

____

Receiving Water ______________________

Is Discharge Covered by an NPDES Permit? ______________________

If No, Why Not? ______________________

NPDES Permit No. ______________________ Expiration Date ______________________

Issuing Agency ______________________ Contact ______________________ Phone ______________________

Permitted Parameters ______________________

____

____

____

____

Exceedence History ______________________

____

Other Comments ______________________

____

PROCESS DATA: INDIRECT DISCHARGE

Inspector(s) ______________________ Date ______________________

____

Industrial Facility ______________________

Industrial Address ______________________

____

____

Industrial Contact ______________________ Phone ______________________

Process Description ______________________

____

____

Discharge Point Location ______________________

____

Discharge Point ID ______________________

Final Receiving Water ______________________

Name of POTW ______________________

POTW Contact ______________________ Phone ______________________

Is Discharge Covered by a POTW Contract? ______________________

Has POTW Instituted a Pretreatment Program? ______________________

If Yes, Describe Type of Treatment ______________________

____

Limited Parameters ______________________

____

____

____

____

Other Comments ______________________

____

SPILL HISTORY

Inspector(s) ______________________ Date ______________________

____

Industrial Facility ______________________

Industrial Address ______________________

____

____

Industrial Contact ______________________ Phone ______________________

SPCC Plan Available ______________________ If Yes, Date Written ______________________

Other Sources ______________________

of Data ______________________

____

Date of Spill ______________________

Type of Spill ______________________

____

Process Location ______________________

____

Spilled Materials ______________________

____

Volume Spilled ______________________

____

Recorded Cause ______________________

____

____

Corrective Actions ______________________

____

Other Comments ______________________

____

10123FRM

SPILL POTENTIAL

Inspector(s) ______________________ Date ______________________

____

Industrial Facility ______________________

Industrial Address ______________________

____

____

Industrial Contact ______________________ Phone ______________________

SPCC Plan Available ______________ If Yes, Date Written ______________

Other Sources ______________________

of Data ______________________

____

Type of Spill ______________________

____

Process Location ______________________

____

Type of Materials ______________________

____

Potential Volume ______________________

____

Possible Causes ______________________

____

____

Spill Containment ______________________

____

Other Comments ______________________

____

FACILITY RUNOFF

Inspector(s) ______________________ Date ______________________

____

Industrial Facility ______________________

Industrial Address ______________________

____

____

Industrial Contact ______________________ Phone ______________________

Runoff Collection Point ______________________

____

Description of Contributing Area ______________________

____

____

____

POTENTIAL RUNOFF CHARACTER

Description of Source	Contamination Potential	Drainage Path
Parking Lots		
Shipping Areas		
Receiving Areas		
Material Storage		
Other Areas		

CORRELATION OF DATA

Inspector(s) ______________________ Date ______________________

____

Industrial Facility ______________________

Industrial Address ______________________

____

____

Industrial Contact ______________________ Phone ______________________

Outfall ID ______________________

Outfall Location ______________________

____

Manhole ID ______________________

Manhole Location ______________________

____

Process ID ______________________

Process Location ______________________

____

Process Description ______________________

____

____

Other Comments ______________________

____

____

CORRELATION OF DATA (cont.)

SIMILAR CHARACTERISTICS

	Outfall ID	Manhole ID	Process ID
Physical Observations			
Odor			
Color			
Turbidity			
Floatables			
Residue			
Vegetation			
Structural Damage			
Chemical Analysis			
pH			
TDS			
Conductivity			
Other Parameters			

FACILITY RUNOFF

Inspector(s) ______________________ Date ______________________

____

Industrial Facility ______________________

Industrial Address ______________________

____

____

Industrial Contact ______________________ Phone ______________________

Runoff Collection Point ______________________

____

Description of Contributing Area ______________________

____

____

____

POTENTIAL RUNOFF CHARACTER

Description of Source	Contamination Potential	Drainage Path
Parking Lots	______________________	______________________
	______________________	______________________
Shipping Areas	______________________	______________________
	______________________	______________________
Receiving Areas	______________________	______________________
	______________________	______________________
Material Storage	______________________	______________________
	______________________	______________________
Other Areas	______________________	______________________
	______________________	______________________

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CORRELATION OF DATA

Inspector(s) ______________________ Date ______________________

____

Industrial Facility ______________________

Industrial Address ______________________

____

____

Industrial Contact ______________________ Phone ______________________

Outfall ID ______________________

Outfall Location ______________________

____

Manhole ID ______________________

Manhole Location ______________________

____

Process ID ______________________

Process Location ______________________

____

Process Description ______________________

____

____

Other Comments ______________________

____

____

CORRELATION OF DATA (cont.)

SIMILAR CHARACTERISTICS

	Outfall ID ______	Manhole ID ______	Process ID ______
Physical Observations			
Odor	______	______	______
Color	______	______	______
Turbidity	______	______	______
Floatables	______	______	______
Residue	______	______	______
Vegetation	______	______	______
Structural Damage	______	______	______
Chemical Analysis			
pH	______	______	______
TDS	______	______	______
Conductivity	______	______	______
Other Parameters			
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______