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Food Processing Wells

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WELLS USED TO INJECT FLUIDS FROM FOOD PROCESSING OPERATIONS

The U.S. Environmental Protection Agency (USEPA) conducted a study of Class V underground injection wells to develop background information the Agency can use to evaluate the risk that these wells pose to underground sources of drinking water (USDWs) and to determine whether additional federal regulation is warranted. The final report for this study, which is called the Class V Underground Injection Control (UIC) Study, consists of 23 volumes and five supporting appendices. Volume 1 provides an overview of the study methods, the USEPA UIC Program, and general findings. Volumes 2 through 23 present information summaries for each of the 23 categories of wells that were studied (Volume 21 covers 2 well categories). This volume, which is Volume 6, covers Class V food processing wastewater disposal wells.

1. SUMMARY

Food processing wastewater disposal wells (FPWDWs) are essentially commercial septic systems[1] used to dispose of food preparation-related wastewater and equipment or facility wash down water. This group of wells also includes food processing wastewater drywells, which allow wastewater to enter the soil untreated. These systems usually inject process wastewater that may contain high levels of organic substances (e.g., food waste), cleaning compound residues, and various inert substances. FPWDWs are typically found at small facilities that usually have less than ten full time employees and are located in unsewered, rural areas.

FPWDWs are similar to domestic septic systems, but instead of receiving toilet and shower water, they receive larger quantities of equipment washdown and process wastewater. As with most domestic septic systems, FPWDWs have one or two holding (or septic) tanks with attached pipes that distribute treated wastewater to adjoining drain fields.

The wastewater entering the soil via FPWDWs, called FPWDW injectate, can contain high biochemical oxygen demand (BOD) levels due to the organic fluids (e.g., blood from animal slaughtering facilities) and some food residues (e.g., shellfish meat from shellfish processing facilities) entering the wastewater stream. In addition, the injectate may contain significant levels of nitrate, nitrite, total coliform, ammonia, turbidity and chlorides. No FPWDW injectate sampling has been performed, so it is difficult to ascertain what constituents typically exceed drinking water maximum contaminant

[1] In this volume a commercial septic system refers to a subsurface wastewater disposal system that may have a slightly larger septic tank than a domestic sanitary septic system and may have additional features such as a grease trap (see Section 4.6.1) or additional septic tank access holes. These septic systems, which are used at the smaller food processing facilities, typically serve less than 20 people per day and the septic tank volume is usually equal to or less than 2,000 gallons. Though still considered a Class V injection well, commercial septic systems are not equivalent to large-capacity septic systems covered in Volume 5 of the Class V Study.

levels (MCLs) or health advisory levels (HALs). However, based on observations during site visits and assumptions described in studies of similar wastewater treatment systems, it appears likely that the concentrations of nitrate, nitrite, total coliform, and ammonia may exceed primary MCLs or HALs. It is also possible that due to the high organic content of the injectate, the secondary MCLs for turbidity and chloride may be exceeded.

FPWDWs typically inject above USDWs and into a variety of different geological formations, terrains, and soils. However, one recently closed FPWDW at a fruit processing facility in Hawaii was injecting directly into a USDW. As with sanitary septic systems, for FPWDWs to work properly it is necessary that the injection zone consist of moderately permeable soils. Site visits in Tennessee revealed that some food processing facilities were being allowed to inject slaughterhouse wastewater, via septic systems, into fractured geologic units and karst terrains that apparently had very little top soil.

Only one USDW contamination incident has been identified that is clearly linked to a FPWDW. In Maine, in 1998, a lobster processing/holding facility discharged large volumes of seawater into its combined food processing well and sanitary septic system. As a result, the chloride concentration in a nearby private drinking water well exceeded the secondary MCLs.

FPWDWs may be vulnerable to receiving spills that occur at the facility. Some food processing facilities use strong cleaning compounds to clean or disinfect equipment and, based on observations from site visits, some facilities may not always be storing these chemicals in storage areas away from floor drains that are connected to FPWDWs. Therefore, spills may result in the release of cleaning/disinfecting chemicals into the FPWDW. FPWDWs may also be used for illicit discharges due to limited oversight and the necessity for rapid and inexpensive disposal of process wastewater.

According to the state and USEPA Regional survey conducted for this study, there are at least 741 documented FPWDWs and more than 1,468 estimated to exist in the U.S. Of the 741 documented wells, 43% are found in Maine and New York and 52% are found Alabama and West Virginia. The remaining wells are found in Alaska, Wisconsin, Hawaii and a few other states. Tennessee (based on discussions with the state Class VUIC coordinator) also has a significant number of FPWDWs but the inventory has not been finalized. These well totals are considered uncertain because many of the previously mentioned states do not distinguish between FPWDWs and other kinds of commercial or industrial wells in their inventories. Overall, it seems that the number of active FPWDWs throughout the country is decreasing because many UIC program staff are actively encouraging individuals not to install FPWDWs and the areas served by sewers are expanding. Additionally, there are some states that are closing all FPWDWs as they are found.

States such as Maine, Alabama and New York, which have significant numbers of FPWDWs, require individual permits or waste discharge licenses prior to construction and operation. However, in Maine if the FPWDW meets local plumbing codes, no discharge license is required. West Virginia and Tennessee, on the other hand, authorize these well types by rule but may require more extensive permitting or closure efforts from the owner or operator if operations result in USDW endangerment. Additionally, these two states require inventory information and other detailed information to be submitted prior to FPWDW operation. In Oregon, FPWDWs fall under a state general permit. Hawaii, with only a few wells, prohibits injection into a USDW unless an individual site-specific permit is issued. Similarly, in Wisconsin, all FPWDWs are permitted individually through the Pollutant Discharge Elimination System. Depending on the type of food being processed, food processing facilities must also comply with food handling and preparation regulations put forth by counties, states, and the federal government. Some of these regulations may affect the quantity and quality of FPWDW injectate.

2. INTRODUCTION

Shallow wells that dispose of wastewater from food processing operations qualify as Class V injection wells as long as the wastewater is not a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA). Using the existing list of Class V well types in 40 CFR §146.5(e), food processing wastewater disposal wells could be either "dry wells used for the injection of wastes into a subsurface formation" (per §146.5(e)(5)), or if the wastewater is disposed via a septic system, "septic system wells used to inject the waste or effluent from ... a business establishment" (per §146.5(e)(9)). In the *1987 Class V UIC Report to Congress*, food processing wastewater disposal wells were considered to be industrial process water and waste disposal (5W20) wells (USEPA, 1987).

On July 29, 1998 (63 FR 40586), USEPA proposed revisions to the Class V UIC regulations that would add new requirements for the following three types of wells that, based on available information, were believed to pose a high risk to USDWs when located in ground water-based source water protection areas: motor vehicle waste disposal wells, industrial wells, and large-capacity cesspools. All other types of Class V wells are to be studied further to determine whether they warrant additional UIC regulation. In the July 29, 1998 Notice, USEPA proposed to include "wells used to inject wastewater from food processing operations" within the "other industrial" well category,[2] which would be excluded from the more stringent regulations proposed for high-risk industrial wells.

Because the term "well" is not commonly associated with the types of subsurface wastewater disposal systems typically found at food processing facilities, it is important to clarify what is considered a FPWDW and what is not. FPWDWs are any systems that accept food processing wastewater and release it untreated or partially treated (as with septic systems) directly into the subsurface or above USDWs. FPWDWs do not include septic systems at food processing facilities that are used solely for the disposal of sanitary waste. The defining criterion for FPWDWs is that the systems are used to treat

[2] The wells in the proposed "other industrial well" category are: (1) wells used to inject fluids from carwashes that are not specifically set up to perform engine or undercarriage washing; (2) wells used to inject non-contact cooling water that contains no additives and has not been chemically altered; (3) wells used to inject fluids from laundromats where no onsite dry cleaning is performed or where no organic solvents are used for laundering; and (4) wells used to inject wastewater from food processing operations. The other three kinds of wells included in the other industrial well category are addressed in separate Volumes of the Class V Study.

and/or dispose of wastewaters that are generated as a result of preparing, packaging, or processing food products.

3. PREVALENCE OF WELLS

For this study, data on the number of FPWDWs were collected through a survey of state and USEPA Regional UIC Programs. The survey methods are summarized in Section 4 of Volume 1 of the Class V Study. Table 1 lists the numbers of Class V FPWDWs in each state, as determined from this survey. The table includes the documented number and estimated number of wells in each state, along with the source and basis for any estimate, when noted by the survey respondents. If a state is not listed in Table 1, it means that the UIC Program responsible for that state indicated in its survey response that it did not have any Class V FPWDWs. The *Food Processing Sector* column provides information on the particular food processing sectors within a state that are known to use FPWDWs. Very few UIC coordinators provided this information since most did not have a good handle on how many of FPWDWs existed in each state or what type of facilities used them.

Based on the inventory of documented wells provided in Table 1, it appears that the use of FPWDWs in the United States is very common. Based on survey responses, there are 741 documented and almost 1,500 estimated FPWDWs in the U.S. However, several other states indicate that they believe these wells exist in their state, but they do not have accurate information on the prevalence of FPWDWs.

Based on the type of survey responses provided and the methods used in estimating the numbers of wells, there is a large degree of uncertainty associated with the totals provided in the last row of Table 1. Many UIC coordinators do not know how many FPWDWs actually exist and others believe that there are many other FPWDWs in addition to the ones that are documented. Though not many states or USEPA Regions provided information on the types of facilities using FPWDWs, the far right hand column suggests that a majority of the FPWDWs can be found at small slaughterhouses and seafood processing facilities.

3.1 States Where Relatively Large Numbers of FPWDWs Are Known to Exist

Conversations with some UIC coordinators combined with the information provided in survey responses indicates that many of the documented FPWDWs are located in states along coasts. These states include Maine, Alabama, New York, and Hawaii. However, it is not clear whether these coastal states have a higher number of FPWDWs because there are a larger number of small seafood processing facilities or because they have simply developed a more complete well inventory. Other non-coastal states also reported, via survey responses or personal conversations, having a fair number of FPWDWs. These other states include West Virginia, Tennessee, and Wisconsin.

Table 1. Inventory of FPWDWs in the U.S.

State	Documented Number of Wells	Estimated Number of Wells		Food Processing Sector (Provided When Available)
		Number	Source of Estimate and Methodology [1]	
USEPA Region 1				
ME	152	152	Professional judgement and inspection experience. Suspects more wells than documented may exist. Maine Department of Environmental Protection is gradually discovering small seasonal facilities that use FPWDWs. These discoveries are likely to increase the number of documented wells.	Many small seasonal facilities (e.g., deer, and moose slaughterhouses and seafood processing facilities).
USEPA Region 2				
NY	174[2]	500	Best professional judgement, based on years of inspections and reviews of business directories.	N/A
USEPA Region 3				
MD	1	NR	UIC program staff suspect that more wells exist.	N/A
WV	223[2]	>223 other industrial wells	Best professional judgement.	N/A
USEPA Region 4				
AL	162[2]	>162	Based on field inspections and discussions with owners of permitted facilities. State believes that other industrial wells exist that are not permitted.	Some seafood processing wells.
FL	5	5	Field visits. State believes more wells exist, but no statewide inventory is available.	N/A
TN	1	1	Suspect many more wells exist in TN.	Primarily custom slaughterhouses.
USEPA Region 5				
MI	1	1	NR	Meat processing facility.
WI	6	>6	UIC program staff suspects more wells than documented may exist based on best professional judgement.	N/A
USEPA Region 6 -- None				
USEPA Region 7				

Table 1. Inventory of FPWDWs in the U.S. (Continued)

State	Documented Number of Wells	Estimated Number of Wells		Food Processing Sector (Provided When Available)
		Number	Source of Estimate and Methodology [1]	
IA	NR	<100	Best professional judgement based on discussions with trade organizations and county sanitarians, and from working with the regulated community.	N/A
USEPA Region 8				
MT	2	>2	Best professional judgement. The documented number of wells may be inaccurate. All cities have not yet been inventoried.	Pork slaughterhouse, and pork products facility.
USEPA Region 9				
CA	0	250	Best professional judgement.	N/A
HI	6	6	N/A	N/A
NV	0	<10	Best professional judgement.	N/A
USEPA Region 10				
AK	8	25	Best professional judgement.	N/A
OR	0[2]	25	Best professional judgement. Many active wells are not documented.	N/A
All USEPA Regions				
All States	741	+/- 1,468	Total estimated number counts the documented number when the estimate is NR or unknown.	

[1] Unless otherwise noted, the best professional judgement is that of the state or USEPA Regional staff completing the survey questionnaire.
[2] Total includes all "other" industrial wells and not only FPWDWs; state data sources used to provide information for this table do not readily differentiate between well types.
N/A Not available.
NR Although USEPA Regional, state and/or Territorial officials reported the presence of the well type, the number of wells was not reported, or the questionnaire was not returned.

Maine has a significant number of documented FPWDWs with a total of 152. According to the state UIC Class V coordinator and information obtained during a visit to the state, the majority of these FPWDWs are seafood and shellfish processing plants located along the coast (Gould, 1999). These small facilities typically process and package shrimp, clams, oysters, lobsters, crab, and fish. It is important to note that the figure of 152 reported by the State of Maine staff was taken from a state inventory performed between 1988 and 1992. Therefore, it is possible that some of the inventory data on FPWDWs in Maine are no longer accurate since some facilities may no longer be in business or have since made connections to sewer lines.

Though only one FPWDW was reported in Tennessee, a recent visit to the state and conversations with the state UIC Class V coordinator indicate that many more small slaughterhouses with FPWDWs do exist in the state (Sorrells, 1999). Like many other states, Tennessee is currently in the process of developing a much more accurate inventory of FPWDWs and other industrial Class V wells. Site visits to both Tennessee and Maine also indicate that most of these slaughterhouses are custom slaughterhouses that on average process less than 15 animals per week, depending on the time of year and the hunting season. Custom slaughterhouse are facilities that process animals according to the specific requests of customers. Once the meat is packaged it is returned to the owner of the animal (see Section 7.1.4 for more detail).

It appears that the majority of FPWDWs are generally found in rural areas that are unsewered. Conversations with some food processing facility owners/operators using FPWDWs reveal that the primary reason for installing a FPWDW is the lack of sewer connections. These owners/operators stated that if sewer connections were available at the time the facility was built, they would have opted for connecting to the sewer lines instead of building a FPWDW.

3.2 Other States

The survey results in Table 1 show that other states suspect that more FPWDWs exist than those documented. Those states include Alaska, California, Iowa, Montana, Nevada, and Wisconsin.

4. WASTEWATER CHARACTERISTICS AND INJECTION PRACTICES

4.1 Methodology

FPWDW "injectate" refers to the wastewater filtering out of the septic system drain lines or out of drywells and into the soil, as opposed to the "raw wastewater" released into a septic tank via floor and sink drains. Many of the facilities employing FPWDWs are small operations that do not have the resources or have not been required to have their raw wastewater or FPWDW injectate characterized. Additionally, these types of facilities and the wastewaters they generate have not typically been the focus of many academic or professional studies. Therefore, very little actual FPWDW injectate data exist in state inspection/permitting records or in published studies.

Some limited slaughterhouse FPWDW injectate quality data were compiled from a Wyoming permit for the operation of a commercial septic system. These data are discussed in Section 4.5.2 of this volume (see references to Wyoming Department of Environmental Quality, 1989). However, because of the overall lack of sampling data, it was necessary to rely on data obtained from other sources to complete this section. These sources include:

C a few previously published studies on raw wastewaters produced by larger food processing plants that use other wastewater treatment/disposal methods besides FPWDWs;
C conversations with state UIC program staff; conversations with food processing facility employees and trade association representatives; and
C personal observations from site visits to ten separate food processing facilities.

The above sources were useful in gaining a better understanding of the types of wastewaters entering FPWDWs, but they were not always useful in determining the quality of the FPWDW injectate after treatment (i.e., septic tank treatment). Therefore, for those FPWDWs that are commercial septic systems, this report makes a distinction between raw wastewater characteristics (before entering the septic tank) and injectate characteristics (after exiting the septic tank). This distinction is made because the biological treatment occurring in a septic tank can significantly alter the characteristics of the raw wastewater if the septic system is operated effciently. Therefore, the raw wastewater and the FPWDW injectate can have very different characteristics (for more information on septic tank treatment processes, refer to Section 4.6 of this volume).

The majority of information regarding raw wastewater characteristics and FPWDW injectate came from personal interviews with facility owners/operators conducted during site visits to food processing facilities using FPWDWs. These site visits, in Tennessee and Maine, were arranged by state UIC program staff. During these visits, interviews with the facility owners/operators were conducted, inspection of wastewater operations were carried out by UIC staff, and digital pictures of the facility were taken. Because FPWDW injectate sampling was not conducted during site visits, the information obtained was qualitative in nature. Pictures of particular facilities and specific operations are provided to help the reader gain a better understanding of the particular operations that generate wastewaters.

As stated above, the majority of facilities employing FPWDWs are small slaughterhouses and seafood processing facilities. There are various other food processing facilities, such as sandwich makers, dog food manufactures, vegetable and fruit processing facilities, and poultry processors that also use FPWDWs. However, information regarding the prevalence of these types of facilities throughout the country is not readily available. Therefore, this volume focuses on those food processing facilities using FPWDWs, that, according to the survey responses and conversations with state UIC authorities, are the most prevalent in the United States.

The following three sections (4.2 - 4.5) are presented in a manner that highlights the differences in wastewater quality before and after septic tank treatment. In addition, because very few wastewater sampling data are available for small food processing facilities using FPWDWs, the following sections provide a fairly comprehensive summary of specific food processing procedures that take place at these types of facilities, thereby enabling the reader to ascertain what types of substances are likely to be found in the raw wastewater. Specifically, the following four sections are organized in the following manner:

• Section 4.2 - general background discussion,

- Section 4.3 - information on the raw wastewater characteristics from slaughterhouse operations,
- Section 4.4 - information on the raw wastewater characteristics from shellfish, poultry and other types of food processing facilities, and
- Section 4.5 - information on the general characteristics of FPWDW injectate (after septic tank treatment).

4.2 Background

Food processing wastewaters vary according to the raw food material used at the facility, particular processing techniques, and other facility procedures such as recycling and use of best management practices (BMPs) (see Sections 6.2, 6.3, and 6.4). In general, the raw wastewater contains organic and inorganic dissolved and suspended solids. The organic component may include fats, oils, grease, animal debris, blood, and vegetable and fruit matter. The inorganic portion may include minerals (from dirt and preserving solutions), phosphates, ammonia, other nitrogenous compounds, and chlorinated compounds from cleaning and disinfection solutions. In addition, the wastewater will also probably contain bacteria, viruses, and other possibly harmful pathogens, depending on the processes used in the facility. Finally, pesticides may be found in the raw wastewater if large quantities of vegetables or fruit are washed.

Like raw wastewater, the principal component in FPWDW injectate is water. In cases where it is released from a septic system, FPWDW injectate will likely contain lower concentrations of all the constituents than are found in the raw wastewater.

The strength or concentration of the organic component in a wastewater is often measured BOD. BOD measures the amount of oxygen required by bacteria and other microorganisms to decompose organic matter. A high BOD level usually indicates that a large amount of oxygen will be used to stabilize the organic portion, thereby lowering the quality of the receiving water (Peavy et al., 1985). Typically, BOD levels are reported as $BOD_{5,}$ which represents the amount of oxygen used in the first five days of decomposition (Vesilind, 1997). Another less commonly used measurement of wastewater strength is chemical oxygen demand (COD), which is a measure of the levels of non-biodegradable organics (Peavy et al., 1985). Other wastewater indicators include total suspended solids (TSS), volatile suspended solids (VSS), and dissolved solids. These water quality terms are used throughout the remainder of this volume.

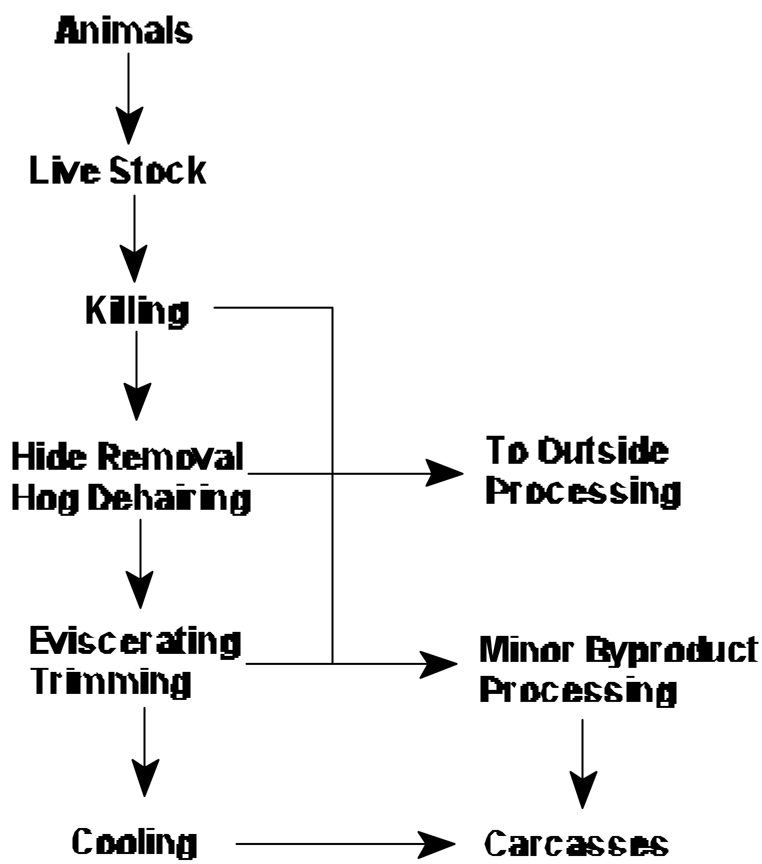
4.3 Slaughterhouses

4.3.1 Slaughterhouse Operations and Drainage Wells

A slaughterhouse is defined as “a plant that slaughters animals and has as its main product fresh meat as whole, half or quarter carcass or smaller meat cuts” (USEPA, 1974). According to the

"Development Document for Effluent Limitations Guidelines and New Source Performance Standards - Red Meat Processing Segments of the Meat Products," slaughterhouses can be grouped according to the amount of secondary processing they perform and the complexity of their operations (USEPA, 1974). Secondary processing includes processing or rendering of carcass remnants (non-meat products like blood and viscera) into products resulting in more concentrated wastewaters. These secondary products include dog foods, hide products, and some pharmaceutical preparations produced from processed blood. Those slaughterhouses that perform no secondary processing and have relatively simple operations are called "simple" slaughterhouses. Conversations with state UIC coordinators and observations made during site visits reveal that most of the slaughterhouses that use FPWDWs can be considered simple slaughterhouses because they do not perform secondary processing. Figure 1 provides a flow diagram of the typical operations taking place at simple slaughterhouses.

Figure 1. Process Flow Diagram for Simple Slaughterhouses



Source: USEPA, 1974

Each of the processes listed in the left hand column of Figure 1 usually take place at the simple slaughterhouse itself. Most of these processes do result in the generation of varying quantities of wastewater, with killing and eviscerating probably generating the highest volumes of wastewater. The right hand column of Figure 1 lists processes that use the wastes generated at the slaughterhouse as raw materials. Generally, these processes occur offsite.

Most of the facilities that use FPWDWs do not typically do any "minor product processing" but instead collect the hides, viscera, and blood, and ship it out for processing elsewhere. Because different kinds of wastewater are generated at different locations within a simple slaughterhouse, it is useful to describe the slaughtering, meat cutting, and packing processes. As the slaughtering and meat packaging process is described, aspects related to the generation of wastewater are highlighted.

The slaughterhouses that were visited during the development of this volume slaughter primarily cattle, hogs, lamb, deer, and sheep. Five of the six slaughterhouses visited are classified as "custom slaughterhouses" and therefore they are exempt from many of the more stringent United States Department of Agriculture (USDA) regulations (see Section 7 for more details). Because of this exemption, custom slaughterhouses are operated in a different manner than most of the larger USDA-inspected slaughterhouses or meat processing facilities. The one remaining slaughterhouse visited was not a custom slaughterhouse and was regularly inspected by the USDA. It is important to note that the information regarding slaughterhouse procedures presented in the following paragraphs was compiled as a result of visiting particular slaughterhouses and therefore, the operational descriptions may not apply to all custom or small slaughterhouses.

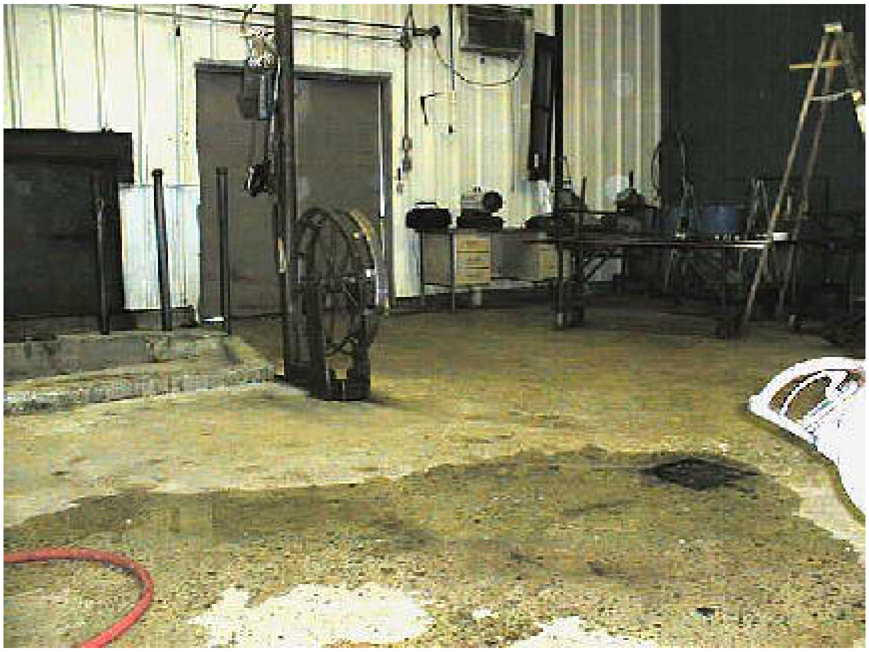
Animal slaughtering includes killing, evisceration, washing, meat cutting, cooling and packaging, not necessarily in that order (USEPA, 1974). At custom slaughterhouses, animals are usually kept in small pens or gated enclosures. These pens usually have concrete floors with metal or wooden gates and often have floor drains. Figure 2 shows a floor drain, without a perforated drain cover, inside one of these animal pens.

Figure 2. Floor Drain Inside of Animal Pen

These floor drains are used to collect pen washdown that typically contains animal urine, fecal matter, high levels of nutrients, sediments, and other solid particles such as hay and hair (USEPA, 1974). Because the floor drain shown in Figure 2 has no cover, it has the potential of receiving larger solids that could affect the treatment efficiency of the FPWDW. During a visit to one slaughterhouse, large amounts of fecal material, dirt, and hay were seen clogging the entrance of the pen floor drain leading to the FPWDW. Some facilities employ dry pen animal clean-up procedures where very little pen washdown is produced. No information on how often dry cleanup procedures for animal pens are used at simple slaughterhouses was available.

From the pen, the animal is walked into the facility via a gated path and into the killing area. The killing area has raised concrete edges along the floor to contain any blood and is shaped like a shallow tub. Figure 3 shows a killing area in the middle of picture (only half of the killing area is visible).

Figure 3. Killing Area and Main Floor



After the animal is killed by some means, it is washed with water to remove dirt and other hide-borne contaminants. It is then either raised by its hind legs or left in the killing area and its jugular vein is cut (this is known as "sticking") to allow the blood to flow out of the animal. During this procedure a large amount of blood, depending on the type of animal, is released and approximately two-thirds to three-fourths of the blood is collected for offsite disposal. The killing area contains a separate floor drain (not seen in the picture since it is inside killing area) that is used to collect the blood released from sticking or that is spilled during blood collection. This floor drain also collects washdown water associated with clean-up of the killing area. Because of the particular activities that take place in the killing area, the killing area floor drain has the potential of channeling large amounts of relatively concentrated blood directly to the FPWDW, if the blood is not collected as is sometimes the case.

Though blood recovery practices are supposed to be employed at all slaughterhouses, it is not clear that this is always the case at custom slaughterhouses. During one visit to a custom slaughterhouse, blood from a cow's jugular vein was observed flowing directly into the floor drain because blood recovery practices were not being used. This animal's concentrated blood was therefore flowing directly into the FPWDW. Figure 4 shows the accumulated blood flowing into a floor drain located near the killing area.

Figure 4. Blood Being Allowed to Flow Directly Into a Floor Drain

It is not known how often events, like those seen in Figure 4, occur at small custom slaughterhouses. According to one facility owner, once the blood reaches the floor, it is usually collected in buckets with the aid of a squeegee. If large amounts of blood are left to accumulate on the floor as seen in Figure 4, the resulting wash water could have relatively high concentrations of blood.

After the animal is bled, the hides and/or hairs are removed. At smaller facilities dehiding is done manually with the aid of conventional or sometimes air-driven knives. Dehiding activities result in the release of additional blood, meat/tissue waste, and other hide-related particles such as dirt. These liquids and solids typically fall to the ground where they are supposed to be collected for proper disposal. If not collected, it is possible that this waste also is washed down into the floor drains. The water used to wash the areas where dehiding takes place will produce a wastewater that usually contains blood, small pieces of tissue, and other smaller inorganic particulate.

To remove the hair from hogs, some facilities use mechanical devices. Two of the more commonly employed machines used for dehairing are the scalding and dehairing machine, both of which are shown below in Figure 5. The operator first inserts the dead hog in the scalding tub (seen in the rear of the picture) and the hot water works to loosen the hair on the hog's hide. The hog is then transferred over to the dehairing machine (seen in the center of the Figure 5) where rotating rubber fins are used to remove the hair via abrasion. Wastewater from both of these processes contains hair, soil, mineral oil (used for lubrication of machinery), and manure. Due to the nutrient levels, this wastewater may have high levels of BOD, ranging up to 3,000 mg/l (USEPA, 1974). The floor drain used to collect spill water and equipment washdown is seen in the middle-bottom of Figure 5. The scalding tub water is also sent to the FPWDW.

Figure 5. Hog Scalding Machine and Floor Drain

After dehiding and/or dehairing (if necessary), the carcass is opened and eviscerated. The carcass is then trimmed and inspected and the balance of the viscera and trimmings are kept in containers that are eventually sent to renderers. Great care is used when eviscerating the animal to avoid rupturing the animal's stomach, which contains acids and other fluids that can affect the quality of the meat and also have a very high BOD content. Figure 6 shows the area where eviscerating take place and shows the containers used to collect animal parts that are sent to the renderers. The equipment and tables seen in Figure 6 are cleaned at the end of every day with disinfectants and/or soaps and rinsed with large quantities of hot water. In general, the wash water entering the FPWDW from these areas contains blood, tissue solids, and residues of cleaning compounds. Hoses are used to wash the carts and equipment and the wash water flows into the floor drain seen below. The blood and tissue pieces from the evisceration and trimming process may find their way into sink drains, which are typically connected to FPWDWs, or this

Figure 6. Floor Drain Receiving Wash Water From Equipment Washdown

waste will be allowed to fall to the floor where water streams from large hoses are used to push the wastes toward the floor drains.

According to one facility owner, most custom slaughterhouses attempt to collect as much of the remaining tissue or scrap trimmings that remain on the tables or floors, so usually only very small pieces are allowed to enter sink or floor drains. Figure 7 shows an accumulation of fat/meat trimming wastes on the floor that will eventually be scooped up and placed in buckets. If the covers are removed, larger solids will drain into the FPWDW.

Figure 7. Accumulation of Fat/Meat Trimming Wastes Near a Floor Drain

After evisceration and trimming the animal carcass is either cut in half or left whole and hung in a cooler where it stays for a predetermined period of time. After hanging the carcass in the cooler, the carcass is washed with large amounts of water and then drip dried. This washing step results in the highest production of wastewater throughout the facility (USEPA, 1974). The fluid that drips from the carcasses contains relatively high concentrations of grease, small amounts of blood, tissue solids, and other fluids. Figure 8 shows animal carcasses hanging inside a cooler and the receiving floor drain.

Figure 8. Carcasses in a Cooler with Pooled Grease/Fatty Fluids Near Floor Drain

After cooling, or aging, the carcasses are cut into smaller sections or individual pieces, according to the requests of the original owner of the animal. As with the evisceration process, tissue and small amounts of fluids usually drip to the floor or into a sink during this final step. After cutting, the meat pieces are packaged and wrapped. At the end of the day all the equipment is thoroughly cleaned with large amounts of water and the washdown water along with bone dust and other fluids (e.g., blood, cleaning solutions) enters the floor drains.

4.3.2 Simple Slaughterhouse Raw Wastewater Characteristics

As described in the previous section, wastewaters entering FPWDWs from custom slaughterhouses usually contain water, organic matter (including grease), suspended solids, and inorganic materials such as phosphorous, nitrogen, and chlorine or other disinfecting chemicals. These compounds enter the waste stream and eventually the FPWDW as blood, meat and fatty tissue, meat extracts, stomach contents (only if ruptured), manure, hair, dirt, lubricating oils, and cleaning compounds (USEPA, 1974). Bacteria are also present in the raw wastewater at most probable number (MPN) levels between 2 to 4 million per 100 ml (USEPA, 1974). Some bacteria, such as salmonella and shigella, can be found in the raw wastewaters and are considered pathogens (World Bank, 1997). In addition to bacteria, there is the potential for viruses and parasite eggs to be found in wastewater. Table 2 shows the typical raw wastewater characteristics of a simple beef slaughterhouse, assuming blood and stomach liquid collection methods are employed. MCLs are also included to enable comparisons.

Table 2. Characteristics of Slaughterhouse Raw Wastewater

Constituent	Simple Slaughterhouse (mg/l unless otherwise indicated)	MCL (mg/l unless otherwise indicated)
pH	7 (units)	6.5 - 8.5 (units)[1]
Total suspended solids	1051	NA[2]
BOD_5	1126	NA
Grease	394	NA
Kjeldahl nitrogen	128	NA
Chlorides as CL	487	250[1]
Nitrates and nitrites	0.01 - 0.85	10 and 1, respectively
Ammonia nitrogen	7 - 50	NA
Total phosphorous as P	9	NA
Hot water	typically above 150 °F	NA

[1] Secondary MCLs

[2] NA is not applicable

Source: USEPA, 1974

The data presented in Table 2 were calculated by dividing the average constituent concentrations from 24 different facilities by the average wastewater flow of the same 24 facilities (for more information see USEPA, 1974). The high levels of organic matter in the wastewater can result in high BOD_5 levels in the raw wastewater. BOD_5 is the wastewater component that is most commonly used in characterizing slaughterhouse wastewater. It is the best measure of the organic load entering the waste stream and it provides a useful measure of the overall strength of the wastewater. The major contributor to BOD_5 levels in the wastewater is blood. Blood is rich in chlorides and nitrogen and has an ultimate BOD of 405,000 mg/l and a BOD_5 between 150,000 and 20,000 mg/l. Ultimate BOD is a measure of the microbial oxygen consumption after 20 days. Cattle typically contain up to 50 pounds (5.7 gallons, assuming blood density of 1.52 g/cm^3) of blood per animal and only 35 pounds of the blood are typically recovered during the blood recovery process (USEPA, 1974). The remaining 15 pounds (1.7 gallons) are lost with wastewater. Stomach manure, which contains partially digested feed material, has a BOD_5 of 50,000 mg/l (USEPA, 1974). In addition, the raw wastewater also contains a high grease/fat content.

From the available publications and observations during site visits, it does not appear that any types of hazardous materials (e.g., heavy metals, pesticides) are discharged by slaughterhouses

(USEPA, 1974). Because hazardous compounds are not typically found in slaughterhouse premises, it is highly unlikely that they will find their way into FPWDWs. Though not classified as hazardous substances, the USDA[3] does permit the use of certain enzymatic compounds for use as cleaning agents in sewage and/or drain lines (U.S. Department of Agriculture, 1986). During site visits, no facility owner stated that they used any type of drain cleaner or septic system enzymatic activator.

As stated earlier, simple slaughterhouse raw wastewater may contain residues of strong cleaning or disinfecting compounds. The concentrations in the raw wastewater vary according to frequency of use, amounts used during cleaning procedures, and frequency and severity of spills near the floor drains or in the sinks. Most of the slaughterhouses that were visited were using food service, USDA-approved cleaning compounds. Others were simply using commonly found household cleaning solutions, like Clorox Bleach and Tide, to clean equipment floors and hands. Most of these domestic cleaning solutions are approved by the USDA and most county public health offices. Household strength bleach usually contains 5 percent sodium hypochlorite and 95percent inert ingredients.

In general, slaughterhouses use large quantities of water for various cleaning operations. A commercial septic system permit for a slaughterhouse in Wyoming states that approximately 60 gallons of water are needed for every animal slaughtered (Wyoming Department of Environmental Quality, 1989). Water usage at slaughterhouses varies according to the rinsing and washing operations that take place at the facility. According to one facility, 7,000 gallons per month of water were being used for all operations. As expected, the use of water and the generation of wastewater is entirely dependent on the number of animals that are slaughtered, cut, and prepared.

4.4 Shellfish, Fish, Poultry and Other Types of Food Processing Facilities

4.4.1 Facility Operations and Drainage Wells

Other types of food processing facilities also employ FPWDWs to dispose of their wastewaters. As with custom slaughterhouses, these other types of food processing facilities usually rely on commercial septic systems. These facilities are also small, operate seasonally, and usually have less than 10 full-time employees. Although there are probably other types of food processing facilities using FPWDWs throughout the country, this section presents information which was either retrieved from facility visits or collected via telephone conversations with state UIC coordinators. Non-slaughterhouse food processing facilities for which sufficient information was collected, include food processing facilities that:

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[3] Some small slaughterhouses are inspected by the USDA and therefore must abide by all relevant sections of the Federal Meat Inspection Act (see Section 7.1.3 for more information). Custom slaughterhouses are exempt from certain sections of the Federal Meat Inspection Act and therefore abide by different regulations (see Section 7.1.4 for more information) and are typically inspected by county public health representatives.

- clean, prepare, and package shellfish (e.g., shrimp, crabs, clams);
- prepare fish-related products (e.g. salmon processing facility);
- process and package/can fruits and vegetables;
- process poultry; and
- prepare packaged sandwiches.

Shellfish and Fish Processing

Shellfish processing facilities were visited because, according to a few UIC representatives and survey responses, they are probably the most common type of food processing facility using FPWDWs besides custom slaughterhouses. The seafood and shellfish processing facilities using FPWDWs are usually located near the coast in unsewered areas. These facilities receive various kinds of shellfish at different times throughout the year and employ a variety of manual shucking[4] and packaging procedures. Shellfish processed at these facilities include crabs, clams, shrimps, oysters, and lobsters. According to one shellfish processing facility owner, during shrimp season the facility can process between 1,000 to 1,200 pounds per day of shrimp. During clam season, the clam processing rate falls between 500 to 1000 pounds per day of clams.

Shellfish processing facilities usually receive shellfish, whole, on ice directly from fishing boats. Depending on the type of shellfish being processed, facilities will use different manual procedures for removing the shell, the head, and the veins from the meat. Figure 9 shows a typical room and the tables where shucking, deveining, and deheading occur.

Figure 9. Room and Equipment Used in Manual Shucking of Shellfish

[4] Shucking is the action of removing the shell of the animal.

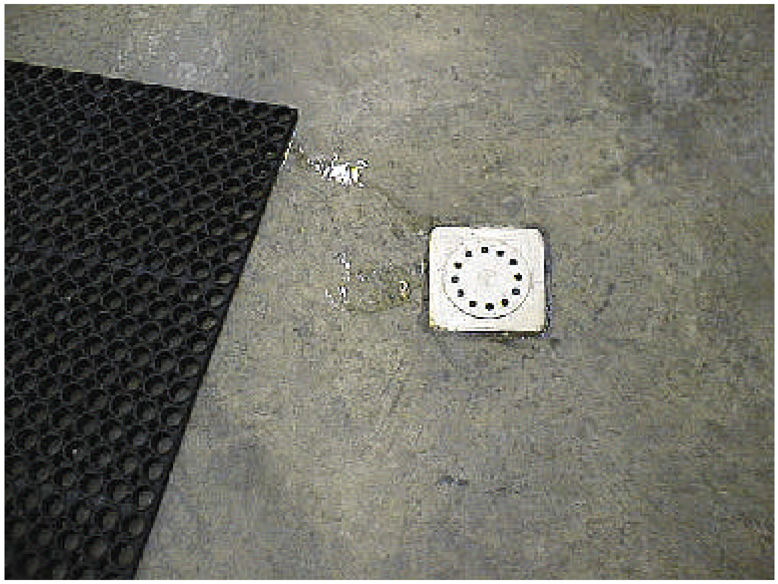
The tables in Figure 9 have holes, with trash cans underneath (not seen), where workers can throw away shells and other larger solids. As with all food processing equipment, the tables are cleaned and disinfected with cleansing compounds (e.g., dishwashing soap, bleach, or other USDA-approved cleaning products) and rinsed off with large quantities of water. The wash water finds its way to the floor drains located throughout the room. Figure 10 shows the location of floor drains in the main processing room of a much smaller facility than that shown in Figure 9.

Figure 10. Floor Drains leading to FPWDWs at a Shellfish Processing Facility

At the shellfish processing facilities visited, the raw wastewater entering the drains and the FPWDW usually contains animal shell material, grit, sand, tissue solids, and large quantities of hot water. It also contains residues of cleaning compounds (e.g., bleach), seawater, and possibly trace levels of other organic compounds. According to one facility owner, the wastewater coming from shell processing facilities has qualities similar to that of domestic wastewater.

The floor drains leading to FPWDWs vary in design and size. However, they usually have a trap, or a lip, under the perforated cover to catch any of the larger solids that may make it through the perforations in the cover. The floor drains found in most of the shellfish processing facilities that were visited had removable covers. Floor drains leading to FPWDWs are also found in cooling or chilling rooms. These coolers contain the peeled and prepared shellfish, and because the temperature is below freezing most of the time, little wastewater enters these floor drains except when they are cleaned. Figure 11 shows a close-up of a floor drain at a shellfish processing facility.

Figure 11. Floor Drain in Shellfish Shucking Room



The number of floor drains in a particular facility varies according to the size of the facility and the expected amount of wastewater the facility is going to generate. In some cases, sinks used to rinse food products and other equipment were also connected to the FPWDW.

Fish processing facilities using FPWDWs were not visited. However, according to the manager of a fish processing facility that did use a FPWDW at one of its smaller locations (not visited due to time constraints), a FPWDW was being used to collect equipment washdown water. This smaller facility processed salmon and produced salmon-cheese paté. Therefore, it is likely the raw wastewater entering the FPWDW contained fish meat, cheese residues, spices, cleaning compound residues, large quantities of grease, and large volumes of hot water. According to the owner, the raw wastewater from the facility closely resembled the qualities of raw domestic wastewater. Unlike domestic septic systems, the FPWDW at this facility was handling much larger quantities of raw wastewater. This fish products facility was using a USDA-approved disinfecting/cleaning compound produced by a company named ECOLAB. The exact chemical makeup of this cleaning compound is not known, but it is likely to contain a disinfectant like chlorine and/or a surfactant chemical.

Fruit and Vegetable Processing and Packaging/Canning

No vegetable or fruit processing facilities were visited but detailed information was collected on two particular facilities of this type. One facility, located in Hawaii, up until recently was using an injection well to dispose of its pineapple processing and canning wastewaters. Prior to injection the wastewater passed through a settling pond where some of the larger solids settled out. After exiting the pond, the wastewater was then mechanically pumped directly into an underlying aquifer 100 feet below the surface. The injectate still contained high concentrations of fruit juices, small pieces of fruit, and was generally high in BOD. According to a Hawaii Department of Health representative, this facility recently switched to a wastewater land application strategy because dangerous methane accumulations were occurring in the injection well and in a few of the surrounding areas (Wong, 1999). However, the facility has opted to keep the injection well operational, in case problems are encountered while land applying the wastewater.

Another facility, located in Wisconsin, is currently using a combined commercial septic system to dispose of mushroom pickling wastewater and sanitary waste from one bathroom (Wisconsin Department of Natural Resources, 1996). This combined system is unique since most facilities visited had separate systems to handle sanitary and food processing wastewaters. This particular facility releases less than 400 gallons per day of wastewater that contains primarily water from mushroom soaking and blanching, mushroom juices, facility wash down water, and sanitary waste. The Wisconsin Department of Natural Resources issued a permit for the operation of this FPWDW under the condition that no pickling brine or non-biodegradable substances be allowed to enter the system. It is not known if problems have occurred at this site.

Poultry Processing

Only one poultry processing facility was visited and it is not known how many other similar types of poultry processing facilities using FPWDWs exist in the country. However, it is possible that similar facilities do exist in rural unsewered areas throughout the country. The facility that was visited processes chickens, turkeys, and other fowl brought in by individuals.

As with slaughterhouses, the animals are first killed in the killing area. At this particular site there were no floor drains in the killing area. According to the owner, the blood generated during the killing process is collected and sent to renderers for further processing. After killing, the animals are defeathered and eviscerated. The unusable poultry wastes (e.g., feathers, intestines) are also collected and sent to rendering facilities. The meat of the animals is then prepared, packaged if necessary, and chilled. All of the cutting, preparation, and packaging activities occur in a separate room next to the killing area. Figure 12 (next page) shows the poultry meat, preparation, packaging and chilling room of the facility that was visited (refrigerator not in view). Figure 12 also shows a preparation table and a window-like opening in the wall above the table that leads to the adjoining killing area. The entire area, including floors and all equipment, is washed down at the end of the day with the large hoses that are seen lying on the floor under the table. Additionally, some equipment may be rinsed prior to use. At this facility there was no septic system in place and wastewater was allowed to flow directly into two drains located in the middle of the preparation room seen in Figure 12. These floor drains lead directly to two drywells under the floor. The floor drains, leading to the drywells, had no covers, so presumably larger solid wastes could also enter the well.

Figure 12. Poultry Processing Room - Meat Cutting and Preparation Table

The wastewater produced at these types of poultry facilities typically contains small pieces of animal tissue, feathers, grit, blood and other meat fluids, bone dust wastewater, grease, oils, and small quantities of cleaning and disinfectant solutions (USEPA, 1975a). In addition, large quantities of hot water are flushed down the drain with the waste compounds. At the visited site a large container (approximately 15 gallons) of a USDA-approved chlorinated disinfectant called "Swell" was being stored at ground level very near the uncovered drywells. This container was closed and did not appear to have a spout for pouring, but instead had a removable plastic lid.

Sandwich Preparation

For this study, one sandwich preparation facility was visited in Tennessee. This facility produced a variety of hot and cold sandwiches for resale in convenience stores. The facility used a commercial septic system to treat wastewater collected through various floor drains and one sink. The wastewater is generated as a result of washing sandwich preparation equipment (e.g., tables, conveyor systems), cooking equipment (pots and pans), and the employee's hands. No hazardous chemicals were observed in the room where the floor drains were located. The facility had been family-owned for many years and employed 20 people. According to the facility owner, the washdown water contained mostly water, bleach (used in disinfecting), dish soap, spices, grease, and organic solids, including pieces of sandwich filling (tuna, chicken) and bread. This facility had not installed a grease trap[5] to contain the fats entering the commercial septic system.

[5] See Section 4.6 for more details regarding a grease trap.

4.4.2 Facility Raw Wastewater Characteristics

Food processing operations, as a whole, use and discharge large quantities of water since water is the most commonly used rinsing and washing substance. The raw wastewaters from the facilities described in Section 4.4.1 can contain high concentrations of biodegradable organic material and high levels of suspended solids (Beszedits and Netzer, 1982). Effluents from fish and poultry plants can also contain substantial levels of fat and grease. Raw wastewaters from poultry processing facilities usually contain a bacterial component (e.g., fecal coliform, salmonella) and some inorganic materials, such as phosphates, nitrates, and nitrites (USEPA, 1975a; Beszedits and Netzer, 1982). Raw wastewaters from shellfish and fish processing facilities can also contain high levels of proteins (Beszedits and Netzer, 1982). In some cases, pH fluctuations may occur at food processing facilities, due to use of strong caustic or acidic cleaners used to wash floors and equipment, but for the most part, the pH of the raw wastewaters is neutral (pH 6.8 to 7.2) (Beszedits and Netzer, 1982).

Table 3 presents typical raw wastewater characteristics for three different types of food processing facilities. The data presented in Table 3 for poultry and crab processing facilities represent the effluent quality from larger, more sophisticated food processing facilities, so they may not accurately reflect the actual qualities of the raw wastewater generated at the smaller facilities using FPWDWs that employ more manual processes. MCLs are also shown in Table 3 to allow for comparisons.

Table 4 provides a more accurate characterization of the raw wastewater produced at the smaller, family-owned shellfish processing facilities that manually hand shuck oysters and clams.

As can be seen in both Table 3 and Table 4, all effluents generated during specific food processing activities typically have high levels of BOD_5, COD, and solids (dissolved and suspended). It is important to remember that the many food processing plants operate on a seasonal basis and this is reflected in the quantity and quality of the wastewaters discharged (Beszedits and Netzer, 1982). The shellfish facilities using FPWDWs process a variety of shellfish depending on the season, so these facilities will most likely discharge raw wastewater, similar to wastewater described in the above tables, at different times throughout the year.

Although food processing wastes are generally free of toxic chemicals, certain cleaning compounds, if improperly used, can exert a strain on the microbial activities taking place in the soil or in the septic tank. The concentrations of cleaning compounds in the raw wastewater vary according to frequency of use, amounts used during cleaning procedures, and frequency and severity of spills near the floor drains or in sinks. Most of the facility owners stated they only used household quality bleach, household quality floor cleaners, dishwashing soap for cleaning food processing equipment, and hand cleaning solutions.

Table 3. Wastewater Characteristics of Three Food Processing Sectors

Wastewater Indicator	Poultry (mg/l)	Shrimp Processing (mg/l)	Crab Processing (mg/l)	MCL (mg/l)
BOD_5	500	207	608	NA[1]
COD	800	228	1076	NA
Total solids	800	530	400	NA
Dissolved solids	300	*	1161	500[2]
Volatile solids	700	*	898	NA
Total suspended solids	500	130	400	NA
Ammonia nitrogen	*	8	14	NA
Chloride	300	*	386	250
Sodium	37	*	*	NA
Magnesium	8	*	*	NA
Calcium	32	*	*	NA
Phosphorous	4	5.1	*	NA
Nitrate nitrogen	*	9.0	1	10
Total alkalinity	*	99 (mg/l as $CaCO_3$)	284 (mg/l as $CaCO_3$)	NA
Kjeldahl Nitrogen	*	46	72	NA
Oil and Fat residues	300	*	0	NA
Hot water	Typically greater than 150 °F			NA

[1] NA is not applicable

[2] Secondary MCL

* No data available in publication.

Sources: USEPA, 1975; Horn and Pohland, 1973

Table 4. Raw Wastewater Characteristics for Oyster and Clam Processing Facilities

Wastewater Indicator	Oyster Processing (For facilities in the East and Gulf Coast Region)	Clam Processing
BOD_5 (mg/l)	455	1130
COD (mg/l)	601	2142
Total suspended solids (mg/l)	416	2240
Ammonia nitrogen (mg/l)	3	6
Organic nitrogen (mg/l)	49	220
Oil and fat residues (mg/l)	20.4	31.7
Hot water	Typically greater than 150 °F	

Sources: USEPA, 1975; Horn and Pohland, 1973

4.5 FPWDW Injectate Quality

FPWDW injectate quality varies according to the construction of the well, design of the well, and facility operations. Based on the site visits conducted during the development of this volume and the additional information retrieved from state UIC offices, it appears that most food processing facilities are employing commercial septic systems. Therefore, this section focuses on the qualities of the typical effluent being released into the soil by the average food processing septic system. In a properly functioning septic system, no wastewater is released by the tank itself, but through drain lines that are attached to the tank.

Site visits revealed that use of drywells is not very common in small food processing facilities since most facilities are required to comply with county or state regulations that often prevent use of drywells at industrial/commercial facilities. Of the ten facilities that were visited, only one poultry facility was using a drywell. Drywells allow wastewater to flow directly into the soil and because no biological treatment occurs, the same raw wastewater that enters the drywell is considered to be FPWDW injectate. Sections 4.3 and 4.4 describe the qualities of the raw wastewaters generated at specific types of food processing facilities; these same qualities would apply to the drywell injectate. It is highly unlikely that custom slaughterhouses would use drywells since drywells do not have the capacity to handle large volumes of high strength wastewater.

4.5.1 Assumptions Regarding Commercial Septic Systems and the Microbial Environments Present in the Septic Tank

As mentioned earlier, little is known about the actual quality of the injectate released by FPWDWs. Therefore, to determine the kinds of compounds present in the injectate, it is necessary to make some assumptions about the degree of biological treatment occurring in the septic tank. Because most of the facility operators stated that they had not encountered too many difficulties with their septic systems (except for a few events that are described in Section 4.6), it will be assumed that food processing facility owners/operators have installed properly designed septic tanks (e.g., properly sized, leveled, and constructed), are discharging raw wastewater into the septic system at accepted flow rates, and are employing reasonable blood recovery procedures (even though, as discussed in Section 4.3.1, some facilities may let blood drain directly into floor drains). It can then be assumed that a certain amount and type of microbial degradation is taking place in the septic tank and the injectate quality will most likely be of better quality than the raw wastewater entering the septic tank.

It is important to note that the FPWDW injectate quality is dependent on septic tank/wastewater retention times, raw wastewater concentrations, food processing facility operational procedures, and other factors. If blood collection mechanisms are not used in custom slaughterhouses or if the treatment capacity limitations of the commercial septic system are exceeded, FPWDW injectate quality will most likely decrease dramatically.

According to information obtained from a Wyoming permit to operate and construct a small slaughterhouse septic system, the microbial degradation taking place in a septic system holding tank resembles the microbial actions occurring in an anaerobic lagoon (Wyoming Department of Environmental Quality, 1989). The comparison to an anaerobic lagoon was chosen by the engineer who installed the septic system, since often the grease and oils in the raw wastewater that enter the tank work to form a "scum blanket" on the top of the wastewater in the holding tank (see Figure 15 in Section 4.6.1 for schematic of a commercial septic system). As a result of the formation of a scum blanket, little oxygen diffuses into the wastewater below, creating an anaerobic system where anaerobic and facultative bacteria[6] will thrive. The assumption regarding anaerobic environments most likely applies to other types of food processing facilities, besides slaughterhouses, because most food processing procedures generate appreciable quantities of grease. However, if a grease trap is installed the assumption that an anearobic environment exists in a septic tank may not be valid. Another reason to assume an anaerobic process is that the temperature of the incoming wastewater can be quite high, which works to maintain an environment favorable to anaerobic activity. Additionally, the wastewaters from food processing facilities generally are of neutral pH and contain high concentrations of carbohydrates, proteins, and nutrients that also work to create an environment favorable to anaerobic or facultative microorganisms (USEPA, 1975b). It is important to note that anaerobic lagoons with an artificial cover or a scum blanket are commonly used at food processing facilities, such as poultry plants and larger slaughterhouses, as the first step in biological treatment or as pretreatment prior to discharge to a municipal system (USEPA, 1974; USEPA, 1975b).

4.5.2 Organic Constituents

The Wyoming permit and several USEPA documents state that anaerobic lagoons are effective at reducing the levels of BOD_5 and suspended solids in the wastewaters prior to release (Wyoming Department of Environmental Quality, 1989; USEPA, 1974). According to information found in the permit, approximately 80 percent to 92 percent of the BOD_5 in the raw wastewater can be removed at temperatures of 75°F and 90°F, respectively. The engineer who designed the septic system for a custom slaughterhouse in Wyoming determined that a BOD_5 removal efficiency of approximately 85 percent could be accomplished in the septic tank, assuming the facility owner stayed under the suggested wastewater flow rate thereby maintaining an adequate retention time. For this particular slaughterhouse, the BOD_5 concentration in the FPWDW injectate is 135 mg/l.

Two USEPA effluent limitations guidelines development documents stated that up to a 95 percent reduction in suspended solids could be achieved via a properly operated anaerobic lagoon used to treat poultry processing plant and slaughterhouse wastewaters (USEPA, 1974; USEPA, 1975a). If anaerobic conditions are maintained in a food processing facility septic tank (e.g., grease layer present and a high temperature), the flow rate of the incoming raw wastewater is low enough to maintain an average wastewater retention time of at least 5 days, and if the septic tank is properly sized, it is possible to assume that a septic tank and an anaerobic lagoon will probably operate in a similar fashion and therefore, treat wastewaters similarly. Because information on food processing facility wastewater flow rates was not readily available during site visits, it is not possible to determine if a

[6] Facultative bacteria can adapt themselves to grow and metabolize in the presence, as well as the absence, of free molecular dissolved oxygen.

sufficient retention time is typically achieved in food processing commercial septic tanks. However, if a food processing facility maintains the necessary conditions, as describe above, it can be assumed that on average an 85 percent reduction in BOD_5 loading and an average 95 percent reduction in TSS loading can be achieved in a properly operating FPWDW septic tank. Therefore, it is possible to make some approximations regarding what the BOD_5 and TSS concentrations in the FPWDW injectate will be. Table 5 presents the typical BOD_5 and TSS levels found in the raw wastewater, as presented in Section 4.3.2 and 4.4.2, for some of the food processing facilities considered in this volume and the expected FPWDW injectate concentrations after BOD_5 and TSS removal.

Table 5. Estimated Injectate BOD_5 and TSS Levels for Food Processing Facilities

Food Processing Facility	BOD_5 in Raw Effluent (mg/l)	Estimated FPWDW BOD_5 Injectate Concentrations, assuming 85% removal efficiency (mg/l)	TSS in Raw Effluent (mg/l)	Estimated FPWDW TSS Injectate Concentrations, assuming 95% removal efficiency (mg/l)
Poultry	500	=75	800	=40
Shrimp	207	=32	530	=27
Crab	608	=91	400	=20
Clam	1130	=170	416	=21
Oyster	455	=68	2240	=112
Slaughterhouse (with blood collection)	1126	=169	1051	=53

The characteristics of the raw wastewater from different types of food processing facilities can vary significantly. These different wastewater characteristics in turn affect septic tank treatment performance and therefore the percent reduction levels for BOD_5 and TSS may vary. There are no primary or secondary MCLs for either BOD_5 or total suspended solids. However, high BOD_5 levels are often associated with poor water quality, possibly poor odor, and high turbidity. It is not known whether the estimated BOD_5 levels in the injectate would normally result in exceedances of the secondary MCLs for or turbidity. Odor can be caused by organic and some inorganic chemicals. Turbidity is caused by suspended matter such as clay, silt, finely divided organic matter, and soluble colored organic compounds.

According to a public information fact sheet sponsored by the University of Florida, a properly operating septic tank will also remove much of the COD as well (Brown, 1998). The other less biodegradable organic and/or inorganic solids that make up some of the TSS portion of the wastewater will most likely settle to the bottom of the septic tank and accumulate there until the tank sludge is pumped out.

Table 3 also shows that dissolved solids may be present in raw wastewater generated at crab and poultry processing facilities. It is not known what happens to these dissolved solids in food processing septic tanks, but it is likely that many of the dissolved solids are used as substrate for bacteria during microbial decomposition. As stated earlier, a few of the food processing facilities were using grease traps to prevent large volumes of grease from entering the septic tank. Grease and oils that may enter the septic tank eventually decompose in the tank or they will liquify slightly and enter the drain lines where they will become part of the injectate.

4.5.3 Inorganic Constituents

As can be seen in Tables 2, 3, and 4, there are various nitrogen compounds present in the raw wastewaters generated at food processing facilities entering the septic tank in the form of ammonia, organic nitrogen, nitrate, and nitrite. The types of nitrogen compounds ultimately entering the soil through the drain lines are functions of the treatment occurring in the septic tank (Brown, 1998). Typically, only 10 percent of the total nitrogen in the raw wastewater is removed as sludge that accumulates at the bottom of the septic tank (Brown, 1998). Because no FPWDW injectate data are available and there is a fair amount of variation in raw wastewater quality from the different food processing facilities, it is difficult to accurately determine what forms of nitrogen will be present in the injectate and at what concentrations. Nitrite (NO_2^-) and nitrate (NO_3^-) are chemicals of concern since there are adverst health effects associated with drinking water that has high levels of these compounds. However, some assumptions concerning the transformation of nitrogen compounds in the septic tanks can be made in order to estimate the levels of nitrate and nitrite in FPWDW injectate.

Because nitrate and nitrite are usually converted to ammonium and other organic forms in an anaerobic environment, such as that possibly found in a FPWDW septic tank, FPWDW injectate may contain primarily soluble ammonium and significant amounts of nitrogen in the organic form (Brown, 1998). According to Tables 2 and 4, the typical raw wastewater from slaughterhouses, shrimp, and crab processing facilities entering the septic tank contains a lower amount of nitrate and nitrite than the primary MCL for both of those compounds, which is 10 and 1 mg/l, respectively. Thus, it may be possible to assume that even if no nitrite or nitrate transformation occurs (which is the case in aerobic environments), the levels of nitrate and nitrite in the injectate, for these three types of facilities, will also be below the MCL. However, if ammonia is present in the wastewater, as is shown in the previous tables, and if an aerobic environment exists in the tank (possible in septic systems where treatment capacity is being exceeded and flow rates are high), some of the ammonia and organic nitrogen in the raw wastewater may be oxidized to nitrite and nitrate, and therefore exceedances in the FPWDW injectate for these two chemical substances may be possible. For additional information on nitrogen reactions and chemical conversions associated with septic tank treatment, refer to Volume 5 of the Class V Study, Large-Capacity Septic Systems Information Summary.

As explained above, exceedances of the MCL for nitrate and nitrite are possible under certain circumstances. However, it is more likely, due to the septic tank conditions, HAL for ammonia of 30 mg/l is exceeded more frequently at some types of food processing facilities. Once ammonia reaches the upper soil horizons, where oxygen may be more plentiful, it is converted back to the more dangerous nitrate and nitrite which easily leaches into ground water (Brown, 1998).

Phosphorous may also be present in the wastewaters entering the septic tank. The most likely originates from either animal manure, blood, or bone. In the anaerobic environments found within the septic tank, it can be expected that phosphorous will be converted into soluble phosphate ions (Brown, 1998). Because of the slow degradation rate of phosphate ions, USDWs could be affected. Phosphate ions typically affect the TDS concentration of the wastewater.

Chlorides originating from blood also present the raw wastewater. The degradation or transformation rates, if any, of chlorides in a septic system are unknown. From Tables 3 and 4 it can be seen that the chloride concentrations in raw wastewater typically exceed the secondary MCL for chloride of 250 mg/l. Therefore, if no chlorides are removed in the septic tank, it is possible that chlorides may be found in the injectate at or above MCLs.

4.5.4 Microbial Components

None of the tables on raw wastewater characteristics presented earlier include any information on bacteria levels because the documents from which the data were extracted did not include this information. However, it is very likely that bacteria, and some viruses, are found at varying concentrations in the raw wastewaters and the injectate. Slaughterhouse injectate will undoubtedly have the highest concentrations of bacteria in the injectate since certain procedures result in the mixing of water with fecal material (e.g., washdown from animal pens), blood, and animal body fluids. Seafood processing facilities will most likely also have a certain amount of bacteria. Because small amounts of fecal material are present in the raw wastewaters from slaughterhouse and seafood processing facilities, it is very likely that fecal coliform bacteria are present in the FPWDW injectate. As stated in Section 4.3.2, bacterial levels in raw slaughterhouse wastewater are in the range of 2 to 4 million per 100 ml. These average levels do exceed the primary MCL for fecal coliform of zero.

According to a USEPA document, the most commonly found harmful bacterial constituents in slaughterhouse raw wastewaters are the shigella and salmonella bacteria (USEPA, 1974). Of the two, salmonella is probably the most common bacteria found in raw wastewaters from slaughterhouses since it is also present in the feces of most animals and sometimes found on the surfaces of food processing equipment and floors. Salmonella bacteria thrive in wet environments shielded from the sun and have a remarkable ability to survive under adverse conditions. Salmonella survive between pH's of 4 to 8, and can grow under a relatively wide temperature range. Salmonella are facultative anaerobic bacteria that can survive under low oxygen conditions such as those found in manure slurry pits, and possibly septic tanks. Due to the general resilience of these bacteria, it is likely that if the raw wastewaters do contain salmonella, some portion of the salmonella bacteria will most likely exit the septic tank and enter the soil with the injectate. However, according to one source, “salmonella can survive but may not actively grow in many environmental waters” (Cornell University, 1997).

Though some animal viruses may be found in the raw wastewater entering septic tanks, it is likely most of those viruses are killed or deactivated due to the unfavorable conditions present in the septic tank. If for some reason viruses were to be in the injectate, it is unlikely that those viruses will survive long enough to pose a threat to USDWs.

4.6 FPWDW Construction and Design Characteristics

There are two main categories of FPWDWs: septic systems and drywells. Because septic systems are the most common types of Class V well employed, the focus of Section 4.6.1 below is on the design and construction of septic systems. A brief discussion on drywells is provided in Section 4.6.2. For more detailed information on the construction of septic systems, refer to Volume 5 of the Class V Study, Large-Capacity Septic Systems Information Summary.

4.6.1 Commercial Septic Systems

The commercial septic systems used at food processing facilities closely resemble domestic septic systems, but instead of being connected to bathrooms and showers, commercial septic systems are usually connected to floor drains and commercial grade food processing sinks. Also, unlike domestic systems, most commercial systems are designed to handle large amounts of wastewater, and some systems have a grease trap installed between the floor drains and the septic tank to collect the greases and fats that are usually generated during food processing.

Floor Drains, Sinks, and Other Equipment

The pathway by which most of the wastewater enters a FPWDW is through floor drains located throughout a food processing facility. The number of floor drains in a particular facility connected to the pipes leading to the commercial-sized septic tank, depends on the size of the facility, the number of rooms where wastewater is generated, and the quantity of wastewater generated in those rooms. Based on observations during site visits, food processing facilities using an FPWDW have approximately 800 to 2000 square feet of plant space. On average 2 to 8 floor drains are placed in the middle of rooms throughout a facility and a slope of about 1/4 to 1/8 inch per foot is built into the floors to allow the wastewater to flow toward the floor drain. For USDA-regulated slaughterhouses, it is recommended that one drain be provided for each 400 square feet of floor area (U.S. Department of Agriculture, 1986). These floor drains are constructed either of PVC or stainless steel and often have and inner diameter of approximately 3 to 4.5 inches. The floor drains have removable, perforated drain covers that are used to prevent the entrance of large solids that could clog up pipes, which the floor drains are connected to, or the drain lines exiting the septic tank. In some types of drains there is a u-shaped trap running along the inside of the drain, directly below the cover, which traps any of the larger solids that manage to pass through the perforated cover. The pipe that is connected to the floor drain usually drops approximately 2 feet before it bends and connects to another pipe laid in the direction of the septic tank.

The sinks that are connected to commercial septic systems are large stainless steel, commercial-grade sinks that have u-shaped elbows in the drain pipes to collect solids and to prevent the release of odors. Most of the sink drains observed during site visits did have perforated covers to prevent the entrance of larger solids that could clog the drains leading to the septic tanks. Other food processing equipment that generates wastewater or that requires the use of water may also be connected directly to drains that lead to septic tanks.

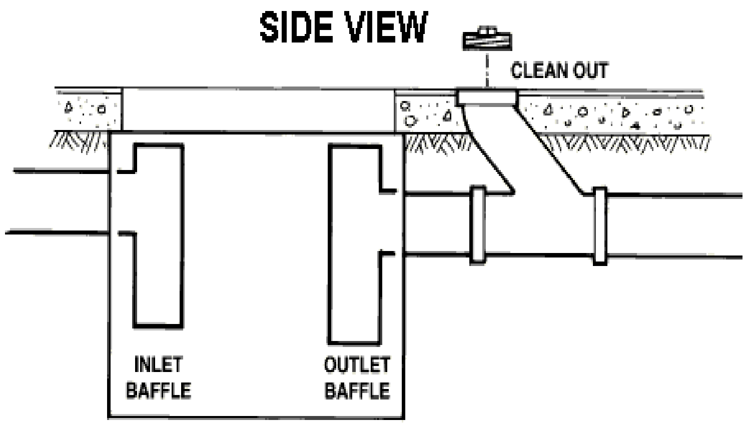
Floor Drain Pipes and Grease Traps

Pipes connected to floor drains are either made out of cast iron, galvanized steel, or PVC and are laid down in the facility foundation soil at a slight angle to enable the wastewater to flow to the septic system. Slaughterhouses regulated by the USDA are required to have drain lines made out of cast iron or galvanized steel. These drain lines must have a minimum diameter of at least four inches (U.S. Department of Agriculture, 1986). Larger diameter drain pipes may be necessary to handle wastewater generated from certain eviscerating procedures. Most of the other non-slaughterhouse food processing facilities visited, such as seafood processing facilities, also had drain lines with a diameter of least 4 inches. The drain pipes connect to the floor drains or sinks which lead to one main pipe that runs the length of the facility. The main drain line usually has a sufficient diameter to handle the wastewater volumes from several floor drains or sinks. At some facilities, specifically those that were USDA regulated, the main drain lines have vent pipes that lead outside of the facility, to allow for proper wastewater flow and to prevent the formation of odors.

Some facilities, such as slaughterhouses, opt to install a grease trap on the main drain pipe in order to collect greases or fats that are generated during particular food processing or preparation steps (Sorrells, 1999). Grease traps can be placed either inside the facility, but away from the food processing area, or outside of the facility closer to the septic tank. They are usually rectangular structures made out of precast concrete with removable covers to allow for periodic cleaning and removal of grease. The devices range in size from 200 gallons to 500 gallons or more. Grease traps work by slowing down the flow of hot greasy water and allowing it to cool. As the hot water cools, the grease and oil separate and float to the top of the trap. The cooler water continues to flow down the pipe to the septic tank. The grease is trapped by baffles that cover the inlet and outlet of the tank, preventing grease from flowing out of the trap. Periodically, or when enough grease accumulates on the water surface, the grease trap is cleaned out or flushed and the grease is removed and disposed of. Figure 13 shows a schematic of a typical grease trap found at a slaughterhouse or food processing facility that generates large amounts of grease-laden wastewater.

In addition to the grease trap the main drain line leading to the septic tank may also have clean-out pipes that lead to the soil surface. These clean-out pipes allow facility owners/operators to access the main drain line and unplug or clean out the line if necessary. Main drain lines are usually placed under 1 to 1.5 feet of soil. Figure 14 shows the main drainage line exiting the slaughterhouse facility and a shallow clean-out access area. Though not discernable in Figure 14, the liquid running along the main drain line is primarily blood. Blood was entering the tank because, during the slaughter taking place at that time, no blood collection procedures were being used.

Figure 13. Schematic of a Grease Trap



Source: Reid, 1999

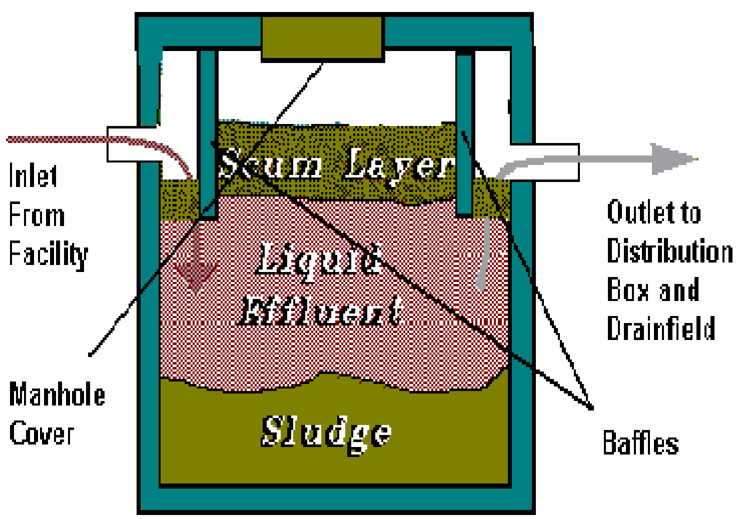
Figure 14. Main Drain Line leading to Septic Tank and Line Cleaning Access Area

If constructed properly, floor drain pipe connections and main drain line connections or joints are fitted with oil resistant compression rings to prevent leaks at the joints (New Hampshire Department of Environmental Services, 1989).

Septic Tanks and Distribution Boxes

After draining through the floor drains or sinks and flowing through the drain lines to the grease separator (if installed) and past the clean-out pipe, raw wastewater flows into the upper portion of the septic tank. The pipe carrying raw effluent is usually placed below the scum line to prevent disruption of the flow dynamics in the tank and to prevent disruption of the scum layer. Within the septic tank, the heavier solids in the raw wastewater will separate from the liquids and will settle to the bottom and become sludge. Some of the lighter solids, such as soap scum or fat, will float to the top of the tank to form a scum layer. The ceiling of the septic tank also contains baffles that are placed near the inflow pipe and near the out flow pipe. These baffles work to stabilize the scum layer and hold back the floating scum from moving past the outlet and into the outflow pipe. The septic tank ceiling also contains a manhole that allows for pumping of the accumulated sludge and periodic servicing if necessary. The scum layer that works to form an anaerobic environment, allows facultative anaerobic bacteria in the tank to break down or digest solids and organic compounds. The remaining liquids then flow out of the tank through the outflow pipe to a distribution box located in the drainfield. Figure 15 shows a cross-sectional diagram of a typical commercial septic system.

Figure 15. Cross Section of Commercial Septic System



All of the food processing facilities visited, except one (a sandwich making facility), had two different septic tanks: one for handling sanitary sewage and the other for handling food processing wastewater. In some cases, the volume of food processing wastewater generated was large enough to require use of two separate but connected septic tanks. When two tanks were used, a flow splitter box was installed on the main drain pipe to channel off equal amounts or raw wastewater to each tank. However, the typical layout observed was one tank connected to one main drain line.

Sizes of septic tanks vary according to the wastewater flow rates and the necessary retention time to properly treat the wastewater before releasing into the soil. The food processing facilities visited were using septic tanks of varying sizes that had been installed behind the main facility structure at a distance of approximately 15 to 30 feet away from the facility wall. The larger slaughterhouses were using 2000 gallon tanks while some of the smaller facilities were using 750 gallon tanks with dimensions of approximately 4 feet by 8 feet. For example, for one smaller slaughterhouse in Wyoming, a 900 gallon septic tank was chosen to handle an estimated wastewater flow of 252 gallons per day with a BOD_5 loading of 1.5 pounds per day.

For the most part, commercial septic tanks are constructed out of concrete, have no seams, and usually have one or two manholes on the top with steel covers. Facility owners/operators usually decide to install a septic system that has a higher treatment capacity than what is actually required, just in case larger than expected wastewater flows are generated and to allow for facility expansion. Figure 16 shows one of the larger slaughterhouses that was visited and in the foreground three manhole covers can be seen. One manhole cover is used to access the smaller septic tank and the other two manholes are used to access the larger tank that was connected to the smaller tank to achieve sequential treatment.

Figure 16. Location of Septic Tanks Behind Slaughterhouse and Manhole Covers

Septic tanks are usually installed by digging out the necessary volume of soil and placing the already constructed septic tank in place and anchoring it to the surrounding soil to avoid shifting. The septic tank is then covered with approximately one to three feet of top soil. The septic tanks seen in

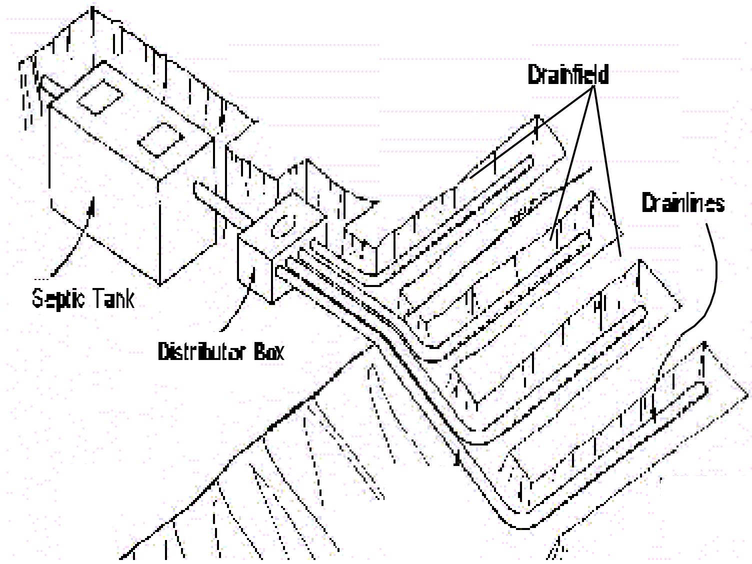
Figure 17 were installed by blasting underlying limestone and laying the tanks within the blasted area. Little to no top soil existed at this location.

Once the wastewater has been detained in the septic tank for a sufficient period of time, the partially treated wastewater exits the septic tank through the outflow pipe. The outflow pipe then carries the wastewater to a simple device called a distribution box. The distribution box serves the purpose of evenly distributing the volume of wastewater to the drain lines that are attached to the box. Typically, a distributor box has 4 to 5 evenly spaced outlets connected to drain lines in the drainfield. A few food processing facilities with two separate septic tanks opted to join the outflow pipes from both septic tanks so as to have only one pipe leading to the distributor box. The distribution box is usually made out of concrete, has a small access cover, and is typically buried under a few inches to a few feet of soil depending on the depth at which the drain lines are laid.

Drainfield and Drain Lines

Once the treated wastewater reaches the distribution box, it is channeled into drain lines that are laid in the backyard. The bottom of the drain lines are perforated at even intervals. As the wastewater passes through the drain lines, it exits the lines through the perforations and percolates into the soil or backfill material that is under the lines. The flow process through the drain lines allows the partially treated wastewater to be distributed evenly throughout the soil. Drain lines are typically made of PVC pipe or specially manufactured, large-diameter corrugated plastic tubing with a diameter of 3 to 4 inches. It is common to lay the lines within a rectangular area in the soil with the outermost drain line forming a rectangular boundary within which the other drain lines are laid in smaller and smaller rectangles. All the drain lines are usually connected at the ends but some facility owners stated that they had not connected the ends of the drain lines. Figure 17 shows the drainfield and one approach to laying out the drain lines.

Figure 17. Drainfield and Drain lines Layout



Adapted from: Reid, 1999

The food processing facilities visited had drainfields of varying sizes because the wastewater flow rates, wastewater compositions, and soil percolation rates were different. However, most facilities had drainfields measuring approximately 25 to 40 feet in length and 20 to 30 feet in width. One slaughterhouse in Wyoming has a drainfield measuring 20 by 30 feet which handles the pretreated wastewater from a 1000 gallon tank. Drainfields are constructed in a variety of ways and with different soils and/or backfill material. In general, trenches are dug in the top soil according to the arrangement in which the drain pipes will be laid. Usually, an attempt is made to have the bottom of the drainfield be at least three feet above the seasonally high water ground water table, or bedrock (Brown, 1998). To help infiltration, small stones or other similar media is laid at the bottom of trenches. The drain pipes are then laid on top of the infiltration media and another layer of infiltration media is poured on top of the drain lines. Typically, drain lines are laid with approximately 5 to 8 feet between them, but spacing varies according to the design. The original top soil that was removed is then placed over the drain lines to fill the trenches. In some cases a layer of hay or other similar material is laid on top of the infiltration trenches and the top soil is then placed on top of the hay. The hay works to prevent the infiltration media from clogging up with soil particles from the upper layer of top soil. Typically, a few feet to 5 inches of soil or backfill material is placed on top of the drain lines. In some cases, the site where the drainfield is placed does not contain enough top soil to construct a proper drainfield with adequate soil infiltration and subsurface treatment. In these cases, clean backfill, such as soil or sand, is brought in to raise the level of the soil surface. With a higher volume of soil, trenches of adequate depth can be built (Minnesota Pollution Control Agency, 1996)

Commercial Septic System Permitting and Siting

All of the commercial septic systems that were observed at food processing facilities had been designed by engineers that had followed the county's environmental or health department standards. According to a few of the permits obtained from state agencies, counties usually require that a test be performed prior to installing a commercial septic system. These tests and analyses usually include:

- depth to ground water;
- soil infiltration/percolation rate;
- setback distance (distance to nearby wells and other structures);
- absorptive capacity of entire drainfield; and
- adequacy of soil type.

If the test results demonstrate that the site is suitable, the septic system is permitted and installation is allowed. Typically, acceptable percolation rates vary from 2.5 to 3 minutes per inch. Though little information was obtained verifying that drain lines injected wastewater above the ground water level, it can be assumed that most if not all the commercial septic systems at food processing facilities are discharging above the ground water level since they were permitted by the county or state agency. In designing a commercial septic system, the most important aspect is determining whether the soils in the drainfield are well drained but yet still retain water long enough to allow for proper wastewater treatment (Brown, 1998). From conversations with facility owners, it appeared that in most cases the septic system had been installed properly according to county regulations. However, a few FPWDWs at particular facilities did not appear to be situated in very suitable areas. For example, one custom slaughterhouse situated on a hill had installed a septic system and a drain filed on the backside of the hill which had a severe slope. In addition, according to a state UIC representative that was on hand, there was very little top soil in that area because of the prevalence of limestone bedrock. Figure 18 shows the highly sloped hillside where the drainfield had been laid.

Figure 18. Sloped Drainfield on Hill with Underlying Karst Geology

The danger with laying a drainfield and a septic tank on such a sloped surface is that the wastewater will flow too quickly through the septic tank and the drain lines to receive adequate treatment. In addition, once the wastewater reaches the drain lines, there is a very high possibility that the wastewater will not infiltrate into the soil in a vertical fashion, but will infiltrate horizontally and reach the surface of the hill where it can flow to surface waters below.

4.6.2 Drywells

Drywells were also observed during the site visits. The drywells seen at one poultry processing facility were essentially holes in the ground with floor drains covering the entrance. These drywells had been placed in the middle of the cutting and preparation room and had openings that were approximately 4 inches wide. According to the facility owners/operators, the wells were approximately 6 feet deep with a layer of gravel on the bottom to aid in the infiltration process. The drywell was approved by the plumbing code official from the county health department. The well itself seemed to be constructed of PVC piping. However, the owner was unsure whether the drywell at this facility was simply a hole in the ground or if it resembled the more common pre-cast concrete drywells. Because there is no treatment taking place, the wastewater generated at the facility was simply flowing into the soil below.

4.7 FPWDW Operational Characteristics and Maintenance Aspects

Because FPWDWs are relatively simple devices, the associated operation and maintenance procedures are also straightforward. One of the most important operational aspects of FPWDWs is maintaining a correct raw wastewater flow rate. At a typical family-owned slaughterhouse that slaughters approximately 3 to 4 animals a day, a flow rate of 250 gallons per day can be expected.

Approximately 100 gallons of this flow is associated with carcass washing and the remaining 150 are associated with cleanup for a 400 square foot facility (Wyoming Department of Environmental Quality, 1989). The wastewater flow rates for other types of food processing facilities are not known because the facility owners did not have information on how much water they were using each month. However, one can assume that wastewater flow rates for most of these small, food processing facilities varies from 100 gallons to over 1000 gallons a day.

To keep a commercial septic system from malfunctioning or clogging, the system has to be periodically cleaned out and the sludges, fats, and sediments from the septic tank have to be removed. The frequency and type of cleaning varied among the different facilities visited. Some owners/operators stated that the septic systems were cleaned once a year and others stated they were cleaned out every four or five months. One shellfish processing facility owner stated that the septic tank onsite was cleaned out three times a year to remove sand that had settled to the bottom. The sand enters the wastewater stream since there is sand accumulation in the fresh shellfish brought to the facility. Some facility owners stated that they had no knowledge of whether their tank or system had been cleaned in the recent past. Other facility owners/operators stated that their tanks had not been cleaned out for three or six years. One slaughterhouse operator stated that it was common practice among smaller custom slaughterhouses to clear the floor drain pipes and septic system of grease and sediment by injecting very hot water from the hose directly into the floor drain.

Out of the ten facilities visited, three facility owners stated that their septic system had plugged at one point or another and two other owners stated that their system (including drain lines) had to be completely cleaned and are in some cases replaced because the system had failed.
One seafood processing facility operator stated that their commercial septic system was severely malfunctioning due to the high wastewater flow rates and the large quantities of greases and food solids that were in the wastewater. In addition, the system had been plugging so it was necessary to pump the septic tank every three weeks to remove the accumulated sludges. This facility processed salmon meat to produce salmon paté.

Those facility owners that acknowledged they were using grease traps (mostly slaughterhouses) stated that they frequently cleaned out their grease traps to remove the accumulated greases and fats. They stated that the grease is simply scraped off the top of the surface of the wastewater and if any grease remains, hot water is used to temporality dissolve the grease so it can flow out to the septic tank. Two different facility owners stated that not enough grease was generated in their process to require a grease trap while another slaughterhouse facility owner acknowledged that a degreaser solution was sometimes injected into the septic system to dissolve the accumulated grease and prevent backups or clogging. No further information was provided by the owner as to what type of degreaser was used. According to one state UIC program representative, one solvent that was occasionally used in rural areas to break up the accumulated greases in the commercial septic systems was trichloroethylene (Sorrells, 1999). However, no actual proof of such an event occurring had been documented.

5. POTENTIAL AND DOCUMENTED DAMAGE TO USDWs

5.1 Injectate Constituent Properties

The primary constituent properties of concern when assessing the potential for Class V FPWDWs to adversely affect USDWs are toxicity, persistence, and mobility. The toxicity of a constituent is the potential of that contaminant to cause adverse health effects if consumed by humans. Appendix D to the Class V study provides information on the health effects associated with contaminants found above MCLs or HALs in the injectate of FPWDWs and other Class V wells. As discussed in Section 4.5, the contaminants that are *most likely* to be found above primary MCLs or HALs in FPWDW injectate are nitrate, nitrite, and possibly total coliform and ammonia. Turbidity and chloride also have the potential of exceeding secondary MCLs. Because of a lack of sampling data, it is not possible to confirm that on average these contaminants exceed drinking water standards. Table 6 presents the reference level for these particular contaminants.

Table 6: Reference Levels for Contaminants That Are Likely to Be Found in FPWDW Injectate

Contaminants	Reference Levels (mg/L)	Level Source
Ammonia	30	HAL*
Chloride	250	Secondary MCL
Nitrate	10	MCL
Nitrite	1	MCL
Total Coliform	<5%+	MCL†*
Turbidity	Not to Exceed 5 NTUs [1]	MCL

* Draft as of October 1996, (USEPA, 1998)

† Treatment technique mandates less than 5% positive samples

[1] Nepholmetric turbidity units

As stated in Section 4.4.2, high levels of bacteria (2 to 4 million MPN) can be found in the raw wastewater from some food processing facilities and it is likely that these bacteria are fecal coliforms. Fecal coliforms are ubiquitous in the environment and generally are not considered harmful, but their presence in treated drinking water supplies points to deficiencies in either water treatment or in the water distribution system. The presence of coliforms is an indication that other more harmful microorganisms also may be present. The MCL for total coliforms is based on sampling results, rather than a specific density or other quantification, and allows no more than 5.0 percent of samples collected during a month to be positive for coliforms (USEPA, 1998).

Persistence is the ability of a chemical to remain unchanged in composition, chemical state, and physical state over time. Appendix E to the Class V study presents published half-lives of common constituents in fluids released in FPWDW and other Class V wells. All of the values reported in Appendix E are for ground water. Caution is advised in interpreting these values because ambient conditions have a significant impact on the persistence of both inorganic and organic compounds. Appendix E to the Class V study also provides a discussion of mobility of certain constituents found in the injectate of FPWDW and other Class V wells.

5.2 Observed Impacts

In January of 1998, a private drinking water well owner in Maine reported to state authorities that a water sample taken from his drinking water well had elevated levels of chloride (1,040 mg/l). At first, it was believed that the road salt applied by the nearby town of Kennebunk was the source of the contamination. However, after further sampling and analysis, bromide, at a concentration of 8.57 mg/l, was detected in the drinking water. This finding eliminated road salt as the source because bromide was not found in the road salt used by Kennebunk. The presence of bromide indicated that trapped seawater was probably causing the contamination. After further monitoring well sampling and analysis and other studies conducted with a terrain conductivity meter, it was determined that the source of the seawater was a lobster processing facility.

This lobster processing/holding facility was using a large tank full of seawater to hold lobsters that were still in their traps. Installed around the tank were nine floor drains that were connected to the facility's septic system. As the lobsters were pulled out of the tank for processing, seawater would fall to the ground and flow to the floor drains. The facility operators would also washdown the floors of the facility every day. Throughout the day the floors accumulated large amount of seawater that would also flow to the floor drains. In addition, the facility owner had in the past sprayed salt water on the facility's dirt road to keep the dust down.

As a result of allowing large quantities of seawater to enter the septic system, seawater was exiting the drain lines and infiltrating down to the USDW. Over the years, the USDW became contaminated with high levels of chloride and detectable levels of bromide. The situation was resolved when the owner of the lobster processing facility, under the direction of the Maine Department of the Environment, closed the floor drains leading to the commercial septic system and connected all remaining drains to the local sewer line.

6. BEST MANAGEMENT PRACTICES

The adoption of BMPs or alternative wastewater management strategies may reduce the risk of USDW contamination posed by food processing facilities using Class V injection wells. Alternatives to injection wells, discussed in Section 6.1, include connecting to a publicly-owned treatment works (POTW), discharging to surface waters via a National Pollution Discharge Elimination System permit (NPDES), applying the wastes to land, trucking off-site for proper disposal, and closing the well. Most of the BMPs available to food processing facilities, discussed in Sections 6.2 through 6.4, are aimed at reducing the rates of water utilization, and as a result, reducing the amounts of wastewater generated. Many of these BMPs, which integrate basic waste minimization and recycling strategies, are becoming increasingly important in the food processing industry as a whole and can have significant, beneficial effects on the nature and quantity of the wastewater (Carawan, 1996b). Unfortunately, most of the facility owners/operators who were interviewed during site visits acknowledged that they were not using any BMPs or pollution prevention methods, except for the few slaughterhouses that were collecting blood.

6.1 Alternatives to FPWDWs

6.1.1 Discharges to POTW

Discharging wastewaters to POTWs is the most common waste disposal method throughout the food processing industry, when sewer service is available. It allows for the safe and regulated flow of wastewaters directly into facilities that are dedicated to handling such types of wastewaters. At larger food processing facilities that generate wastewater with high BOD_5 loadings, pretreatment prior to discharge is often required to meet local minimum water quality treatment standards and to avoid a surcharge for excessively dirty water. Pretreatment can include techniques designed to remove fats, proteins, carbohydrates, and other materials with secondary market value (Walsh and Ray, 1996). Preatement units also generate sludges that must be disposed of properly. Unfortunately, discharging to a POTW is an option that the majority of the food processing facilities currently using FPWDWs do not have since these facilities are located in rural areas that are unsewered.

6.1.2 Discharges Via a NPDES Permit

Another option for some of the larger food processing facilities currently using FPWDWs is to attempt to obtain an NPDES permit under the Clean Water Act. The permit would then allow food processing facilities to discharge directly to surface waters. A permit would require monitoring of pollutant levels and would place limits on the amount of pollutants discharged and the amount of wastewater discharged. In some cases (e.g., larger slaughterhouses with high BOD_5 pollution loads), the NPDES permit would most probably require installation of a small wastewater treatment unit to treat the wastewater prior to discharge. As with POTW discharges, it may be necessary to properly dispose of sludges that accumulate in these pretreatment units (Walsh and Ray, 1996).

6.1.3 Discharges Via Land Application Systems

One alternative strategy that could potentially be used by certain types of food processing facilities is that of applying wastewater to the land via land application systems. Some food processing facilities are currently spraying their wastewaters on land where an agricultural crop such as hay or trees are grown (Walsh and Ray, 1996). The crops utilize the wastewater and the carbohydrates and nutrients in the wastewater. As with all wastewater disposal methods, land application requires a permit. The permit in turn often requires monitoring of ground water and limitations on the amounts of pollutants discharged onto the land (Walsh and Ray, 1996). This alternative would not be suitable for slaughterhouses due to the potential for pathogens to be transmitted and other associated odor and aesthetic issues. However, land application could be suitable for those types of food processing facilities that generate wastewater that is appropriate for crops. Typically, wastewaters suitable for crop application meet the agronomic needs of the specific crop and contain the appropriate levels of nitrogen. Additionally, wastewaters used for land application contain low levels of metals and fecal coliform. For more information on land application of wastewaters, refer to USEPA biosolids rules in 40 CFR Part 503. Since most of these facilities are located in rural areas, the potential for finding suitable open land is higher than in more urban areas. For example, in New Hampshire, a land application strategy was used for the wastewater generated from a food processing facility that processed honey and maple syrup. This particular facility had been experiencing severe clogging problems with their septic system (due the high BOD and phosphorus levels in the injectate) because excessive biological/bacterial mats had formed under the drain lines. After some research, it was determined that the facility's wastewater could be safely sprayed onto a nearby hayfield (New Hampshire Department of Environmental Services, 1989).

6.1.4 Wastewater Hauling

Another option for small food processing facilities located in unsewered area is to have their wastewater collected and transported offsite. This can be accomplished by containing the generated wastewater in a holding tank and having an authorized wastewater hauler pump the tank and transport the wastewater to a facility that can adequately treat it (Walsh and Ray, 1996).

6.1.5 Closing

Finally, there is the option of simply closing the FPWDWs found at food processing facilities and finding an alternative wastewater disposal method, such as the ones described above.

6.2 Waste Audit

Some food processing wastewater specialists recommend that facilities complete wastewater audits to determine what practices lead to excessive water consumption or wastewater generation (Powell, 1997). As the first step, owners/operators identify and understand the sources and destinations of all plant wastes. During this step, all inflows and outflows of water are identified, and the path of water through the plant is traced from beginning to end. Water meters can be installed throughout food processing plants to accurately record water use. Once water usage has been fully documented, the potential sources of waste can be investigated. Often, ineffective equipment, personnel, and sanitation procedures are the largest waste generators in plants (Powell, 1997). The last step of the wastewater audit is to sample and characterize the plant's effluent to identify problems (Powell, 1997).

6.3 Dry Cleanup

Once a waste audit is performed, or even if that step is bypassed, owners/operators can begin implementing a variety of BMPs that can in the long run work to protect the environment and reduce costs associated with water utilization. Probably the single most effective method of reducing wastewater generation rates is to employ dry cleanup methods throughout the facility. The goal of dry cleanup methods is to attempt to capture all non-liquid waste (e.g., pieces of meat, shells, etc.) and prevent this type of waste from entering the wastewater (Carawan, 1996a). Capturing non-liquid waste can greatly reduce the BOD_5 levels in the wastewater. Michael Powell, from the University of Georgia, summarized the goals of dry cleanup accurately in the statement "if you don't put product into the waste stream, you don't have to pay to take it out" (Powell, 1994). Dry cleanup methods can be adapted to various procedures at food processing facilities and often include taking the following steps:

- installing trays and other devices below tables to collect solid wastes;
- instructing employees to remove dry wastes from the floor and equipment before cleaning with water;
- cleaning and storing dry cleanup tools and utensils separate from regular wet cleanup gear;
- keeping screens on all floor drains at all times; and
- making every effort to contain liquid or wet wastes, thereby reducing the quantities of water used to washdown dirty areas (Carawan, 1996b).

Dry cleaning alone can cut BOD levels in wastewater by significant amounts (Carawan, and Stengel, 1996). However, to reap the benefits of dry cleanup, facility owners/operators will have to train their employees to follow new procedures. In addition to training employees, it is crucial that managers and owners show an interest in reducing water utilization and work to heighten employee awareness (Carawan, 1996b). For example at one plant, procedural changes implemented through employee training resulted in a 33 percent reduction in BOD and a 25 percent reduction in water utilization at a Maryland dairy processing plant (Carawan and Stengel, 1996). In addition to dry cleanup procedures, there are other BMPs that can be implemented to minimize water use. These proven methods include:

- waste minimization training for employees;
- rigorous equipment maintenance and monitoring;
- wastewater recycling; and
- use of high-pressure, low-volume cleaning equipment (Carawan and Stengel, 1996).

6.4 Specific BMPs for Slaughterhouses

As with most industries, BMPs within the food processing industry vary according to the type of end product that is being produced. This section describes specific BMPs and pollution prevention methods applicable to operations involving the slaughter of animals.

As described above, the meat industry has the capacity of generating significant quantities of solid waste (in the form of wastes destined for rendering plants) and wastewaters with excessively high BOD_5 levels (World Bank, 1997). Most of the organic load, dissolved solids, and suspended solids in slaughterhouse wastewater are soluble proteins, solid tissues (blood, flesh, and fat), and debris (feathers, scales, and slimes) from product processing. Much of this material can be recovered and sold to external markets (as animal feed or for rendering) or reused within the plant. In addition to collecting solid wastes for recycling, there are other measures that small slaughterhouses can take to reduce the concentration of liquid wastes and the generation of wastes in general. Theses measures include:

- recovering and processing blood;
- allowing up to 7 minutes for blood draining (this lowers the amount of blood found in the carcass thereby minimizing blood releases during evisceration and meat cutting);
- minimizing water consumption by using taps with automatic shut-offs;
- using high water pressure in hoses (less time required to clean equipment);
- preventing solid wastes and concentrated fluids (animal fluids) from entering the wastewater stream;
- separating cooling waters from process wastewaters and recirculating cooling water;
- instituting dry cleanup procedures prior to wet cleaning;
- installing grease traps and screens on main drain lines leading to septic tanks to recover fats and small solids;
- optimizing the use of detergents and disinfectants in washing water; and
- removing manure from pens in solid form (World Bank, 1997).

If high levels of bacteria are found in the wastewaters leaving the slaughterhouse or in the FPWDW injectate, facilities could adopt procedures to disinfect wastewaters prior to discharge.

7. CURRENT REGULATORY REQUIREMENTS

Several federal, state, and local programs exist that either directly manage or regulate Class V FPWDWs. On the federal level, management and regulation of these wells falls primarily under the UIC program authorized by the Safe Drinking Water Act (SDWA). Some states and localities have used these authorities, as well as their own authorities, to extend the controls in their areas to address endemic concerns associated with FPWDWs.

7.1 Federal Programs

7.1.1 SDWA

Class V wells are regulated under the authority of Part C of SDWA. Congress enacted the SDWA to ensure protection of the quality of drinking water in the United States, and Part C specifically mandates the regulation of underground injection of fluids through wells. USEPA has promulgated a series of UIC regulations under this authority. USEPA directly implements these regulations for Class V wells in 19 states or territories (Alaska, American Samoa, Arizona, California, Colorado, Hawaii, Indiana, Iowa, Kentucky, Michigan, Minnesota, Montana, New York, Pennsylvania, South Dakota, Tennessee, Virginia, Virgin Islands, and Washington, DC). USEPA also directly implements all Class V UIC programs on Tribal lands. In all other states, which are called Primacy States, state agencies implement the Class V UIC program, with primary enforcement responsibility.

FPWDWs currently are not subject to any specific regulations tailored just for them, but rather are subject to the UIC regulations that exist for all Class V wells. Under 40 CFR 144.12(a), owners or operators of all injection wells, including FPWDWs, are prohibited from engaging in any injection activity that allows the movement of fluids containing any contaminant into USDWs, "if the presence of that contaminant may cause a violation of any primary drinking water regulation . . . or may otherwise adversely affect the health of persons."

Owners or operators of Class V wells are required to submit basic inventory information under 40 CFR 144.26. When the owner or operator submits inventory information and is operating the well such that a USDW is not endangered, the operation of the Class V well is authorized by rule. Moreover, under section 144.27, USEPA may require owners or operators of any Class V well, in USEPA-administered programs, to submit additional information deemed necessary to protect USDWs. Owners or operators who fail to submit the information required under sections 144.26 and 144.27 are prohibited from using their wells.

Sections 144.12(c) and (d) prescribe mandatory and discretionary actions to be taken by the UIC Program Director if a Class V well is not in compliance with section 144.12(a). Specifically, the Director must choose between requiring the injector to apply for an individual permit, ordering such action as closure of the well to prevent endangerment, or taking an enforcement action. Because FPWDWs (like other kinds of Class V wells) are authorized by rule, they do not have to obtain a permit unless required to do so by the UIC Program Director under 40 CFR 144.25. Authorization by rule terminates upon the effective date of a permit issued or upon proper closure of the well.

Separate from the UIC program, the SDWA Amendments of 1996 establish a requirement for source water assessments. USEPA published guidance describing how the states should carry out a source water assessment program within the state's boundaries. The final guidance, entitled *Source Water Assessment and Programs Guidance* (USEPA 816-R-97-009), was released in August 1997.

State staff must conduct source water assessments that are comprised of three steps. First, state staff must delineate the boundaries of the assessment areas in the state from which one or more public drinking water systems receive supplies of drinking water. In delineating these areas, state staff must use "all reasonably available hydrogeologic information on the sources of the supply of drinking water in the state and the water flow, recharge, and discharge and any other reliable information as the state deems necessary to adequately determine such areas." Second, the state staff must identify contaminants of concern, and for those contaminants, they must inventory significant potential sources of contamination in delineated source water protection areas. Class V wells, including FPWDWs, should be considered as part of this source inventory, if present in a given area. Third, the state staff must "determine the susceptibility of the public water systems in the delineated area to such contaminants." State staff should complete all of these steps by May 2003 according to the final guidance.[7]

7.1.2 Food and Drug Administration and the Federal Food, Drug and Cosmetic Act

The U.S. national regulatory authority for public protection and seafood regulation is vested in the Food and Drug Administration (FDA). The FDA operates an oversight compliance program for fishery products under which responsibility for the product's safety, wholesomeness, identity, and economic integrity rests with the processor or importer, who must comply with regulations promulgated under the Federal Food, Drug and Cosmetic (FD&C) Act, as amended, and the Fair Packaging and Labeling Act. Some states have entered into agreements with the FDA concerning regulatory oversight of shellfish processing facilities. In these states, FDA provides financial support by contract to state regulatory agencies for the inspection of food plants, including seafood. Most of the seafood processing facilities visited for this study were inspected by the state. A few relevant FDA regulations are summarized and presented below because the process and steps outlined in these regulations can affect the quantity and quality of wastewater being injected via FPWDWs.

Most FDA in-plant inspections consider product safety, plant/food hygiene and economic fraud issues, while other inspections address subsets of these compliance concerns. Samples may be taken during FDA inspections in accordance with the agency's annual compliance programs and operational plans or because of concerns raised during individual inspections. These analyses are for a vast array of defects including chemical contaminants, decomposition, net weight, radionuclides, various microbial pathogens, food and color additives, drugs, pesticides, filth and marine toxins such as Paralytic Shellfish Poison and domoic acid. FDA conducts both mandatory surveillance and enforcement inspections of domestic seafood harvesters, growers, wholesalers, warehouses, carriers and processors under the authority of the FD&C Act.

A more recent FDA program, called the Hazard Analysis and Critical Control Point, or HACCP, aims to further ensure seafood's safety. This program requires seafood processors, repackers and warehouses--both domestic and foreign exporters to this country--to follow a modern food safety system. This system focuses on identifying and preventing hazards that could cause food-borne illnesses rather than relying on spot-checks of manufacturing processes and random sampling of finished seafood products to ensure safety. The hazards can involve bacteria, viruses, parasites, natural toxins, and chemical contaminants.

Also, under FDA's HACCP regulations, seafood companies will have to write and follow basic sanitation standards that ensure, for example, the use of safe water in food preparation; cleanliness of food contact surfaces, such as tables, utensils, gloves and employees' clothes; prevention of cross-contamination; and proper maintenance of hand-washing, hand-sanitizing, and toilet facilities. Some of these HACCP requirements can end up affecting the quality and quantity of wastewater exiting the

[7] May 2003 is the deadline including an 18-month extension.

facility. This is especially true in areas where there are no local effluent limitations on the wastewater entering the septic system (above information from U.S. Food and Drug Administration, 1995).

7.1.3 United States Department of Agriculture - The Federal Meat Inspection Act and the Poultry Products Inspection Act

Most meat and poultry processing facilities are regulated by the USDA, specifically by the Food Safety and Inspection Service (FSIS). However, many of the slaughterhouse facilities using FPWDWs that were visited during the development of this study were not inspected by the FSIS, but by the local county health department (see Section 7.1.4 below). Those facilities falling under the purview of the USDA are advised to follow specific guidelines regarding the preparation and handling of food products. Many of these guidelines do have an effect on the quality and quantity of wastewaters generated. Some of the operational guidelines that affect wastewater quality and quantity include the use of appropriate cleaning/disinfecting solutions and minimum temperatures for waters used in rinsing and cleaning equipment.

The USDA also has more detailed guidelines (not enforceable) for slaughterhouses regarding facility plumbing design and wastewater management. Some of the wastewater management guidelines specifically address those facilities using Class V wells. These guidelines are found in 62 CFR 164 and the USDA Agricultural Handbook 570. In general, these guidelines aim to prevent the contamination of food products through proper design of plumbing systems and proper management of wastewaters. Specifically, the guidelines state that if a septic system is chosen as the method of handling wastewaters, it must be designed and operated to conform with all local, state, and USEPA regulations. Also, the USDA recommends that all parts of a floor where wet operations are conducted, be well drained, and as a general rule, it is recommended that one drainage inlet be installed for each 400 square feet of floor area. In addition, the USDA has specific guidelines for slaughterhouses regarding:

- floor drain pipe diameters;
- design of floor drains;
- accessibility and design of sewer pipes;
- location of wastewater treatment (siting of septic tank); and
- installation of grease traps.

The FSIS also requires that wastewater lines carrying sanitary waste not be connected to drainage lines within a facility that handles slaughterhouse wastewaters. In other words, if FPWDWs are being used, two separate septic systems must be installed to handle the different kinds of wastewater.

In addition to the above guidelines, the FSIS has created a new regulatory system for meat and poultry safety within the meat and poultry plants it regulates. The new, science-based system has two major components that directly affect facilities. First, the FSIS is requiring the plants it regulates to implement Hazard Analysis and Critical Control Points (HACCP) systems as a tool for preventing and controlling contamination so products meet regulatory standards. Second, the FSIS established food safety performance standards that plants must meet and is currently conducting testing and other activities to ensure those standards are being met. Implementation of HACCP systems allows regulated slaughterhouses the flexibility to meet the performance standards through a variety of means. This added flexibility may in turn affect slaughterhouse wastewater generation rates and constituent levels.

Small plants, defined as having 10 or more employees, but fewer than 500, are required to implement HACCP by January 25, 1999. Very small plants (like those most likely to use FPWDWs) with fewer than 10 employees or annual sales of less than $2.5 million, must implement HACCP by January 25, 2000 (U.S. Department of Agriculture, 1998).

7.1.4 Exempt Custom Slaughtering Facilities

Many of the slaughterhouses visited during the development of this volume were exempt from the more stringent regulations found in 9 CFR 303 through 307, providing for inspections conducted by the FSIS. These facilities were inspected by county health department officials who presumably were checking for compliance with the regulations for exempt facilities. Specifically, 9 CFR Part 303 exempts custom slaughterhouses that cut, prepare, and package meat exclusively for the individual who brought the animal to the facility. Part 303 provides that, "the requirements of the Act and the regulations in this subchapter for inspection of the preparation of products do not apply to the custom preparation by any person of carcasses, parts thereof, meat or meat food products derived from the slaughter by any individual of cattle, sheep, swine, or goats of his own raising or from game animals, delivered by the owner thereof for such custom preparation, and transportation in commerce of such custom prepared articles, exclusively for use in the household of such owner, by him and members of his household and his nonpaying guests and employees." However, the custom slaughterhouse still must abide by some provisions found in 9 CFR Part 308 and other provisions found in 9 CFR Part 316 and Part 317. For details on the operational requirements for exempt custom slaughtering facilies, refer to Attachment A of this volume.

7.2 State and Local Programs

As discussed in Section 3, approximately 95 percent of the documented FPWDWs in the nation exist in four states: Alabama, Maine, New York, and West Virginia. Attachment B of this volume describes in greater detail how these states and six other states currently control FPWDWs. This section briefly summarizes the key regulatory strategies adopted by the four states with the largest number of FPWDWs.

Alabama

Alabama, a UIC Primacy state for Class V wells, requires the owner or operator operating of an existing or proposed Class V well to submit a permit application to the Alabama Department of Environmental Management (ADEM) (335-6-8-.14(a)-(e) Alabama Administrative Code). The owner or operator must provide the following information in the permit application:

- construction plans,
- site hydrogeology,
- wastewater characteristics (constituents and physical properties), and
- name of facility and other related information.

ADEM can require further efforts from the owner or operator of the FPWDW in order to protect USDWs and prevent violations of primary drinking water regulations. If a permit is issued, the permit typically describes BMPs, and may require monitoring of wastewater and ground water monitoring. Additionally, the permit may require modifications in the construction plans of the FPWDW to prevent contamination of the receiving USDW.

Maine

Maine, a UIC Primacy state for Class V wells, requires anyone disposing of waste or wastewater through a Class V well to obtain a waste discharge license from the Maine Department of Environmental Protection (DEP). (Title 38, Water Statutes Section 413). A waste discharge license is also needed for installation, operation, and maintenance of a subsurface wastewater disposal system, unless the system is designed and installed in conformance with the Maine Subsurface Wastewater Disposal Rules (144 CMR 241). Typically if subsurface discharges are not licensed under 144 CMR 241, they are ineligible for a wastewater discharge under Section 413.

Maine has categorized food processing wastewater entering FPWDWs as "High Risk" and therefore the DEP provides the following options to food processing facilities:

- seal entrances to FPWDWs (e.g, floor drains),
- connect to sewer lines if available,
- install a holding tank and properly dispose of wastewater, or
- separate the facility into two areas where "High Risk" wastewaters can be contained and treated safely (Department of Environmental Protection - State of Maine, 1998).

Typically, guidance regarding use of BMPs is provided to the owner or operator after a discharge license has been issued or a subsurface wastewater disposal permit has been approved. BMP guidance is also offered to the owner or operator during facility inspections.

New York

USEPA Region 2 directly implements the UIC program for Class V injection wells in New York. Region 2 attempts to classify a well in the highest appropriate risk category. Therefore, septic systems receiving industrial wastes (like some food processing facilities) are classified as industrial wells. In addition, New York, under the authority of the state's Environmental Conservation Law, requires that dischargers using FPWDWs obtain permits. These State Pollution Discharge Elimination System (SPDES) permits specify effluent limitations, monitoring requirements, and schedules of compliance. In general, industrial wells are not allowed to inject contaminants at concentrations above the MCLs.

West Virginia

West Virginia, a UIC Primacy state for Class V wells, generally authorizes FPWDWs by rule, unless the West Virginia Office of Water Resources requires an individual permit (West Virginia Code of State Regulations Title 47-13). Injection is authorized initially for five years under the permit by rule provisions. Rule-authorized wells, such as most FPWDWs, are required to meet monitoring schedules. Facilities must meet MCLs at the point of injection. West Virginia generally prohibits any underground injection activity that causes or allows the movement of fluid containing any contaminant, if that contaminant may cause a violation of any primary drinking water standard.

ATTACHMENT A
OPERATIONAL AND PROCESS REQUIREMENTS FOR EXEMPT CUSTOM SLAUGHTERHOUSES

Custom slaughterhouses, which are exempt from FSIS inspections, are required to abide by the following requirements. Those requirements which have the potential of affecting the quantity and quality of wastewater are listed below:

(1) Manual cleaning and sanitizing:

(A) For manual washing, rinsing and sanitizing of utensils and equipment, a sink with not fewer than three compartments shall be provided and used. Sink compartments shall be large enough to permit the accommodation of the equipment and utensils, and each compartment of the sink shall be supplied with hot and cold potable running water. Fixed equipment and utensils and equipment too large to be cleaned in sink compartments shall be washed manually or cleaned through pressure spray methods.

(B) Drain boards or easily movable dish tables of adequate size shall be provided for proper handling of soiled utensils prior to washing and for cleaned utensils following sanitizing and shall be located so as not to interfere with the proper use of the dishwashing facilities.

(C) Equipment and utensils shall be preflushed or prescraped and, when necessary, presoaked to remove gross food particles and soil.

(D) Except for fixed equipment and utensils too large to be cleaned in sink compartments, manual washing, rinsing and sanitizing shall be conducted in the following sequence: (1) Sinks shall be cleaned prior to use. (2) Equipment and utensils shall be thoroughly washed in the first compartment with a hot detergent solution that is kept clean. (3) Equipment and utensils shall be rinsed free of detergent and abrasives with clean water in the second compartment. (4) Equipment and utensils shall be sanitized in the third compartment according to one of the methods prescribed in this section.

(E) The food-contact surfaces of all equipment and utensils shall be sanitized by: (1) Immersion for at least ½ minute in clean, hot water at a temperature of at least 170 °F; or (2) Immersion for at least 1 minute in a clean solution containing at least 50 parts per million of available chlorine as a hypochlorite and at a temperature of at least 75 °F; or (3) Immersion for at least 1 minute in a clean solution containing at least 12.5 parts per million of available iodine and having a pH not higher than 5.0 and at a temperature of at least 75 °F; or (4) Immersion in a clean solution containing any other chemical sanitizing agent allowed under 21 CFR 178.1010 that will provide the equivalent bactericidal effect of a solution containing at least 50 parts per million of available chlorine as a hypochlorite at a temperature of at least 75 °F for 1 minute; or (5) Treatment with steam free from materials or additives other than those specified in 21 CFR 173.310 in the case of equipment too large to sanitize by immersion, but in which steam can be

confined; or (6) Rinsing, spraying, or swabbing with a chemical sanitizing solution of at least twice the strength required for that particular sanitizing solution.

(F) When hot water is used for sanitizing, the following facilities shall be provided and used: (1) An integral heating device or fixture installed in, on, or under the sanitizing compartment of the sink capable of maintaining the water at a temperature of at least 170 °F; and (2) A numerically scaled indicating thermometer, accurate to ± 3 °F, convenient to the sink for frequent checks of water temperature; and (3) Dish baskets of such size and design to permit complete immersion of the tableware, kitchenware, and equipment in the hot water.

(G) When chemicals are used for sanitization, they shall not have concentrations higher than the maximum permitted under 21 CFR 178.1010 and a test kit or other device that accurately measures the parts per million concentration of the solution shall be provided and used.

(2) Mechanical cleaning and sanitizing:

(A) Cleaning and sanitizing may be done by spray-type or immersion dishwashing machines or by any other type of machine or device if it is demonstrated that it thoroughly cleans and sanitizes equipment and utensils. These machines and devices shall be properly installed and maintained in good repair. Machines and devices shall be operated in accordance with manufacturers' instructions, and utensils and equipment placed in the machine shall be exposed to all dishwashing cycles. Automatic detergent dispensers, wetting agent dispensers, and liquid sanitizer injectors, if any, shall be properly installed and maintained.

(B) The pressure of final rinse water supplied to spray-type dishwashing machines shall not be less than 15 nor more than 25 pounds per square inch measured in the water line immediately adjacent to the final rinse control valve. A 1/4-inch IPS valve shall be provided immediately up stream from the final rinse control valve to permit checking the flow pressure of the final rinse water.

(C) Machine or water line mounted numerically scaled indicating thermometers, accurate to ± 3 °F, shall be provided to indicate the temperature of the water in each tank of the machine and the temperature of the final rinse water as it enters the manifold.

(D) Rinse water tanks shall be protected by baffles, curtains, or other effective means to minimize the entry of wash water into the rinse water. Conveyors in dishwashing machines shall be accurately timed to assure proper exposure times in wash and rinse cycles in accordance with manufacturers' specifications attached to the machines.

(E) Drain boards shall be provided and be of adequate size for the proper handling of soiled utensils prior to washing and of cleaned utensils following sanitization and shall be so located and constructed as not to interfere with the proper use of the dishwashing facilities. This does

not preclude the use of easily movable dish tables for the storage of soiled utensils or the use of easily movable dish tables for the storage of clean utensils following sanitization.

(F) Equipment and utensils shall be flushed or scraped and, when necessary, soaked to remove gross food particles and soil prior to being washed in a dishwashing machine unless a prewash cycle is a part of the dishwashing machine operation. Equipment and utensils shall be placed in racks, trays, or baskets, or on conveyors, in a way that food-contact surfaces are exposed to the unobstructed application of detergent wash and clean rinse waters and that permits free draining.

(G) Machines (single-tank, stationary-rack, door-type machines and spray-type glass washers) using chemicals for sanitization may be used Provided that; (1) The temperature of the wash water shall not be less than 120 °F. (2) The wash water shall be kept clean. (3) Chemicals added for sanitization purposes shall be automatically dispensed. (4) Utensils and equipment shall be exposed to the final chemical sanitizing rinse in accordance with manufacturers' specifications for time and concentration. (5) The chemical sanitizing rinse water temperature shall be not less than 75 °F nor less than the temperature specified by the machine's manufacturer. (6) Chemical sanitizers used shall meet the requirements of 21 CFR 178.1010. (7) A test kit or other device that accurately measures the parts per million concentration of the solution shall be available and used.

(H) Machines using hot water for sanitizing may be used provided that wash water and pumped rinse water shall be kept clean and water shall be maintained at not less than the following temperatures:

(1) Single-tank, stationary-rack, dual-temperature machine: Wash temperature = 150 °F, Final rinse temperature = 180 °F;
(2) Single-tank, stationary-rack, single-temperature machine: Wash temperature = 165 °F, Final rinse temperature = 165 °F;
(3) Single-tank, conveyor machine: Wash temperature = 160 °F, Final rinse temperature = 180 °F;
(4) Multitank, conveyor machine: Wash temperature = 150 °F, Pumped rinse temperature = 160 °F, Final rinse temperature = 180 °F; and
(5) Single-tank, pot, pan, and utensil washer (either stationary or moving-rack): Wash temperature = 140 °F, Final rinse temperature = 180 °F.

(I) All dishwashing machines shall be thoroughly cleaned at least once a day or more often when necessary to maintain them in a satisfactory operating condition (above information from 9 CFR Part 303 - “Exemptions”)

ATTACHMENT B
STATE AND LOCAL PROGRAM DESCRIPTIONS

This attachment does not describe every state's program; instead it focuses on 10 states where the majority of the documented FPWDWs are known to exist or where UIC program staff have estimated that large numbers of FPWDWs may be present: Alabama, Alaska, California, Hawaii, Maine, New York, Oregon, Tennessee, West Virginia, and Wisconsin. The descriptions highlight the state's definition of FPWDWs, when available, and outline the licensing and other administrative requirements FPWDWs must satisfy.

Alabama

Alabama is a UIC Primacy state for Class V wells. The Alabama Department of Environmental Management (ADEM) has promulgated requirements for Class V UIC wells under Chapter 335 of the Alabama Administrative Code (AAC).

Permitting

The owner/operator of an existing or proposed Class V well must submit a permit application to ADEM including the following information (335-6-8-.14(a)-(e) AAC):

- facility name and location;
- name of owner and operator;
- legal contact;
- depth, general description, and use of the injection well; and
- description of pollutant injected, including physical and chemical characteristics.

ADEM is required by the AAC to assess the possibility of adverse impact on a USDW posed by the well, and to determine any special construction and operation requirements that may be required to protect a USDW (335-6-8-.15(1) AAC). If ADEM determines that the proposed action may have an adverse impact on a USDW, the applicant may be required to submit a permit application in the manner prescribed for Class I and Class III wells. When those permit application requirements are applied, the permit application processing and issuance procedures will follow the rules set forth for Class I and III wells (335-6-8-.15(3) AAC). The AAC specifies that "Class V wells may be allowed insofar as they do not cause a violation of primary drinking water regulations under 40 CFR Part 142" (335-6-8-.07 AAC).

Siting and Construction

The AAC specifies that injection wells shall be sited so that they inject into a formation that is beneath the lowermost USDW located within five miles of the well (335-6-8-.20 AAC). However, Class V wells are specifically exempted (335-6-8-.25 AAC).

Construction requirements also are specified for all injection wells. However, Class V wells are specifically exempted (335-6-8-.25 AAC). They are required to be constructed in such a manner that they may not cause a violation in USDWs of primary drinking water regulations under 40 CFR Part 142, and when required by ADEM must be constructed by a well driller licensed by ADEM (335-6-8-.25 AAC).

Operating Requirements

Class V wells are required to be operated in a manner that may not cause violation of primary drinking water regulations under 40 CFR 142. ADEM may order the operator to take necessary actions to prevent violation, including closure of the well (335-6-8-.16 AAC).

A method of obtaining grab and composite samples of pollutants after all pretreatment and prior to injection must be provided at all sites. Spill prevention and control measures sufficient to protect surface and ground water from pollution must be taken at all sites (335-6-8-.22 AAC).

Monitoring requirements may be specified in the permit, by administrative order, by directive, or included in the plugging and abandonment plan (335-6-8-.28 AAC).

Plugging and Abandonment

A plugging and abandonment plan may be required by permit or administrative order. If necessary, it may be required to include aquifer cleanup procedures. If pollution of a USDW is suspected, ground water monitoring may be required after well abandonment (335-6-8-.27 AAC).

Alaska

USEPA Region 10 directly implements the UIC program for Class V injection in Alaska. In addition, Chapter 72 of the Alaska Administrative Code AAC addresses wastewater disposal to ground water.

Permitting

Disposal of non-domestic wastewater is subject to restrictions in 18 AAC 072.500, including review and approval of a non-domestic wastewater system plan by the Alaska Department of Environmental Conservation.

California

USEPA Region 9 directly implements the UIC program for Class V injection wells in California. In addition, the California Water Quality Control Act (WQCA) establishes broad requirements for the coordination and control of water quality in the state, sets up a state Water Quality Control Board, and divides the state into nine regions, with a Regional Water Quality Control Board that is delegated responsibilities and authorities to coordinate and advance water quality in each region (Chapter 4 Article 2 WQCA). A Regional Water Quality Control Board can prescribe requirements for discharges (waste discharge requirements or WDRs) into the waters of the state (13263 WQCA). These WDRs can apply to injection wells (13263.5 and 13264(b)(3) WQCA). In addition, the WQCA specifies that no provision of the Act or ruling of the state Board or a Regional Board is a limitation on the power of a city or county to adopt and enforce additional regulations imposing further conditions, restrictions, or limitations with respect to the disposal of waste or any other activity which might degrade the quality of the waters of the state (13002 WQCA).

Permitting

Although the Regional Water Quality Control Boards do not permit injection wells, the WQCA provides that any person operating, or proposing to operate, an injection well (as defined in §13051 WQCA) must file a report of the discharge, containing the information required by the Regional Board, with the appropriate Regional Board (13260(a)(3) WQCA). Furthermore, the Regional Board, after any necessary hearing, may prescribe requirements concerning the nature of any proposed discharge, existing discharge, or material change in an existing discharge to implement any relevant regional water quality control plans. The requirements also must take into account the beneficial uses to be protected, the water quality objectives reasonably required for that purpose, other waste discharges, and the factors that the WQCA requires the Regional Boards to take into account in developing water quality objectives, which are specified in §13241 of the WQCA ((13263(a) WQCA). However, a Regional Board may waive the requirements in 13260(a) and 13253(a) as to a specific discharge or a specific type of discharge where the waiver is not against the public interest (13269(a) WQCA).

California counties take a variety of approaches to regulation of food processing and similar types of wells. For example, Yolo County regulates these wells under the Yolo County Water Quality Ordinance Sections 6-8.101-6.8.1301. Other counties prohibit these wells. For example, Merced County prohibits wells from receiving waste from food processing disposal as well as other types of disposal. Santa Clara Valley Water District also forbids these wells. Glenn County notes that it is very unlikely that the County would permit the construction of any industrial waste disposal well. Riverside County applies the requirements in their Plumbing Code and considers flow, soil type, and depth of ground water in determining whether to approve wells.

Hawaii

USEPA Region 9 directly implements the UIC program for Class V injection wells in Hawaii. In addition, Chapter 23 of Title 11 of the Hawaii Administrative Rules (HAR), effective July 6, 1984, amended November 12, 1992, establishes a state UIC program. This program groups Class V wells for purposes of permitting into 6 subclasses. The subclasses, however, do not specifically address food processing wells (11-23-06(b)(3) HAR).

Permitting

Underground injection through a Class V well is prohibited except as authorized by permit. A permit for injection into USDW is based on evaluation of the contamination potential of the local water quality by the injection fluids and the water development potential for public or private consumption. Permits are issued not to exceed five years. Permit applications must include specified information, including location, description, and operating plans (11-23-12, 11-23-13, and 11-23-16 HAR).

Siting and Construction

Wells are required to be sited beyond an area that extends at least one-quarter mile from any part of a drinking water source, including not only the surface expression of the water supply well, tunnel, or spring, but also all portions of the subsurface collection system (the UIC line).
Special buffer zones are required if the well is located in a caprock formation that overlies a volcanic USDW under artesian pressure (11-23-10 HAR).

No injection well may be constructed unless a permit application has been made and the construction has been approved. Construction standards for each type of well are not specified, due to the variety of injection wells and their uses. If large voids such as lava tubes or solution cavities are encountered, special measures must be taken to prevent unacceptable migration of the injected fluids (11-23-09 HAR).

Operating Requirements

A Class V well may not be operated in a manner that allows the movement of fluid containing a contaminant into a USDW, if the presence of that contaminant may cause a violation of any national or state primary drinking water rule or otherwise adversely affect the health of one or more persons. All wells must be operated in such a manner that they do not violate any rules under Title 11 HAR regulating water quality and pollution, including Chapter 11-20, relating to potable water systems, Chapter 11-62, relating to wastewater systems, and Chapter 11-55, relating to water pollution control. The state may also impose other limitations on quantity and quality of injectate as deemed appropriate. An operator may be ordered to take such actions as may be necessary to prevent a violation of primary drinking water standards, including cessation of operations (11-23-11 HAR).

Monitoring Requirements

Operating records generally are required for wells, including the type and quantity of injected fluids and the method and rate of injection (11-23-12 HAR). The operator of an injection well must keep detailed records of the operation, including but not limited to the type and quantity of fluids, and method and rate of injection per well (11-23-18 HAR).

Plugging and Abandonment

An operator wishing to abandon a well must submit an application, and the well must be plugged in a manner that will not allow detrimental movement of fluids between formations (11-23-19 HAR).

Maine

Maine is a UIC Primacy State for Class V wells. The Maine Department of Environmental Protection administers the UIC program, with support from EPA Region 1. Title 38 of the Maine Revised Statutes Annotated (MRSA) establishes, among other programs, the state's ground water protection program (38 MRSA §§ 401-404), pollution control program, including waste discharge licensing provisions (38 MRSA §413), and ground water classification standards (38 MRSA §465-C). Rules controlling the subsurface discharge of pollutants by well injection implemented by the Department of Environmental Protection are found in 06 Code of Maine Regulations (CMR) Chapter 543.

Permitting

The rules controlling subsurface discharge of pollutants by well injection provide that all subsurface discharges of fluids into or through a well are prohibited except as authorized in accordance with the rules. The state recognizes five classes of wells, reflecting the definitions adopted by the federal UIC program. Any subsurface discharge into or through a Class V well that would cause or allow the movement of fluid into an USDW that may result in a violation of any Maine Primary Drinking Water Standard, or which could otherwise advsersely affect human health, is prohibited (06-096.543.3.D CMR). (The state designates ground water as either Class GW-A, for use as public drinking water supplies or Class GW-B for uses other than drinking water supplies. However, no ground water to date has been classified as GW-B. The Primary Drinking Water Standards are set forth in Department of Human Services rules in 10-144A CMR 231.)

Class V wells must obtain a waste discharge license issued under 38 MRSA §413 (1-B) prior to the commencement of the discharge. Specifically 06-096.543.4.B CMR, which implements 38 MRSA §413, states that for Class V wells, "Discharges of fluids into or through Class V wells may be maintained, provided that (1) a waste therefor is issued by the Board (of Regulations) prior to commencement of the discharge (or it is determined by the Board that the proposed discharge is beyond the waste discharging licensing jurisdiction), and (2) any other applicable statutes and regulations administered by the Board are satisfied, including the requirements of Section (3) D of these regulations". Section (3) D refers to the prohibition against violating Maine Drinking Water Standards described in the previous paragraph.

However, there are exceptions to the discharge license requirements of 38 MRSA §413 (1-B). According to a publication titled "DEP Issue Profile - Underground Injection Control Program" developed by the State of Maine DEP in June of 1998, "a license is not required for those Class V wells which discharge to a subsurface waste water disposal (septic) system permitted, designed and installed in conformance with the Maine Subsurface Waste Water Disposal Rules (144A CMR 241) and used solely for the discharge of waste water". 144 CMR 241 governs the siting, design, construction and inspection of subsurface waste water disposal systems in order to protect the health, safety and welfare of the citizens of Maine. According to the introductory language in 144 CMR 241, "These rules provide minimum State design criteria for subsurface wastewater disposal to assure environmental sanitation and safety". In 144 CMR 241 waste water is defined as, "... any domestic waste water, or other waste water from commercial, industrial or residential sources of which is similar in quality (both constituents and strength) to that of domestic wastewater". The definition continues with, "domestic waste water is any waste water produced by ordinary living uses, including liquid waste containing animal or vegetable matter in suspension or solution, or the water-carried waste from the discharge of water closets, laundry tubs, washing machines, sinks, dish washers, or other source of water-carried wastes of human origin".

Class V wells also can be redesignated or subject to additional regulatory requirements. Any Class V well receiving toxic or hazardous compounds is redesignated as a Class IV well and, as such, is prohibited. The rules controlling the subsurface discharge of pollutants also note that the Maine Hazardous Waste, Septage, and Solid Waste Management Act (38 MRSA § 1301 et seq.) or the Site Location of Development Act (38 MRSA § 481 et seq.,) could apply to certain Class V wells.

New York

USEPA Region 2 directly implements the UIC program for Class V injection wells in New York. However, under the state's Environmental Conservation Law, the Department of Environmental Conservation, Division of Water Resources (DWR) has promulgated regulations in the state Code Rules and Regulations, Title 6, Chapter X, Parts 703, 750 -758 that establish water quality standards and effluent limitations and create a state pollutant discharge elimination system requiring permits for discharges into the waters of the state. Such discharges must comply with the standards in Part 703, and must be monitored in accordance with requirements in Part 756.

Permitting

Applications for a State Pollution Discharge Elimination System (SPDES) permit must be submitted on a required form, describe the proposed discharge, supply such other information as the DWR requests, and are subject to public notice (751.1 DWR). SPDES permits must ensure compliance with effluent limitations and standards, and will include schedules of compliance, monitoring requirements, and records and reports of activities (Parts 751 - 756).

Operating Requirements

Effluent limits (Part 703) in the SPDES permit must be met. Monitoring and reporting requirements in the SPDES permit must be met (756.1 DWR).

Plugging and Abandonment

Not specified by statute or regulations.

Oregon

Oregon is a UIC Primacy state for Class V wells. The UIC program is administered by the Department of Environmental Quality (DEQ). Under the state's Administrative Rules (OAR) pertaining to underground injection, a "waste disposal well" is defined as any bored, drilled, driven or dug hole, whose depth is greater than its largest surface dimension, which is used or is intended to be used for disposal of sewage, industrial, agricultural, or other wastes and includes drain holes, drywells, cesspools and seepage pits, along with other underground injection wells (340-044-0005(22) OAR). Construction and operation of a waste disposal well without a water pollution control facility (WPCF) permit is prohibited. Certain categories of wells are prohibited entirely, including wells used for underground injection activities that allow the movement of fluids into a USDW if such fluids may cause a violation of any primary drinking water regulation or otherwise create a public health hazard or have the potential to cause significant degradation of public waters.

Permitting

Any underground injection activity that may cause, or tend to cause, pollution of ground water must be approved by the DEQ, in addition to any other permits or approvals required by other federal, state, or local agencies (340-044-0055 OAR). Permits are not to be issued for construction, maintenance, or use of waste disposal wells where any other treatment or disposal method which affords better protection of public health or water resources is reasonably available or possible (340-044-0030 OAR). A waste disposal well, if not absolutely prohibited, must obtain a WPCF permit (340-044-0035 OAR, 340-045-0015 OAR).

Siting and Construction

Permits for construction or use of waste disposal wells include minimum conditions relating to their location, construction, and use necessary to prevent migration of fluids into a USDW (340-044-0035 OAR).

Abandonment and Plugging

Upon discontinuance of use or abandonment, a waste disposal well is required to be rendered completely inoperable by plugging and sealing the hole. All portions of the well which are surrounded by "solid wall" formation must be plugged and filled with cement grout or concrete. The top portion of the well must be effectively sealed with cement grout or concrete to a depth of at least 18 feet below the surface of the ground, or if this method of sealing is not effective by a manner approved by the DEQ (640-044-0040 OAR).

Tennessee

USEPA Region 4 directly implements the UIC program for Class V injection well in Tennessee. However, the state has enacted a regulation addressing underground injection in Section 1200-4-6-.01 of the Administrative Code (TAC) pursuant to the state's Water Quality Control Act. The statute protects all waters of the state, including ground water. Although the rules do not explicitly address food processing wells, the rule defines Class V wells as those that are not Class I, II, III, or IV (1200-4-6.06(5)(j) TAC).

Permitting

Under the Tennessee rules, construction and operation of an injection well is prohibited unless authorized by an injection well permit or by a rule of the Tennessee Department of Environment and Conservation (DE&C) (1200-4-6.03 TAC). No permit may be issued or authorization by rule allowed where an injection well causes or allows the movement of fluid containing any contaminant that would result in the pollution of ground water. A permit or authorization by rule must include terms and conditions reasonably necessary to protect ground water classified pursuant to 1200-4-6.05(1) from pollution (1200-4-6.04(1) TAC). Injection into Class V wells generally is authorized by rule, subject to compliance and demonstration of mechanical integrity (1200-4-6.07 TAC).

A permit application must provide identification information and list all permits or construction approvals received or applied for under the UIC program under federal or state law. It must provide a topographic map extending one mile beyond the property boundary, describe each well where fluids are injected, and also wells, springs, surface water bodies, and drinking water wells within a quarter mile of the facility property boundary (1200-4-6-08 TAC).

Siting and Construction

The variety of wells and uses preclude specific construction standards. A well must be designed and constructed for its intended use, in accordance with good engineering practices, and the design and construction must be approved by the DE&C. Wells must be constructed so that their intended use does not violate the water quality standards (1200-4-6-.14(7) TAC).

Operating Requirements

Wells are required to be operated in such a manner that they do not present a hazard to ground water classified in the state (1200-4-6-.14(8) TAC). The well operator is required to monitor injection fluids, injection operations, and local ground water supplies in accordance with monitoring requirements determined by the type of well, nature of the injected fluid, and water quality of the receiving aquifer (91200-4-6-.14(9) TAC).

Plugging and Abandonment

The DE&C must approve a proposed plugging method and type of cement. Plugging may be carried out by any recognized method that is acceptable to DE&C (1200-4-6-.14(11) TAC). Within 90 days after completion of plugging, the permittee shall provide the DE&C documentation that the well has been adequately plugged and abandoned (1200-4-6-.14(9)).

West Virginia

West Virginia is a UIC Primacy state for Class V wells. Regulations establishing the UIC program are found in Title 47-13 West Virginia Administrative Code (WVAC) of state Regulations. The state does not identify a separate category of Class V industrial wells, but does specify that Class V includes injection wells not included in Classes I, II, III, or IV (47-13-3.4.5. WVAC).

Permitting

Class V injection wells are authorized by rule unless the Office of Water Resources of the Division of Environmental Protection requires an individual permit (47-13-12.4.a. and 47-13-13.2 WVAC). Injection is authorized initially for five years under the authorization by rule provisions.

Operating Requirements

Owners or operators of Class V wells are required to submit inventory information describing the well, including its construction features, the nature and volume of injected fluids, alternative means of disposal, the environmental and economic consequences of well disposal and its alternatives, operation status, and location and ownership information (47-13-12.2 WVAC).

Rule-authorized wells must meet the requirements for monitoring and records (requiring retention of records pursuant to 47-13-13.6.b. WVAC concerning the nature and composition of injected fluids until 3 years after completion of plugging and abandonment); immediate reporting of information indicating that any contaminant may cause an endangerment to USDWs or any malfunction of the injection system that might cause fluid migration into or between USDWs; and prior notice of abandonment (47-13-13.6 WVAC).

The rules enact a general prohibition against any underground injection activity that causes or allows the movement of fluid containing any contaminant into USDW, if the presence of that contaminant may cause a violation of any primary drinking water regulations under 40 CFR Part 142 or promulgated under the West Virginia Code or may adversely affect the health of persons. If at any time a Class V well may cause a violation of the primary drinking water rules the well may be required to obtain a permit or take such other action, including closure, that will prevent the violation (47-13-13.1 WVAC). Inventory requirements for Class V wells include information regarding pollutant loads and schedules for attaining compliance with water quality standards (47-13-13.2.d.1 WVAC).

If protection of a USDW is required, the injection operation may be required to satisfy requirements, such as for corrective action, monitoring, and reporting, or operation, that are not contained in the UIC rules (47-13-13.2.c.1.C. WVAC).

Plugging and Abandonment

A Class V well required to obtain an individual permit will be subject to permit conditions pertaining to plugging and abandonment to ensure that the plugging and abandonment of the well will not allow the movement of fluids either into a USDW or from one USDW to another. A plan for plugging and abandonment will be required (47-13-7(f) WVAC).

Wisconsin

Wisconsin is a UIC Primacy state for Class V wells. The Department of Natural Resources (DNR) has promulgated regulations in Chapter 812 of the Natural Resources Administrative Code pertaining to well construction. They prohibit injection except in limited cases:

> "The use of any well, drillhole, or water system for the underground placement of any waste, surface or subsurface water or any substance . . . is prohibited unless the placement is a department-approved activity necessary for remediation of contaminated soil, ground water, or an aquifer (NR 812.05).

Permitting

DNR regulations establish the requirements for discharge permits to discharge from a point source, including a well, to the waters of the state, including ground waters (NR Chapter 200). The list of exclusions from the discharge prohibition does not include food processing wells (NR 200.03(3)).

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