2015

Exploring the relationship between attachment and antibiotic resistance of Escherichia coli from swine manure

Martha Reye Zwonitzer
Iowa State University

Exploring the relationship between attachment and antibiotic resistance of *Escherichia coli* from swine manure

by

Martha Reye Zwonitzer

A thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Environmental Science

Program of Study Committee:

Michelle L. Soupir, Co-major Professor

Laura R. Jarboe, Co-major Professor

Steve Mickelson

Iowa State University

Ames, Iowa

2015

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEGEMENTS

I would like to thank my co-committee chairs, Michelle Soupir and Laura Jarboe and my committee members, Steve Mickelson and Ramesh Kanwar, for their guidance and support throughout the course of this research.

I would also like to thank my friends, colleagues, the department faculty and staff for making my time at Iowa State University a wonderful experience. In addition, I would like to thank my family for standing by me throughout this tedious process and for their willingness to help as needed.

ABSTRACT

Antibiotics are widely utilized in swine production for treatment and prevention of disease, growth promotion, and to improve the efficiency of feed. Antibiotic resistance has been present since the invention and subsequent use of antibiotics and bacteria have used antibiotic resistant mechanisms to overcome attacks in the environment. Under antibiotic pressure resistant mutants can spontaneously form and resistance genes can be passed between bacteria. Use of antibiotics at subtherapeutic levels is thought to add selective pressure for the development of antibiotic resistant bacteria both enteric and in the environment. However, there is still a large knowledge gap in understanding why some bacteria develop resistance rapidly and others remain susceptible.

The ability to attach to surfaces has been shown to result in bacterial persistence in the environment. Presence of attachment factors, such as pili, could be linked to the persistence of uropathogenic *E. coli* in humans. Few studies have been completed investigating the mechanisms responsible for adhesion of bacteria in the environment, and even fewer still have been performed examining relationships between attachment and antibiotic resistance. Understanding these relationships might have an impact on the timing and methodology of manure application or the use of antibiotics utilized in both human and animal prophylaxis at subtherapuetic levels in feeding operations. The objectives of this study were to: 1) detect and quantify the fraction of bacteria isolated from manure collected from conventional and organic swine production facilities in Iowa showing preferential attachment to quartz; 2) quantify the levels of resistance (susceptible,

intermediate, or resistant) of isolates collected from conventional and organic swine production facilities to amoxicillin (AMX), ampicillin (AMP), chloramphenicol (CMP), chlortetracycline (CTC), erythromycin (ERY), gentamycin (GEN), kanamycin (KAN), nalidixic acid (NAL), neomycin (NEO), tetracycline (TET), tylosin (TYL), streptomycin (STP), and sulfamethazine (SMZ); and, 3) statistically quantify any relationships between antibiotic resistance and attachment under different management practices (conventional and organic).

E. coli isolates were enumerated from manure collected from six swine production facilities under two management systems—organic, with no antibiotics given and conventional, with antibiotics fed sub-therapeutically. Isolates were subjected to an attachment assay using quartz as a model for fine sand to assess presence of adhesion. A known quantity of each isolate (0.5 McFarland Standard) was added to a conical tube with adequate quartz surface for attachment of all bacteria, after mixing for 20 minutes and settling for five minutes, supernatant was sampled and the bacteria present were enumerated. Attachment was calculated as the difference between the input quantity of bacteria and the output quantity (i.e. the quantity of bacteria in the supernatant). Results show a significantly ($p < .0005$) higher relationship between conventional swine management and attachment.

Antibiotic resistance was quantified using 13 antibiotics at susceptible, intermediate, and resistant MIC concentrations. Results from this study found that *E. coli* isolated from manure produced under conventional management systems had statistically higher resistance to AMX, AMP, CTC, ERY, KAN, NEO, STP, TET, and TYL; interestingly, a higher level of susceptibility to NAL was found under this management system. A statistically significant relationship was not shown between antibiotic resistance levels and attachment of *E. coli* from conventional systems, but was for organic management systems. Further understanding of the relationship between antibiotic resistance and attachment under organic and conventional systems is critical to understanding and potentially preventing exposure of human populations to antibiotic-resistant bacteria.

CHAPTER 1: GENERAL INTRODUCTION

1.1 Introduction

According to the U.S. Department of Agriculture's NASS (2008), the swine industry produced approximately 65 million hogs and pigs on 65,650 operations, including 8,940 hogs and pigs which were produced on 258 certified organic operation. The total value of the swine industry during that time period was just over $5 billion. Within the state of Iowa the swine industry produced 18.2 million head valued at just under $1.4 million.

The subtherapeutic use of antibiotics in animal production such as those used in the swine industry is believed to provide selective pressure for the development and increase of antibiotic resistant bacteria. Resistant variants, as well as indigenous resistant species can become dominant and spread through host-animal populations. Enteric bacteria can undergo selective pressure in animal intestinal tracts and be excreted in manure. Research has also shown that approximately 80 to 90 percent of all orally administered antibiotics can pass through the animal with little or no alteration in chemical structure (Levy, 1992; Onan and LaPara, 2003; Thiele-Bruhn, 2003).

Swine manure is typically disposed of by land applying, and serves as a source of valuable nutrients and organics; however, when manure is land applied prior to a hydrologic event the environment can receive high levels of enteric bacteria—and the antibiotic resistance genes they carry (Campagnolo et al., 2002). Along with receiving bacteria loads, it has also been shown that unaltered antibiotics can persist in the environment for extended periods of time, conferring additional selective pressure for enteric and indigenous bacterial populations (Chee-Sanford et al., 2009). The transport of antibiotic resistant bacteria to surface and groundwater is a potential critical threat to human health through exposure during recreational activities.

The magnitude of the impact antibiotic resistant bacteria can be measured by an increase in morbidity, mortality, and higher healthcare costs, nearly $30 billion annually, needed to treat such infections (Holmberg et al., 1987; Phelps, 1989). A concerted assault has been mounted against the usage of antibiotics in an agricultural setting, founded on the assumption that all such usage is unwise since it might serve as a repository for bacterial resistance in zoonotic species (Levy, 1984). Concern exists that antibiotic resistant bacteria can spread through the food chain causing infection as well; however, it should be noted that proper food hygiene and cooking practices can effectively alleviate this concern.

As in human systems, once in the environment bacteria can form biofilms, which may lead to the transfer of antibiotic resistance genes among and within bacterial species (Olson et al., 2002). Antibiotic resistance can be transferred via mechanism of horizontal and vertical gene transfer. Research has shown that biofilm-associated bacteria are 10 to 1,000 times less susceptible to some antimicrobial agents than the same cells in a planktonic state (Luppens et al., 2002); however, it should be noted that the levels of resistance of bacteria in biofilms is dependent on the microorganism, the environmental conditions, and the agent being applied.

It has been shown that bacteria are subjected to environmental pressures that must be overcome in order to attach, survive and thrive. These include organic matter content, pH, irradiation by sunlight, nutrient limitations, natural competition and predation, and temperature; it should be noted that temperature seems to have the greatest effect on bacterial survival. Within the soil matrix it has been shown that cells preferentially attach to particles of a given size range and are then subjected to the natural forces acting on those particles (Jeng et al., 2005). Other researchers found that differences in the propensity for attachment might exist between pathogenic and non-pathogenic strains of *E. coli* (Boerlin et al., 2005; Smyth et al., 1978); these findings are supported with research in the field of human medicine. Attachment to biomaterials is facilitated by attachment factors such as pili, fimbriae, and other surface attachment proteins, however, to our knowledge there is only one study that attempts to explain the basis for the idea that a relationship exists between antibiotic resistance and bacterial attachment to environmental particles, including quartz (Lu et al., 2010).

Results of this study will further the understanding of the relationship that may exist between subtherapeutic antibiotic usage in the swine industry, antibiotic resistance, and attachment to quartz. This research will be important in the development of recommendations to producers regarding the utilization of antibiotics as feed additives, and the application method and timing of manure applied to agricultural lands.

1.2 Goals and Objectives

The goal of this project is to demonstrate that selection for antibiotic resistance by subtherapeutic antibiotic use in agriculture co-selects for bacteria with increased attachment to sediment. The following specific objectives were studied:

- To detect and quantify the fraction of bacteria isolated from manure collected from conventional and organic swine production facilities in Iowa showing preferential attachment to quartz;
- To quantify the levels of resistance (susceptible, intermediate, or resistant) of isolates collected from conventional and organic swine production facilities to amoxicillin (AMX), ampicillin (AMP), chloramphenicol (CMP), chlortetracycline (CTC), erythromycin (ERY), gentamycin (GEN), kanamycin (KAN), nalidixic acid (NAL), neomycin (NEO), tetracycline (TET), tylosin (TYL), streptomycin (STP), and sulfamethazine (SMZ); and,
- To statistically quantify relationships between antibiotic resistance and attachment under different management practices (conventional and organic).

1.3 Hypothesis

The following hypotheses were tested:

- *Escherichia coli* isolates from manure produced under conventional management swine systems will have higher levels of attachment to quartz than isolates from manure produced under organically managed swine systems.
- *Escherichia coli* isolates from manure produced under conventional management swine systems will confer higher levels of resistance to AMX, AMP, CMP, CTC, ERY, GEN, KAN, NAL, NEO, TET, TYL, STP, and SMZ.

- A statistical relationship will exist between the levels of resistance to antibiotics and attachment of *Escherichia coli* isolates collected from swine manure produced under conventional and organic management systems.

1.4 Thesis Organization

The objectives of this research were tested via laboratory experiments using *E. coli* collected from the field. Chapter one consists of the literature review on antibiotic resistance, antibiotic usage by the swine industry, classes of antibiotics and modes of resistance to those antibiotics, transport of antibiotic resistant bacteria in the environment, bacterial attachment and implications for transport, including a summary of previous attachment and antibiotic resistance studies. Chapter two presents a paper prepared submission to a peer-reviewed journal. Chapter three provides overall conclusions, implications of the study, and recommendations for further research.

CHAPTER 2: LITERATURE REVIEW

Antibiotics are used in human and veterinary medicine for treatment and prevention of disease, and for other purposes such as prophylaxis and growth promotion in animals. Antimicrobial agents can be naturally-occurring, semi-synthetic or synthetic compounds and can be administered orally or topically and their modes of action are diverse.

2.1 Antibiotic Resistance

The matter of antibiotic resistance has been present since the advent of antibiotics. Antibiotic-producing organisms use the mechanism of antibiotic resistance to protect themselves against their own products as do other biological susceptible microorganisms against competitive attacks in nature. The presence of antibiotics can result in the formation of spontaneously resistant mutants as well as bacteria-to-bacteria acquired resistance. Resistant variants such as these, as well as naturally resistant species can become dominant and spread through host-animal populations. Increased antibiotic usage results in a greater likelihood that resistance will develop within exposed pathogenic and commensal bacterial populations (Levy, 2002; Levy and Marshall, 2004). However, there is vast diversity within an individual treated with antibiotics—some bacteria develop resistance very rapidly, and others remain susceptible.

The magnitude of the impact drug-resistant bacteria can be measured by an increase in morbidity, mortality, and higher healthcare costs needed to treat such infections (Holmberg et al., 1987). The total cost attributed to treating nosocomial resistant infections, either by the need for higher-priced antibiotics or lengthened hospitalizations, in the United States (U.S.) is estimated to be approximately $30 billion annually (Phelps, 1989). Over the last half century many “new” antibiotics have been licensed in the United States; however, many of these compounds have been variants of previously licensed compounds with relatively minor alterations in their structures. Therefore, bacteria resistant to their predecessors have quickly developed mechanisms of resistance to these “newcomers” (Lipstitch et al., 2002).

The use of antibiotics for purposes other than therapeutic application is a subject of debate (Arnold et al., 2004; Ferber, 2003; Livermore, 2003; Phillips et al., 2003). The movement opposing excessive clinical use of antibiotics has been somewhat equally directed at human and veterinary medicine, but a concerted assault has been mounted against the application of antibiotics in an agricultural setting. This attack has been founded on the assumption that all such usage is unwise since it might serve as a repository for bacterial resistance in zoonotic species (Levy, 1984; Levy, 2001; Witte, 1998). The rising cost associated with the treatment of resistant bacterial strains has prompted many nations to research the impact antibiotics have had within their nation. Such organizations include: the U.S. National Antimicrobial Resistance Monitoring System (NARMS), Denmark’s Danish Integrated Antimicrobial Resistance Monitoring and Research Program (DANMAP), the Canadian Coordinating Committee on Antimicrobial Resistance in Canada, as well as others across the globe. In 1997, the World Health Organization (WHO) recommended the cessation of all antimicrobial agents in agriculture for growth promotion if that agent is also used therapeutically in humans or is known to select for cross-resistance to human antibiotics (World Health Organization, 1998).

Over the past 50 years the discovery of therapeutic and prophylactic qualities of many antibiotics by scientists and health has occurred simultaneously with their advent. Within the U.S. agricultural industry more than 10 million pounds of antibiotics are used per year, accounting for at least half of all antibiotics produced in the country (Lipstitch et al., 2002). During animal production, antibiotics are routinely used at therapeutic levels for treatment of infections and at subtherapeutic levels for prophylaxis and growth.

According to some estimates between 80 and 90 percent of the orally administered antibiotics may pass through the animal with little or no alteration in chemical structure (Levy, 1992; Onan and LaPara, 2003; Thiele-Bruhn, 2003) and are excreted as animal waste. The disposal of animal waste could be a possible reservoir for antibiotic resistant bacteria from animal operations. A majority of animal manures are applied to the agricultural lands surrounding the operation on which they were generated; however, in some cases the amount of manure available for application is greater than the acreage available for land application (United States Environmental Protection Agency, 2004). There is, therefore, an amplified threat of adding non-degradable antibiotic residues and resistant enteric bacteria to soil, possibly leading to the proliferation of resistance in indigenous bacteria populations (Chee-Sanford et al., 2001; De Liguoro et al., 2003; Gavalchin and Katz, 1994; Sengelov et al., 2003; Sorum et al., 2006; United States Environmental Protection Agency, 2002) .

2.2 Antibiotic use by the swine industry

2.2.1 Certified Organic Swine Production

For over a decade, the organic sector has been one of the fasted growing segments of U.S. agriculture. In 1990, when Congress passed the Organic Foods Production Act the

U.S. had under a million acres of certified organic farmland. By the implementation of the national organic standards in 2002, the total number of organic acres had doubled, and this number doubled again between 2002 and 2005 (United States Department of Agriculture National Agricultural Statistics Service, 2010). The organic livestock sector has witnessed even more unprecedented growth, due in part to the implementation of the "certified organic" label. This label required all inputs into organic livestock production to be organic as well which lead to an increased need for organic feedstuffs, and therefore, an increase in organic field acreage.

Farms and processing facilities that grow and process organic foodstuffs must be certified by USDA-accredited certifying agents. Each operation must have a written Organic Farm Plan that must be made available upon request. Organic pork production is based on minimal usage of off-farm inputs. Swine projected for meat markets must be raised organically during the last five weeks of gestation and without the use of growth hormones or antibiotics. It should be noted, however, that the organic industry is does not withhold treatment from sick animals, they must simply remove them from the facility after treatment.

The number of hogs and pigs produced organic operations increased by 58 percent between 2000 and 2005 (Dimitri and Oberholtzer, 2009). According to USDA's National Agricultural Statistics Service (2010) 8,940 hogs and pigs were grown on 258 farms by the end of 2008. Iowa was the number one organic hog growing state with an inventory of 3,413 grown on 19 operations. The organic market for swine in Iowa added $1.59 million dollars to Iowa's economy; Wisconsin had 32 operations with gross sales of $419,528.

2.2.2 Natural Swine Production

The concept of "natural" swine production is one that was born out of the advent of niche markets. Like beef, natural pork products may qualify for USDA process verification, but such programs are administered by the organization or company that has registered the brand name, not by USDA. Naturally-produced hogs and pigs are grown such that they fit into a specific branded program in which the brand owner sets the requirements and is the sole entity responsible for compliance.

In order to use the term "natural" on a product's label, the USDA has three requirements: 1) the product must have undergone minimal processing; 2) no artificial ingredients may be used in processing; and, 3) that the product contains no additives to prolong shelf-life. The U.S. Department of Agriculture does not require specific management practices be followed during the life of a "naturally" grown animal.

2.2.3 Conventional Swine Production

According to the U.S. Department of Agriculture's NASS (2008), approximately 65 million hogs and pigs were produced in the U.S. on 65,650 operations with a total value of over $4.7 billion. Within the state of Iowa, alone, 18.2 million head of swine were produced on 8,500 operations. The swine industry in Iowa was valued at $1.365 million.

Conventional swine production accounts for all other hogs and pigs that are not produced according to USDA's organic standard. In conventional swine production, the use antibiotics, dewormers and parasiticides have been discovered to reduce the feed required per unit of gain as well as overall weight gain of pigs within an operation (Carlson and Fangman, 2000). In 2000, the United States Department of Agriculture's National Animal

Health Monitoring System (NAHMS) reported that during a six month period prior to the Swine 2000 survey that antibiotics were added to the diets of more than 75 percent of swine operations regardless of class; within sites with grower/finisher pigs 88.5 percent of sites fed antibiotics (USDA Animal and Plant Health Inspection Service, 2002). Of the sites surveyed 79 percent reported feed additives on the label, while 21 percent did not. Of the 21 percent utilizing off-label additives, 57 percent included additives at greater than the recommended dosages or were being fed to the incorrect class of pig (Dewey et al., 1997). Dewey et al. (1997) also reported that producers utilizing a veterinary consultant had greater than a two-fold likelihood of using feeds with additives.

2.3 Antibiotic Classifications

Antibiotics, since their discovery, have proven to have tremendous impact on human health and well-being. Antibiotics are antimicrobial compounds that inhibit the growth (bacteriostatic) of microorganisms or kill (bactericidal) the organism outright by targeting function or growth and replication processes. Bactericidal antibiotics are usually characterized by interfering with enzyme synthesis or by targeting the bacterial cell wall or membrane (Figure 1). Bacteriostatic compounds usually disrupt protein synthesis.

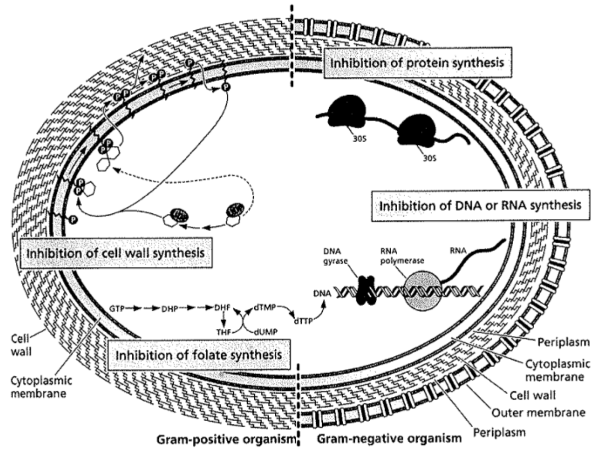

Figure 1. Major targets for antibacterial action. (Adapted from a poster on Mechanisms of Antibiotic Action and Resistance, C. Walsh, J. Trauger, P. Courvalin, and J. Davies (2001), Trends in Microbiology, The Lancet Infectious Disease, Current Opinion in Microbiology, Trends in Molecular Medicine).

Antibiotics are broken into classes based on chemical structure, mode of action, or spectrum of activity. These classifications include: aminoglycosides, β-lactams (carbapenems, cephalosporins, and penicillins); glycopeptides; macrolides; oxazolidinones; quinolones (including fluoroquinolones); sulfonamides; and, tetracyclines (Kummerer, 2009). Most classes of antibiotics, including β-lactams, tetracyclines, aminoglycosides, and macrolides originally derived from natural sources, and then chemically altered into the drugs that are in use today. However, some important classes are synthetically produced, including the sulfonamides, quinolones, and oxazolidinones.

2.3.1 Modes of Action

2.3.1.1 Aminoglycosides

Aminoglycosides are bacteriostatic antibiotics. They inhibit bacteria from synthesizing proteins by binding to the 30S ribosomal subunit. This binding inhibits the translocation of transfer RNA during translation and therefore disrupts the synthesis process needed for growth. Eukaryotic cells have ribosomes which differ in size and structure from prokaryotes; therefore, aminoglycosides do not interfere with human protein synthesis. In gram-negative bacteria the mode of action of aminoglycosides may be somewhat different. These compounds seem to displace cations in the bacterial cell biofilm responsible for linking the lipopolysaccharide molecules creating holes which may lead to cell death prior to the antibiotic’s binding to the ribosomal subunit.

2.3.1.2 β-lactams

Penicillins and cephalosporins, two β-lactam antibiotics, work by interfering with interpeptide linkages of peptidoglycan, a strong, structural molecule found in bacterial cell walls. Without peptidoglycan cross-links intact, cell walls are structurally weak and prone to collapse or lyse when bacteria attempt to divide. Because eukaryotic cells do not have cell walls human cells are not damaged by penicillins.

2.3.1.3 Glycopeptides

Glycopeptides are large, rigid molecules which inhibit a latter step in the synthesis of prokaryotic cell wall peptidoglycan. Because of their structure glycopeptides only bind with peptides of specific configuration and are therefore selectively toxic. This selective binding inhibits the formation of the glycan chains which act as the backbone of the cellular wall subunits as they are extruded through the cytoplasmic membrane. This results in a lack of rigidity in the cell wall. The selective toxicity makes susceptibility to the glycopeptides antibiotics more difficult (Reynolds, 1989).

2.3.1.4 Macrolides

Macrolides bind irreversibly to the 50S ribosomal subunit of bacteria. This bond inhibits translocation of tRNA during translation in much the same way as the aminoglycosides. Macrolides are not toxic to eukaryotic cells because they lack the 50S subunit.

2.3.1.5 Oxazolidinones

Oxazolidinones are a relatively new class of antibiotics, and are the only chemically novel class to be introduced into clinical use since the 1970s (Lipstitch et al., 2002). Oxazolidinones are active against a large spectrum of gram-positive bacteria. They act on bacteria by inhibiting protein synthesis by binding to the P site at the 50S ribosomal subunit. This class of antibiotics has become important in the treatment of methicillin- and vancomycin-resistant nosocomial bacterial infections.(Bozdogan and Appelbaum, 2004).

2.3.1.6 Quinolones

DNA is packaged very differently in eukaryotes and bacteria. Bacteria use DNA gyrase to supercoil DNA while eukaryotes coil their DNA around histone proteins. Quinolone antibiotics inhibit the DNA gyrase enzyme needed for replication of bacterial DNA, thereby making it difficult for bacteria to multiply.

2.3.1.7 Sulfonamides

Dihydropteroate synthetase (DHPS) activity is necessary in folate synthesis, and folate is required for the cellular synthesis of nucleic acids, such as DNA and RNA. Sulfonamides are competitive inhibitors of DHPS in the bacterial metabolic pathway. If these antibiotics are successful, DNA cannot be synthesized and therefore, cell division cannot occur. Because eukaryotic cells do not synthesize folate, sulfa drugs do not cause the same disruption.

2.3.1.8 Tetracyclines

Tetracyclines can inhibit bacteria by acting on both bacteria and their host; however, the latter is less likely because eukaryotic cells lack a tetracycline uptake mechanism and, therefore, concentration of antibiotic necessary for this mode of action to occur is never achieved. Within bacterial cells, tetracyclines inhibit protein synthesis by blocking the codon-anticodon interaction during attachment of the tRNA amino acid to the ribosome.

Twenty-three federally approved products with antimicrobial activity were marketed as feed additives, in 2001 (Feedstuffs, 2001). Of the 23 approved additives, 15 claimed to promote growth. While some approved additives used for promotion of growth and prophylaxis have no cross-over into human medicine, many used for prophylaxis and therapeutic applications are closely related to antibiotics used in human medicine such as: β-lactams, tetracyclines, macrolides, quinolones, and sulphonamides.

Apprehension exists regarding the use of antimicrobial feed additives and their residues in meat products produced from treated animals. For this reason producers are legally required to adhere to a pre-slaughter withdrawal period when feeding particular feed additives. Among regulatory agencies and consumers an even greater concern exists—that regular use of antibiotics as feed additives may result in the development of resistant microorganisms that can compromise the effectiveness of antibiotics used to treat human and animal disease.

2.4 Mechanisms of Resistance

Antibiotic resistance development depends on many factors including, but not limited to, the pharmacokinetics and pharmacodynamics of the specific antibiotics and the source of the bacteria (Lanz et al., 2003). The basic concept of pharmacodynamics is the coupling of the total antibiotic exposure in the serum or other sites, also known as the area under the concentration-time curve (AUC), to the amount of microbiological activity of the drug against the organism (Capitano and Nightingale, 2001; Nicolau, 2003). The minimal inhibitory concentration (MIC) is commonly used as the measure of the microbiological activity, and therefore, the AUC/MIC is the primary pharmacodynamic parameter. It is this parameter that signifies the degree to which the exposure time and serum concentration of the antibiotic exceed the minimum needed to disrupt the microbiological cycles necessary for life. As the AUC/MIC ratio becomes greater so does the possibility of eradication of the microorganism (Nightingale et al., 2001).

In order for antibiotic therapy to be effective in eradication of a pathogen as quickly as possible with minimal adverse effect on the recipient, three basic conditions must exist (Capitano and Nightingale, 2001). First, the antibiotic must recognize and bind to an active target site on the microbe. Such target sites are unique for different antibiotic classes, but the ultimate goal is the same—to disrupt a necessary biochemical reaction in the lifecycle of the organism. Secondly, the concentration of the antibiotic must be sufficient to occupy a significant number of these sites on the microorganism. The final condition that must met is that the antibiotic must occupy the target sites for a critical time period.

2.4.1 Development and Acquisition of Resistance

Microorganisms have developed several mechanisms with which to overcome the deleterious effect of antibiotics, but all involve either modification of existing genetic material or acquisition of new genetic material. Antibiotic resistance which develops in the presence of selective pressure is a microbiological phenomenon (Phillips et al., 2003). Spontaneous mutations within the genome of a microorganism during replication or due to failure in the DNA repair system is known as primary resistance. Such resistance occurs in approximately every 10^{-7} to 10^{-8} bacteria, making it extremely rare. Rarer still is the development of resistance to a specific antibiotic via spontaneous mutations since such resistance is often due to multiple mutations in very specific sites of the genome.

The development of spontaneous mutants is facilitated by the presence of large numbers of ubiquitous bacterial cells, coupled with their short generation times. Within the *Escherichia coli* genome, for example, there are 3000 genes, 0.3 percent (10/3000) of which spontaneously mutate during replication. If a specific mutation confers a selective advantage (e.g. the ability to persist in the presences of an antibiotic) then the resistant bacterium will survive to replicate and pass on that mutation to future generations. Direct passage of resistance genes to the progeny is called vertical gene transfer. The lack of antibiotic in the environment directly impacting the bacteria will result in the concentration of the resistance genes being quite small due; however, if the selective pressure persists, individuals lacking the mutations in the resistance gene(s) will die out and the mutants will thrive and propagate. Even at low concentrations, antibiotics in the environment can provide the selective pressure for resistance to develop.

The occurrence of resistance to multiple antibiotics among many species of bacteria simultaneously led researchers to look for alternative resistance mechanisms. Lateral or horizontal gene transfer (HGT) is a process in which small groups of genetic material within DNA can be transferred between individual bacteria (de la Cruz and Davies, 2006). This occurs via three processes: conjugation, transduction and transformation (Ochman et al., 2000).

Conjugation is occurs when direct cell-to-cell contact between bacteria that are not necessarily closely related, results in the transfer of plasmids, circular molecules of extra chromosomal DNA that carry genetic information, from one cell to the other. This transfer occurs by cell-to-cell contact or through a connecting structure, like a bridge, by conjugal plasmids or conjugal transposons. Due to the presence of an origin of transfer gene and transfer genes, conjugative plasmids are said to be self-transmissible (Cowan and Talaro, 2008). Conjugal transposons can play a role in the transfer of antibiotic resistance, especially in enterococci. The transposons possess the genetic information necessary to facilitate their transfer between cells, from plasmid to plasmid or from chromosome to plasmid via conjugation. Conjugation is thought to be the primary mechanism of transfer of antibiotic resistance genes among bacterial cells (Mazel and Davies, 1999).

Transduction occurs when bacteria-specific viruses or bacteriophages transfer DNA between two closely-related bacteria. The bacteriophage binds to the bacterial cell membrane and then injects and replicates its DNA inside the bacterium. The virus will then either replicate until it lyses the cell or it incorporates the genes it carries into the bacterial genome. If antibiotic resistance genes are incorporated, vertical gene transfer can occur.

During transduction, phages can also incorporate part of the host cell's DNA; therefore, a phage without a resistance gene could obtain it from the host cell.

Transformation occurs when foreign DNA from the environment surrounding a bacterium is incorporated into its genome. The DNA may be present in the environment because of the lysing of bacteria due to phage replication or some other process resulting in cellular death. If the foreign DNA has an origin of replication that is recognized by the host cell's DNA polymerases, the bacteria will replicate the foreign DNA in tandem with their own DNA.

2.4.2 Mechanisms of Antibiotic Resistance

Mechanisms evolved in bacteria which confer them with antibiotic resistance. Such mechanisms can chemically alter the antibiotic or render it inactive via physical transfer through an efflux pump, out of the cell or through the modification of its target site (Figure 2) (Davies, 1994). Plasmids can carry with it genes which can alter existing bacterial enzymes which in turn modify an antibiotic to the point of inactivation, rendering it ineffective against a microorganism. Other plasmid-derived genes can be activated to trigger activation of an antibiotic-degrading enzyme, while others can result in the creation of an efflux pump.

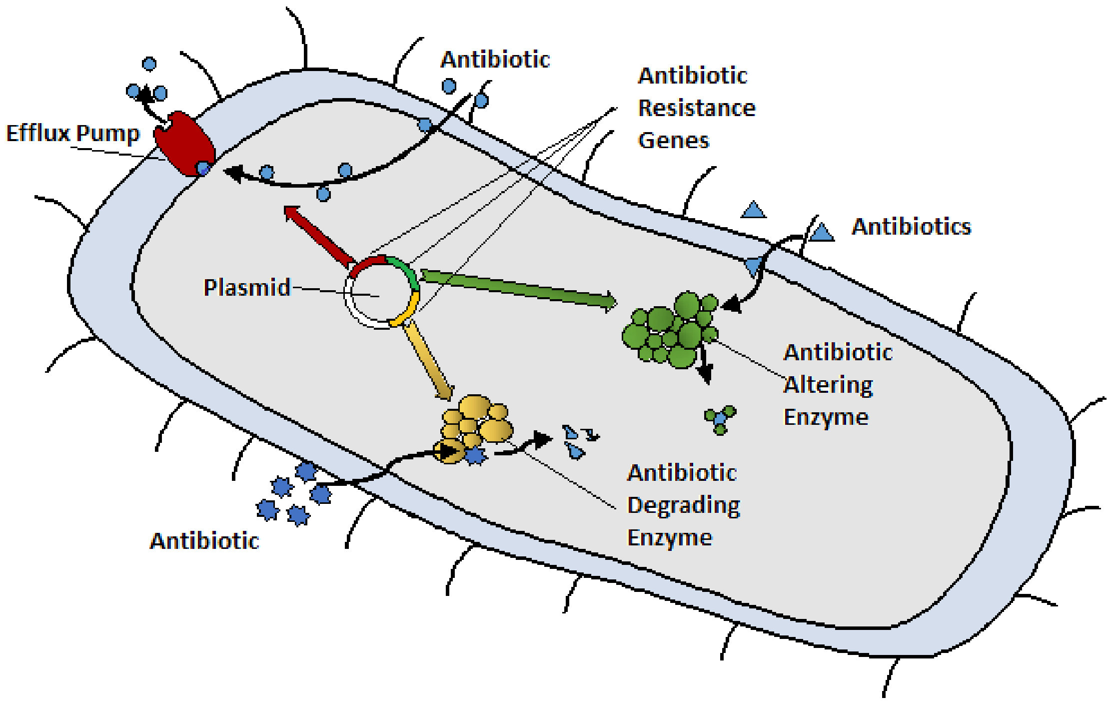

Figure 2. Bacterial antibiotic resistance mechanisms (Adapted from Yim, 2009).

Efflux pumps are transport proteins involved in the removal of antibiotics and other toxic substrates from within cells to the external environment. These proteins are found in both gram-positive and gram-negative bacteria (Van Bambeke et al., 2000). Efflux pumps may be substrate-specific or may effectively transport a range of structurally diverse compounds, including multiple classes of antibiotics. Such pumps can be associated with multiple drug resistance (Webber and Piddock, 2003). It has been estimated that approximately seven percent of all genes in the bacterial genome are involved in transport and that a large number of these encode efflux pumps (Lomovskaya et al., 2001; Saier and Paulsen, 2001).

2.4.3 Transport of Antibiotic Resistant Bacteria in the Environment

In order to affect human health, antibiotic resistant bacteria selected by antibiotic use in humans or animals must be transmitted to man and either transfer their resistance to other disease-causing bacteria or cause disease themselves. For many important human pathogens, clinical usage of antibiotics is sufficient to create a problem. For example, the issues of resistant *Staphylococcus aureus*, penicillin- and macrolide-resistant *Staphylococcus pneumonia*, and macrolide-resistant *Staphylococcus pyogenes* did not arise from the use of antibiotics in animals (King et al., 2002; Perez-Trallero et al., 2001). However, in other cases research has shown that exposure to antibiotics in the gastrointestinal tract of animals may provide adequate selective pressure for resistance to develop, thereby acting as a possible reservoir for the distribution of resistant bacteria to other animals, humans, and into the environment (Andremont, 2003). Within the environment bacteria have exhibited the ability to exchange their genetic information within their species as well with indigenous bacteria present in the soil and water (Amabile-Cuevas and Chicurel, 1992; Salyers et al., 1995; Stewart, 1989).

Studies have shown that almost half of all drinking water wells tested in the U.S. have been positive for fecal indicator organisms (Macler and Merkle, 2000). Common sources of environmental fecal indicator organisms include faulty or inadequately designed septic systems, land-applied biosolids, leaking municipal sewer lines, as well as animal agriculture-related activities such as the use of manures as fertilizers, runoff from confined animal feeding operations, faulty storage lagoons for manure, and the pasture-feeding of livestock (Gerba and Smith, 2005; Jensen et al., 2001; Macler and Merkle, 2000).

Animal waste handling and treatment practices as well as land application of human and animal waste is common practice, making contamination of ground and surface waters, soils, and crops with antibiotics and antibiotic resistant bacteria a plausible concern (Jindal et al., 2006). Because of the expense associated with testing for specific pathogenic organisms, most testing agencies responsible for water quality monitoring test for the presence of indicator organisms such as total coliforms, fecal coliforms, *E. coli*, or enterococci (Leclerc and Mosel, 2001; Lucena et al., 2006). The presence of these organisms indicates that the water may be contaminated with fecal matter, and therefore, pose a risk to human health.

Antibiotic resistant bacteria have been found in association with cattle, poultry and swine operations, as well as in the gut of wild birds and feral animals (Dolejska et al., 2008; Jay et al., 2007; Koike et al., 2007; Mawdsley et al., 1995; Sharma et al., 2009). Research conducted by Sapkota et al., (2007) compared water sources up-gradient and down-gradient from a concentrated swine feeding operation and found elevated levels of fecal indicators and antibiotic-resistant enterococci in the down-gradient sources. Their findings provided additional evidence that water sources contaminated with swine manure could be a factor in the spread of antibiotic resistance. Other studies have documented similar results from swine and other confined animal operations (Chee-Sanford et al., 2001; Parveen et al., 2006; Sayah et al., 2005). Kobashi et al. (2005) reported that the presence of antibiotic resistance in feces is directly related to the presence of antibiotics in feedstuffs fed in animal operations, and Storteboom et al. (2007) stated that feeding antibiotics led to greater levels of antibiotic resistance genes in manure than did the therapeutic usage of antibiotics.

Once genetically modified microorganisms are introduced into the environment they can be dispersed by rain, percolation or runoff and can then be subject to selective pressure from antibiotics within the soil or those produced by microbes present in the soil. Infiltration of water through land-applied manure is chief mode of pathogen transport to soils and groundwater (Chee-Sanford et al., 2009). Laboratory studies have been conducted to simulate bacterial transport through soil (Abu-Ashour et al., 1994; Jiang et al., 2007; Pote et al., 2003). Studies have found that the properties of soil including, presence of macropores, the amount of organic matter, and soil type, texture and size affect the movement of bacteria in soil (Gagliardi and Karns, 2000; Guber et al., 2005; Guber et al., 2007) . Also notable is the fact that the length of time bacteria can persist in the soil varies with temperature, moisture, pH and the species of native bacteria present. Boes et al. (2005) reported that *E. coli* from swine slurry can survive in a clay soil for 21 days, while others have reported persistence ranges of O157:H7 as: 84 to 300 days in water, 2 to 300 days in soil, approximately 100 days in slurry, and one day on dry surfaces (Cieslak et al., 1993; Tauxe, 1997; Wang and Doyle, 1998; Zhao et al., 1995).

It has been reported that over 76 million people contract foodborne illnesses in the U.S. (Mead et al., 1999) at an approximated cost of $6.9 billion annually (Allos et al., 2004), and that other industrialized countries are battling the same issues (Flint et al., 2005). Recently, there has been heightened concern regarding the presence of antibiotic-resistant bacteria in food-producing domestic animals (Guerra et al., 2003) which might be available then to spread to humans through the food-to-fork chain thereby, creating the potential for a human-health concern (Johnson et al., 2007). It should be noted, however, that research on the reduction of transmission of all foodborne pathogens, regardless of whether they are antibiotic resistant or not, by good hygiene practices on farms, in abattoirs, during every part of the marketing chain, in preparation of foods, and by the consumer should be a priority. Reduction in the incidences of such outbreaks would equate to a reduced potential for an resistance in animals to cause any human health concerns (Havelaar et al., 2010).

2.5 Bacterial Attachment and Implications for Transport

2.5.1 Factors Impacting Attachment to Particles

Bacterial cells have fimbriae and pili on their surface, which are structurally similar to flagella, but are not utilized for motility. Fimbriae are composed pilin, a self-assembling protein subunit. Pilin appears to enable bacteria to attach to surfaces or to form pellicles on surfaces of liquids. Fimbriae are shorter and more numerous than flagella and pili are generally longer and less numerous than fimbriae. Pilli are utilized in the reproductive cycle of bacteria, they serve as specific receptors for some viruses, and have a role in cellular attachment to surfaces.

The glycocalyx is a carbohydrate-enriched coating found outside the outer membrane of gram-negative bacteria or the peptidoglycan of gram-positive cells. In bacteria the presence of the glycocalyx is associated with their ability to infect (2006). The glycocalyx has two primary functions: evasion and promotion of adhesion. During evasion the glycocalyx can increase the surface diameter of the bacteria and effectively hides the components of the cell that would be detected by the immune response. The glycocalyx promotes the adhesion of bacterial cells to inert and living surfaces and thereby aids in biofilm formation (Brown and Gauthier, 1983; Sakai, 1980). Biofilms are used by bacteria for increased persistence in low nutrient environments, for evasion of antibiotic activity, for quorum sensing, and for horizontal gene transfer. Cellular glycocalyx can vary from bacteria to bacteria and in response to growth conditions and availability of nutrients.

Microbial transport is dependent on the retention of the bacteria through filtration and binding of bacteria to the surfaces of particles in a porous medium. If attachment or adsorption is sufficient, bacteria are held within the medium. The interactions between bacteria and solid surfaces can involve numerous complex processes. Guber et al. (2005) conducted an experiment testing the effect of manure on bacterial attachment. They found that soil without manure resulted in greater levels of *E. coli* attachment, and that, in general, increasing manure content decreased attachment (Guber et al., 2007). The decreased attachment was attributed to an increase in pH and ionic strength; however, Guber et al. also noted that the effect could be due to modification of the soil surface by the organic and inorganic components of manure, the attachment of bacteria to the manure particles, competition with indigenous bacteria for attachment sites, or by the effect of organic matter on the bacterial cell surface components (Daniels, 1972; Unc and Goss, 2004).

2.5.2 Implications of Particle-Mediated Transport

Studies have shown that preferential attachment to particulate matter (Auer and Niehaus, 1993; Fries et al., 2006; Ling et al., 2002) may increase the survival time of bacteria (Burton et al., 1987; Gerba and McLeod, 1976) and can therefore be factors effecting survival and transport of bacteria in the environment (Pommepuy et al., 1992). Henis et al. (1989) and others have noted that bacteria associated to particles may be subject to natural forces, such as settling, and may thrive within stream bottom sediment. Bai and Lung (2005) found that the concentrations of fecal bacteria were between 10 to 10,000 higher than concentrations in the overlying water column. During high flow events total suspended solids concentrations can increase due to mixing of the bottom sediments, and thus bottom sediments could be an important latent bacterial reservoir (McDonald et al., 1982; Muirhead et al., 2004; Nagels et al., 2002; Sherer et al., 1992). In the absence of new sources contamination, the resuspension of bottom sediments could possibly lead to elevated concentrations of *E. coli* (Davis et al., 1995; Stephenson and Rychert, 1982; Whitman and Nevers, 2003), and therefore, elevated human health concerns. Even more alarming is the possibility that antibiotic resistant bacteria could attach and persist or thrive within the environment only to become a potential source of contamination over a long period of time.

2.5.3 Previous examination of Attachment and Resistance

Research has shown that biofilm formation is an important factor in the survival and replication of bacteria in certain environments, and that vertical gene transfer is facilitated in biofilms, in part due to proximity of cells (Hannan et al., 2010). Within the human body, biofilms are important factors in development of human diseases. A few examples of diseases that are directly a product of biofilms include: colitis, vaginitis, urethritis, conjunctivitis and otitis (Davies, 2003). In dentistry, gingivitis is evidence of the presence of biofilms. Biofilms also colonize medical equipment such as venous, urinary, and arterial catheters, and have been found on shunts as well (Passerini et al., 1992; Pople et al., 1992). Much of the literature from the medical community has focused on control of biofilm formation and disinfection.

Adhesion to surfaces, *in vivo*, has also been shown to lead to bacterial persistence in animal experiments. Hagberg and colleagues (1983) showed that the presence of certain genes (*pap* and *pil*) conferred adhesion to different surfaces, but could have implications in the persistence of uropathogenic *E. coli* in humans. A study conducted in 2000 (Wullt et al.) supported the study by Hagberg et al. (1983), by showing that expression of P fimbriae, and the resulting increased urinary tract infection rate, was directly related to a *pap*-negative phenotype, when compared to a *pap*-positive phenotype.

Increased antibiotic resistance is a general trait associated with biofilm-embedded bacteria. It has been shown that biofilm-associated bacterial cells are 10 to 1,000 times less susceptible to some antimicrobial agents than the same cells in a planktonic state. Luppens et al., (2002) reported that when compared to planktonic cells of the same species, a 600-fold increase in concentration of sodium hypochlorite (considered to be one the most effective antibacterial agents) was required to kill *Staphylococcus aureus* cells in a biofilm. Several factors of biofilms could potentially lead to increased resistance including decreased metabolic and growth rates of biofilm bacterial cells, location of cells within the biofilm, and the extracellular polymeric substance matrix of biofilms could decrease the interaction of the antimicrobial with cells by repelling or adsorbing the agent (Donlan and Costerton, 2002). It has been shown that biofilm-associated bacteria are physiologically, and genetically different from planktonic cells, and may express protective factors, such as stress-response regulons and multiple efflux pumps (Brown et al., 1988; Gilbert et al., 2002; Mah and O'Toole, 2001; Stewart, 2002). However, it should be noted that the resistance of biofilms to antimicrobial treatments is dependent on the microorganism and the agent being utilized.

In a study by Olson et al., (2002) susceptibility of planktonic and biofilm bacteria were compared. The researchers found that ampicillin, ceftiofur, cloxacillin, oxytetracycline, penicillin G, streptomycin, tetracycline, enrofloxacin, erythromycin, gentamicin, tilmicosin and trimethoprim-sulphadoxine of were effective in controlling *Actinomyces pyogenes, Corynebacterium renale, Corynebacterium pseudotuberculosis, Staphylococcus aureus, S. hyicus* and *Streptococcus agaloctiae*. Biofilms of these bacteria showed resistance to the same antibiotics. Other biofilm bacteria, including *Salmonella* sp. and *Pseudomonas aeruginosa,* tested in this study showed similar susceptibility as their planktonic counterparts. *Pseudomonas aeruginosa*, an opportunistic pathogen that causes lung infections in cystic fibrosis patients, was shown to have increased resistance to the antibiotic tobramycin by forming a biofilm on a surface in the presence of mucin than a clean glass surface (Landry et al., 2006), which supports the hypothesis that bacteria can alter their phenotype and genotype in response to their environment.

Studies including clinical isolates have reported a relationship exists between the presence of some attachment factors and antibiotic resistance. Ampicillin resistant bacteria have been shown to persist in the human intestinal tract as well as susceptible bacteria (Karami et al., 2008). Arisoy et al., (2008) stated that a-fimbrial adhesion, s-fimbriae, and p-pili are related to tobramycin resistance in clinical strains. Given the genetic association of genes that encode for attachment and antibiotic resistance (Nowrouzian et al., 2001), it is not unexpected that such a relationship exists.

Within the natural environment bacteria have been shown to attach plants, soil, and to rocks, via biofilms, submerged in water. Few studies have been performed detailing the relationship between adhesion and antibiotic resistance or adhesion and virulence. One exception is literature related to the pathogenesis of *Agrobacterium tumefaciens*. *A. tumefaciens* is the causal agent for crown gall formation, and pathogenesis involves the transfer of a segment of DNA from the bacterial plasmid to the plant host cell; therefore, bacterial attachment is necessary for virulence. Research has shown that a large number of genes are necessary for plant host-cell attachment, and in the case of *A. tumefaciens*, may be directly related to the ability of the pathogen to survive and thrive (Matthysse et al., 2000).

In the soil environment, bacteria have been shown to preferentially attach to certain soil particles, differentiated by type and size. A study performed by Jeng et al., (2005) looked at *E. coli* attachment to sediments in stormwater. They found that attachment to the silt fraction, clay fraction, and sand fraction were 80%, 18%, and 2%, respectively. Additional research has also indicated that as the size of the particles decreases that attachment increases (Fontes et al., 1991; Guber et al., 2007; Oliver et al., 2007; Pachepsky et al., 2008). Smyth et al. (1978) and Boerlin et al. (2005) stated that differences in the propensity for attachment might exist between pathogenic and non-pathogenic strains of *E. coli*, and the same has proven true in human medicine (see above). A study performed by Gallagher et al (2013) reported no patterns in sorption of *E. coli*, from different sources, related to antibiotic exposure, but that sorption by different strains is highly variable and may be related to environmental conditions. Despite the research that exists related to the mechanisms that reports that bacteria possess genes that code for attachment mechanisms such as pili, fimbriae, and other surface attachment-related proteins, currently there is no research that explains the basis for bacterial attachment to environmental particles, including quartz.

Lu et al. (2010) evaluated 203 *E. coli* porcine isolates and found that attachment to quartz was related to the presence of Type I attachment factor as well as to resistance to streptomycin, chlortetracycline, tetracycline, and tylosin. Attachment factors Type I, p-pili, and Ag43 were associated with resistance to neomycin and amoxicillin. The authors hypothesized that this relationship was present due to encoding of resistance and virulence genes on a single mobile genetic element.

2.6 Summary

Although literature exists that reports preferential attachment to certain surfaces by bacteria, and that relationships exists between attachment and antibiotic resistance in clinical isolates, this relationship has only been reported once in agricultural isolates. In order to make accurate recommendations to producers regarding the utilization of antibiotics as feed additives, and application rates and timing of manure the relationships between attachment, resistance, and virulence must be studied in more depth.

2.7 Literature Cited

2006. Glycocalyx [Online]. Available by Gale Cengage <http://www.enotes.com/microbiology-encyclopedia/glycocalyx> (verified 15 September).

Abu-Ashour, J., D.M. Joy, H. Lee, H.R. Whiteley, and S. Zelin. 1994. Transport of microorganims through soil. Water, Air and Soil Pollution 75:141-158.

Allos, B.M., M.R. Moore, P.M. Griffin, and R.V. Tauxe. 2004. Surveillance for Sporadic Foodborne Disease in the 21st Century: The FoodNet Perspective. Clinical Infectious Diseases 38:S115-S120.

Amabile-Cuevas, C.F., and M.E. Chicurel. 1992. Bacterial plasmids and gene flux. Cell 70:189-199.

Andremont, A. 2003. Commensal flora may play key role in spreading antibiotic resistance. ASM News 69:601-607.

Arisoy, M., A.Y. Rad, A. Akin, and N. Akar. 2008. Relationship between susceptibility to antimicrobials and virulence factors in paediatric *Escherichia coli* isolates. International Journal of Antimicrobial Agents 318:S4-S8.

Arnold, S., B. Gassner, T. Giger, and R. Zwahlen. 2004. Banning antimicrobial growth promoters in feedstuffs does not result in increased therapeutic use of antibiotics in medicated feed in pig farming. Pharmacoepidemiol Drug Safety 13.

Auer, M.T., and S.L. Niehaus. 1993. Modeling fecal coliform bacteria. 1. Field and laboratory determination of loss kinetics. Water Research 27:693-701.

Bai, S., and W.S. Lung. 2005. Modeling sediment impact on the transport of fecal bacteria. Water Research 39:5232-5240.

Boerlin, P., R. Travis, C.L. Gyles, R. Reid-Smith, N. Janecko, H. Lim, V. Nicholson, S.A. McEwen, R. Friendship, and M. Archambault. 2005. Antimicrobial resistance and virulence genes of *Escherichia coli* isolates from swine in Ontario. Applied and Environmental Microbiology 71:6753-6761.

Boes, J., L. Alban, J. Bagger, V. Mongelmose, D.L. Baggsen, and J.E. Olsen. 2005. Survival of *Escherichia coli* and *Salmonella typhimurium* in slurry applied to clay soil on a Danish swine farm. Preventative Veterinary Medicine 69:213-228.

Bozdogan, B., and P.C. Appelbaum. 2004. Oxazolidinones: activity, mode of action, and mechanisms of resistance. Journal of Antimicrobial Agents 23:113-119.

Brown, M.L., and J.J. Gauthier. 1983. Cell density and growth phase as factors in the resistance of biofilms of *Pseudomonas aeruginosa* (ATCC 27853) to Iodine. Applied and Environmental Microbiology 59:2320-2322.

Brown, M.R., D.G. Allison, and P. Gilbert. 1988. Resistance of bacterial biofilms to antibiotics: a growth-rate related effect? Journal of Antimicrobial Chemotherapy 22:777-783.

Burton, J., G.A., D. Gunnison, and G.R. Lanza. 1987. Survival of pathogenic bacteria in various freshwater sediments. Applied and Environmental Microbiology 53:633-638.

Campagnolo, E.R., K.R. Johnson, A. Karpati, C.S. Rubin, D.W. Kolpin, M.T. Meyer, J.E. Esteban, R.W. Currier, K. Smith, K.M. Thu, and M. McGeehin. 2002. Antimicrobial residues in animal waste and water resources proximal to large-scale swine and poultry feeding operations. Science of the Total Environment 299:89-95.

Capitano, B., and C.H. Nightingale. 2001. Optimizing antimicrobial therapy through use of pharmacokinetic/pharmacodynamic principles. Mediguide to Infectious Diseases 21:1-8.

Carlson, M.S., and T.J. Fangman. 2000. Swine Antibiotics and Feed Additives: Food Safety and Considerations. MU Guide. MU Extension, University of Missouri-Columbia:1-6.

Chee-Sanford, J.C., R.I. Aminov, I.J. Krapack, N. Garrigues-Jeanjean, and R.I. Mackie. 2001. Occurrence and diversity of tetracycline resistance genes in lagoons and ground-water underlying two swine production facilities. Applied Environmental Microbiology 67:1494-1502.

Chee-Sanford, J.C., R.I. Mackie, S. Koike, I.G. Krapac, Y.F. Lin, A.C. Yannarell, S. Maxwell, and R.I. Aminov. 2009. Fate and transport of antibiotic residues and antibiotic resistance genes following land application of manure waste. Journal of Environmental Quality 38:1086-1108.

Cieslak, P.R., T.J. Barrett, P.M. Griffin, K.F. Gensheimer, G. Beckett, J. Buffington, and M.G. Smith. 1993. *Escherichia coli* O157:H7 infection from a manured garden. Lancet Infectious Diseases 342:367.

Cowan, M.K., and K.P. Talaro. 2008. Microbiology: A Systems Approach McGraw-Hill.

Daniels, S.L. 1972. The adsorption of microorganisms onto solid surfaces, a review. Developments in Industrial Microbiology 13:211-253.

Davies, D. 2003. Understanding biofilm resistance to antibacterial agents. Nature Reviews 2:114-122.

Davies, L. 1994. Inactivation of Antibiotics and the Dissemination of Resistance Genes. Science 264:375-382.

Davis, C.M., J.A. Long, M. Donald, and N.J. Ashbolit. 1995. Survival of fecal microorganisms in marine and freshwater sediment. Applied and Environmental Microbiology 61:1888-1896.

de la Cruz, F., and J. Davies. 2006. Horizontal gene transfer and the origin of species: lessons from bacteria. Trends in Microbiology 8:128-133.

De Liguoro, M., V. Cibin, F. Capolongo, B. Halling-Sorensen, and C. Montesissa. 2003. Use of oxytetracycline and tylosin in intensive calf farming: evaluation of transfer to manure and soil. Chemosphere 52:203-212.

Dewey, C.E., B.D. Cox, B.E. Straw, E.J. Bush, and H.S. Hurd. 1997. Associations between off-label feed additives and farm size, veterinary consultant use, and animal age. Preventative Veterinary Medicine 31:133-146.

Dimitri, C., and L. Oberholtzer. 2009. Marketing U.S. Organic Foods: Recent Trends From Farmers to Consumers. United States Department of Agriculture Economic Research Service.

Dolejska, M., D. Senk, A. Cizek, J. Rybarikova, O. Sychra, and I. Literak. 2008. Antimicrobial resistant *Escherichia coli* isolates in cattle and house sparrows on two Czech dairy farms. Veterinary Science 85:491-494.

Donlan, R.M., and J.W. Costerton. 2002. Biofilms: survival mechanisms of clinically relevant microorganisms. Clinical Microbiology Review 15:167-193.

Feedstuffs. 2001. Feed Additive Compendium, Miller Publishing Co., Minnetonka, MN.

Ferber, D. 2003. Antibiotic resistance - WHO advises kicking the livestock antibiotic habit. Science 301:1027.

Flint, J.A., Y.T. Van Duynhoven, F.J. Angulo, S.M. DeLong, P. Braun, M. Kirk, E. Scallan, M. Fitzgerald, G.K. Adak, P. Sockett, A. Ellis, G. Hall, N. Gargouri, H. Walke, and P. Braam. 2005. Estimating the burden of acute gastroenteritis, foodborne disease, and pathogens commonly transmitted by food, and international review. Clinical Infectious Diseases 41:698-704.

Fontes, D.E., A.L. Mills, G.M. Hornberger, and J.S. Herman. 1991. Physical and chemical factors influencing transport of microorganisms through porous media. Applied and Environmental Microbiology 57:2473-2481.

Fries, J.S., G.W. Characklis, and R.T. Noble. 2006. Attachment of fecal indicator bacteria to particles in the Neuse River Estuary, NC. Journal of Environmental Engineering-ASCE 132:1338-1345.

Gagliardi, J.V., and J.S. Karns. 2000. Leaching of *Escherichia coli* O157:H7 in diverse soils under various agricultural management practices. Applied and Environmental Microbiology 66.

Gavalchin, J., and S.E. Katz. 1994. The persistence of fecal-borne antibiotics in soil. Journal of AOAC International 77:481-485.

Gerba, C.P., and J.S. McLeod. 1976. Effect of sediments on the survival of *Escherichia coli* in marine waters. Applied and Environmental Microbiology 32:114-120.

Gerba, C.P., and J. Smith. 2005. Sources of pathogenic microorganisms and their fate during land application of wastes. Journal of Environmental Quality 34:42-48.

Gilbert, P., T. Maira-Litran, A.J. McBain, A.H. Richard, and F.W. White. 2002. The physiology ad collective recalcitrance of microbial biofilm communities. Advances in Microbial Physiology 46:202-256.

Guber, A.K., D.R. Shelton, and Y.A. Pachepsky. 2005. Effect of manure on *Escherichia coli* attachment to soil. Journal of Environmental Quality 34:2086-2090.

Guber, A.K., Y.A. Pachepsky, D.R. Shelton, and O. Yu. 2007. Effect of Bovine Manure on Fecal Coliform Attachment to Soil and Soil Particles of Different Sizes. Applied and Environmental Microbiology 73:3363-3370.

Guerra, B., E. Junker, A. Schroeter, B. Malorny, S. Lehmann, and R. Helmuth. 2003. Phenotypic and genotypic characterization of antimicrobial resistance in German *Escherichia coli* isolates from cattle, swine and poultry. Journal of Antimicrobial Chemotherapy 52:489-492.

Hagberg, L., R. Hull, S. Hull, S. Falkow, R. Freter, and C. Svanborg Eden. 1983. Contribution of adhesion to bacterial persistence in the mouse urinary tract. Infection and Immunity 40:265-272.

Hannan, S., D. Ready, A.S. Jasni, M. Rogers, J. Pratten, and A.P. Roberts. 2010. Transfer of antibiotic resistance by transformation with eDNA within oral biofilms. FEMS Immunology and Medical Microbiology 59:345-349.

Havelaar, A.H., S. Brul, A. de Jong, R. de Jonge, M.H. Zwietering, and B.H. ter Kuile. 2010. Future Challenges to Microbial Food Safety. International Journal of Food Microbiology 139:S79-S94.

Henis, Y., K.R. Gurijala, and M. Alexander. 1989. Factors involved in multiplication and survival of *Escherichia coli* in lake water. Microbial Ecology 17:171-180.

Holmberg, S.D., S.L. Solomon, and P.A. Blake. 1987. Health and economic impacts of antimicrobial resistance. Review of Infectious Diseases 9:1065-1078.

Jay, M.T., M. Cooley, D. DCarychao, G.W. Wiscomb, R.A. Sweitzer, L. Crawford-Milsza, J.A. Farrar, D.K. Lau, J. O'Connell, A. Millinton, R.V. Asmundson, E.R. Atwill, and R.E. Mandrell. 2007. *Escherichia coli* O157:H7 in Feral Swine near Spinach Fields and Cattle, Central California cost. Emerging Infectious Diseases 13:1909-1911.

Jeng, H.C., A.J.H. England, and H.B. Bradford. 2005. Indicator organisms associated with stormwater suspended particles and estuarine sediment. Journal of Environmental Science and Health 40:779-791.

Jensen, L.B., S.B. Baloda, M. Boye, and F.M. Aarestrup. 2001. Antimicrobial resistance among *Pseudomonas* ssp. and the *Bacillus cereus* group isolated from Danish agricultural soil. Environmental International 26:581-587.

Jiang, G., M.J. Noonan, G.D. Buchan, and N. Smith. 2007. Transport of *Escherichia coli* through variably saturated sand columns and modeling approaches. Journal of Contaminated Hydrology 93:2-20.

Jindal, A., S. Kocherginskaya, A. Mehboob, M. Robert, R.I. Mackie, L. Raskin, and J.L. Zilles. 2006. Antimicrobial Use and Resistance in Swine Waste Treatment Systems. Applied Environmental Microbiology 72:7813-7820.

Johnson, J.R., M.R. Sannes, C. Croy, B. Johnston, C. Clabots, M.A. Kuskowski, J. Bender, K.E. Smith, P.L. Winokur, and E.A. Belongia. 2007. Antimicrobial drug-resistant *Escherichia coli* from humans and poultry products, Minnesota and Wisconsin, 2002-2004. Emerging Infectious Diseases 13:838-846.

Karami, N., C. Hannoun, I. Adlerberth, and A.E. Wold. 2008. Colonization dynamics of ampicillin-resistant *Escherichia coli* in the infantile colonic microbiota. Journal of Antimicrobial Chemotherapy 62:703-708.

King, A., T. Bathgate, and I. Phillips. 2002. Erythromycin susceptibility of viridans streptococci from the normal throat flora of patients treated with azithromycin or clarithromycin. Clinical Microbiology and Infection 8:85-92.

Kobashi, Y., A. Hasebe, and M. Nishio. 2005. Antibiotic-resistant bacteria from feces of livestock, farmyard manure, and farmland in Japan-case report. Microbes and Environments 20:53-60.

Koike, S., I.G. Krapac, H.D. Oliver, A.C. Yannarell, J.C. Chee-Sanford, R.I. Aminov, and R.I. Mackie. 2007. Monitoring and source tracking of tetracycline resistance genes in lagoons and groundwater adjacent to swine production facilities over a 3-year period. Applied Environmental Microbiology 73:4813-4823.

Kummerer, K. 2009. Antibiotics in the aquatic environment - A review - Part I. Chemosphere 75:417-434.

Landry, R.M., D. An, J.T. Hupp, P.K. Singh, and M.R. Parsek. 2006. Mucin-*Pseudomonas aeruginosa* interactions promote biofilm formation and antibiotic resistance. Molecular Microbiology 59:142-151.

Lanz, R., P. Kuhnert, and P. Boerlin. 2003. Antimicrobial resistance and resistance gene determinants in clinical *Escherichia coli* from different animal species in Switzerland. Veterinary Microbiology 91:73-84.

Leclerc, H., and D.A.A. Mosel. 2001. Advances in bacteriology of the coliform group: Their suitability as markers of microbial water safety. Annual Review of Microbiology 55:201-234.

Levy, S.B. 1984. Playing antibiotic pool: time to tally the score. New England Journal of Medicine 311:663-665.

Levy, S.B. 1992. The antibiotic paradox: How miracle drugs are destroying the miracle Plenum Publishing, New York.

Levy, S.B. 2001. Antibiotic resistance: consequences of inaction. Clinical Infectious Diseases 33:S124-S129.

Levy, S.B. 2002. The Antibiotic Paradox: How Misuse of Antibiotics Destroys their Curative Powers. Second ed. Perseus, Cambridge, MA.

Levy, S.B., and B. Marshall. 2004. Antibacterial resistance worldwide: causes, challenges and responses. Nature Medicine 10:S122-S129.

Ling, T.Y., E.C. Achberger, C.M. Drapcho, and R.L. Bengtson. 2002. Quantifying adsorption of an indicator bacteria in a soil-water system. Transactions of the American Society of Agricultural Engineers 45:669-674.

Lipstitch, M., R.S. Singer, and B.R. Levin. 2002. Antibiotics in agriculture: When is it time to close the barn door? Proceedings of the National Academy of Sciences 99:5752-5754.

Livermore, D.M. 2003. Bacterial resistance: origins, epidemiology, and impact. Clinical Infectious Diseases 36:S11-S23.

Lomovskaya, O., M.S. Warren, A. Lee, J. Galazzo, R. Fronko, M. Lee, J. Blais, D. Cho, S. Chamberland, R. Renau, R. Leger, S. Hecker, W. Watkins, K. Hoshino, H. Ishida, and V.J. Lee. 2001. Identification and Characterization of Inhibitors of Multidrug Resistance Efflux Pumps in *Pseudomonas aeruginosa*: Novel Agents for Combination Therapy. Antimicrobial Agents and Chemotherapy 45:105-116.

Lu, P., M.L. Soupir, M. Zwonitzer, B. Huss, and L.R. Jarboe. 2010. Antibiotic resistance in agricultural *E. coli* isolates is associated with attachment to quartz. (submitted).

Lucena, F., R. Ribas, A.E. Duran, S. Skraber, C. Gantzer, C. Campos, A. Moron, E. Calderon, and J. Jofre. 2006. Occurrence of bacterial indicators and bacteriophages infecting enteric bacteria in groundwater in different geographical areas. Journal of Applied Microbiology 101:96-102.

Luppens, S.B., M.W. Reji, R.W. van der Heijden, F.M. Rombouts, and T. Abee. 2002. Development of a standard test to assess the resistance of *Staphylococcus aureus* biofilm cells to disinfectants. Applied and Environmental Microbiology 68:4194-4200.

Macler, B., and J.C. Merkle. 2000. Current knowledge on groundwater pathogens and their control. Hydrogeology Journal 8:29-40.

Mah, T.F., and G.A. O'Toole. 2001. Mechanisms of biofilm resistance to antimicrobial agents. Trends in Microbiology 9:34-39.

Matthysse, A.G., H. Yarnall, S.B. Boles, and S. McMahan. 2000. A region of the *Agrobacterium tumefaciens* chromosome containing genes required for virulence and attachment to host cells. Biochimica et Biophysica Acta 1490:208-212.

Mawdsley, J.L., R.D. Bardgett, R.J. Merry, B.F. Pain, and M.K. Theodorou. 1995. Pathogens in livestock waste, their potential for movement through soil and environmental pollution. Applied Soil Ecology 2:1-15.

Mazel, D., and J. Davies. 1999. Antibiotic resistance in microbes. Cellular Molecular Life Science 56:742-754.

McDonald, A., T. Kay, and A. Jenkins. 1982. Generation of faecal and total coliform surges by stream flow manipulation in the absence of normal hydrometeorological stimuli. Applied and Environmental Microbiology 44:295-300.

Mead, P.S., L. Slutsker, V. Dietz, L.F. McCaig, J.S. Bresee, C. Shapiro, P.M. Griffin, and R.V. Tauxe. 1999. Food-Related Illness and Death in the United States. Emerging Infectious Diseases 5:840-841.

Muirhead, R.W., R.J. Davies-Colley, A.M. Donnison, and J.S. Nagels. 2004. Faecal bacteria yields in artificial flood events: quantifying in-stream stores. Water Research 38:1215-1224.

Nagels, J.S., R.J. Davies-Colley, A.M. Donnison, and R.W. Muirhead. 2002. Faecal contamination over flood evens in a pastoral agricultural stream in New Zealand. Water Science and Technology 45:45-52.

Nicolau, D.P. 2003. Optimizing outcomes with antimicrobial therapy through pharmacodynamic profiling. Journal of Infection and Chemotherapy 9:292-296.

Nightingale, C.H., T. Murakawa, and P.G. Ambrose, (eds.) 2001. Antimicrobial Pharmacodynamics in theory and Clinical Practice. Marcel Dekker, Inc., New York, NY.

Nowrouzian, F., I. Adlerberth, and A.E. Wold. 2001. P fimbriae, capsule and aerobactin characterize colonic resident *Escherichia coli*. Epidemiology and Infection 126:11-18.

Ochman, H., J.G. Lawrence, and E.A. Groisman. 2000. Lateral gene transfer and the natural of bacterial innovation. Nature 405:299-304.

Oliver, D.M., C.D. Clegg, A.L. Heathwaite, and P.M. Haygarth. 2007. Preferential attachment of *Escherichia coli* to different particle size fractions of an agricultural grassland soil. Water, Air, and Soil Pollution 185:369-375.

Olson, M.E., H. Ceri, D.W. Morck, A.G. Buret, and R.R. Read. 2002. Biofilm bacteria: formation and comparative susceptibility to antibiotics. Canadian Journal of Veterinary Research 66:86-92.

Onan, L.J., and T.M. LaPara. 2003. Tylosin-resistant bacteria cultivated from agricultural soil. FEMS Microbiology Letters 220:15-20.

Pachepsky, Y.A., O. Yu, J.S. Karns, D.R. Shelton, A.K. Guber, and v. Kessel. 2008. Strain-dependent variations in attachment of *E. coli* to soil particles of different sizes. Institute of Agrophysics 22:61-66.

Parveen, S., J. Lukasik, T.M. Scott, M.L. Tamplin, K.M. Portier, S. Sheperd, K. Braun, and S.R. Farrah. 2006. Geographical variation in antibiotic resistance profiles of *Escherichia coli* isolated from swine, poultry, beef and dairy cattle farm water retention ponds in Florida. Journal of Applied Microbiology 100:50-57.

Passerini, L., K. Lam, J.W. Costerton, and E.G. King. 1992. Biofilms on indwelling vascular catheters. Critical Care Medicine 20:665-673.

Perez-Trallero, E., D. Vicente, M. Montes, J.M. Marimon, and L. Pineiro. 2001. High Proportion of Pharyngeal Carriers of Commensal Streptococci Resistant to Erythromycin in Spanish Adults. Journal of Antimicrobial Chemotherapy 48:225-229.

Phelps, C.E. 1989. Bug/drug resistance. Sometimes less is more. Medical Care 27:194-203.

Phillips, I., M. Casewell, T. Cox, B. De Groot, C. Friis, R. Jones, C. Nightingale, R. Preston, and J. Waddell. 2003. Does the use of antibiotics in food animals pose a risk to human health? A critical review of published data. Journal of Antimicrobial Chemotherapy 53:28-52.

Pommepuy, M., J.F. Guillaud, E. Dupray, A. Derrien, F. LeGuyadoer, and M. Crormier. 1992. Enteric bacterial survival factors Water Science Technology 25:93-103.

Pople, I.J., R. Bayston, and R.D. Hayward. 1992. Infection of cerebrospinal fluid shunts in infants: a study of etiological factors. Journal of Neurosurgery 77:29-36.

Pote, J., M.T. Ceccherini, V.T. Van, W. Rosselli, W. Wildi, P. Simonet, and T.M. Vogel. 2003. Fate and transport of antibiotic resistance genes in saturated soil columns. European Journal of Soil Biology 39:65-71.

Reynolds, P.E. 1989. Structure, biochemistry and mechanism of action of glycopeptide antibiotics. European Journal of Clinical Microbiology and Infectious Diseases 8:943-950.

Saier, M.H., and I.T. Paulsen. 2001. Phylogeny of Multidrug Transporters. Seminars in Cell and Developmental Biology 12:205-213.

Sakai, D.K. 1980. Electrostatic mechanism of survival of virulent *Aeromonas salmonicida* strains in river water. Applied and Environmental Microbiology 51:1343-1349.

Salyers, A.A., N.B. Shoemaker, A.M. Stevens, and L.Y. Li. 1995. Conjugative transposons: An unusual and diverse set of integrated gene transfer elements. Microbiological Reviews 59:579-590.

Sapkota, A.R., F.C. Curriero, K.E. Gibson, and K.J. Schwab. 2007. Antibiotic-Resistant Enterococci and Fecal Indicators in Surface Water and Groundwater Impacted by a Concentrated Swine Feeding Operation. Environmental Health Perspectives 115:1040-1045.

Sayah, R.S., J.B. Kaneene, Y. Johnson, and R. Miller. 2005. Patterns of antimicrobial resistance observed in *Escherichia coli* isolates obtained from domestic- and wild-animal fecal samples, human septage, and surface water. Applied Environmental Microbiology 71:1394-1404.

Sengelov, G., Y. Agerso, B. Halling-Sorrensen, S.B. Baloda, J.S. Andersen, and L.B. Jensen. 2003. Bacterial antibiotic resistance levels in Danish farmland as a result of treatment with pig manure slurry. Environment International 28:587-595.

Sharma, R., K. Munns, T. Alexander, T. Entz, P. Mirzaagha, L.J. Yanke, M. Mulvey, E. Topp, and T. McAllister. 2009. Diversity and Distribution of commensal Fecal *Escherichia coli* Bacteria in Beef Cattle Administered Selected Subtherapeutic Antimicrobials in a Feedlot Setting. Applied Environmental Microbiology 74:6178-6186.

Sherer, J., R. Miner, J. Moore, and J. Buckhouse. 1992. Indicator bacterial survival in stream sediments. Journal of Environmental Quality 21:591-595.

Smyth, C.J., P. Johnsson, E. Olsson, O. Soderlind, J. Rosengren, S. Hjerten, and T. Waldstrom. 1978. Differences in hydrophobic surface characteristics of porcine enteropathogenic *Escherichia coli* with or without K88 antigen as revealed by hydrophobic interaction chromatography. Infection and Immunity 22:462-472.

Sorum, M., P.J. Johnsen, B. Aasnes, T. Rosvoll, H. Kruse, A. Sundsfjord, and G.S. Simonsen. 2006. Prevalence, persistence, and molecular characterization of glycopeptide-resistant *Enterococci* in Norwegian poultry and poultry farms 3 to 8 years after the ban on avoparcin. Applied Environmental Microbiology 56:782-787.

Stephenson, G.R., and R.C. Rychert. 1982. Bottom sediment: a reservoir of *Escherichia coli* in rangeland streams. Journal of Range Management 35:119-123.

Stewart, G.J. 1989. The mechanism of natural transformation., p. 139-164, *In* S. B. Levy and R. V. Miller, eds. Gene transfer in the environment. McGraw-Hill, New York.

Stewart, P.S. 2002. Mechanisms of antibiotic resistance in bacterial biofilms International Journal of Medical Microbiology 292:107-113.

Storteboom, H.N., S.C. Kim, K.C. Doesken, K.H. Calrson, J.G. Davis, and A. Pruden. 2007. Response of antibiotics and resistance genes to high-intensity and low-intensity manure management. Journal of Environmental Quality 36:1695-1703.

Tauxe, R.V. 1997. Evolving foodborne diseases: An evolving public health challenge. Emerging Infectious Diseases 3:425-434.

Thiele-Bruhn, S. 2003. Pharmaceutical antibiotic compounds in soils - A review. Journal of Plant Nutrition and Soil Science 166.

Unc, A., and M.J. Goss. 2004. Transport of bacteria from manure and protection of water resources. Applied Soil Ecology 25:1-18.

United States Department of Agriculture National Agricultural Statistics Service. 2008. Agricultural Statistics 2008.

United States Department of Agriculture National Agricultural Statistics Service. 2010. 2008 Organic Survey.

United States Environmental Protection Agency. 2002. Environmental and Economic Benefit Analysis of Final Revisions to the National Pollutant Discharge Elimination System Regulation and the Effluent Guidelines for Concentrated Animal Feeding Operations. EPA 821-R-03-003. USEPA Office of Water, Washington, DC.

United States Environmental Protection Agency. 2004. Risk assessment evaluation for concentrated animal feeding operations EPA 600/R-04/042. National Environmental Publications Internet Site.

USDA Animal and Plant Health Inspection Service. 2002. NAHMS Swine 2000: Feed Management of Swine.

Van Bambeke, F., E. Balzi, and P.M. Tulkens. 2000. Antibiotic Efflux Pumps. Biochemical Pharmacology 60:457-470.

Wang, G., and M.P. Doyle. 1998. Survival of enterohemorrhagic *Escherichia coli* O157:H7 in water. Journal of Food Protection 61:662-667.

Webber, M.A., and L.J.V. Piddock. 2003. The Importance of Efflux Pumps in Bacterial Antibiotic Resistance. Journal of Antimicrobial Chemotherapy 51:9-11.

Whitman, R.L., and M.B. Nevers. 2003. Foreshore sand as a source of *Escherichia coli* in nearshore water of a Lake Michigan beach. Applied and Environmental Microbiology 69:5555-5562.

Witte, W. 1998. Medical consequences of antibiotic use in agriculture. Science 279:996-997.

World Health Organization. 1998. The World Health Report 1998. World Health Organization, Geneva.

Wullt, B., G. Bergsten, H. Connell, P. Rollano, N. Gebretsadik, R. Hull, and C. Svanborg. 2000. P fimbriae enhance the early establishment of *Escherichia coli* in the human urinary tract. Molecular Microbiology 38:456-464.

Yim, G. 2009. Attack of the Superbugs: Antibiotic Resistance The Science Creative Quarterly, Vol. 4.

Zhao, Z., M.P. Doyle, J. Shere, and L. Garber. 1995. Prevalence of enterohemorrhagic *Escherichia coli* O157:H7 in a survey of dairy herds. Applied and Environmental Microbiology 61:1290-1293.

CHAPTER 3. QUANTIFYING ATTACHMENT AND ANTIBIOTIC RESISTANCE OF *ESCHERICHIA COLI* FROM CONVENTIONAL AND ORGANIC SWINE MANURE

A paper submitted to the *Journal of Environmental Quality*

Martha R. Zwonitzer*, Michelle L. Soupir, Laura R. Jarboe, and Douglas R. Smith

M.R. Zwonitzer, Texas A&M AgriLife Research, 1102 East FM 1294, Lubbock, Texas 79403 and Iowa State University, Department of Agricultural and Biosystems Engineering, 3358 Elings Hall, Ames, Iowa 50011; M.L. Soupir, Iowa State University, Department of Agricultural and Biosystems Engineering, 3358 Elings Hall, Ames, Iowa 50011; L.R. Jarboe, Iowa State University, Department of Chemical and Biological Engineering, 2114 Sweeney Hall, Ames, Iowa 50011-2230; and D.R. Smith, USDA-ARS, Grassland, Soil and Water Research Laboratory, 808 East Blackland Road, Temple, Texas 76502. Support for research provided by Iowa State University and is submitted for thesis fulfillment. Received May 28, 2015. *Corresponding author (martha.zwonitzer@ag.tamu.edu).

Abstract

Broad spectrum antibiotics are often administered at subtherapeutic levels along with feed rations to promote growth and for prophylaxis. Previous studies have shown that bacteria preferentially attach to sediments affecting their transport in overland flow; however, quantitative understanding regarding the attachment mechanisms and their relationship to antibiotic resistance which may affect human health is still mostly unknown. The objective of this study is to examine the relationships between resistance and attachment to sediment in *Escherichia coli* collected from swine manure. Five hundred and fifty-six isolates were collected from six farms, two organic and four conventional (antibiotics fed prophylactically). Antibiotic resistance was quantified using 13 antibiotics at three MIC concentrations: resistant, intermediate, and susceptible. Isolates were subjected to an attachment assay. Results show *E. coli* isolates from conventional systems had higher levels of resistance to amoxicillin, ampicillin, chlortetracycline, erythromycin, kanamycin, neomycin, streptomycin, tetracycline, and tylosin ($p < 0.001$). Results also indicate that *E. coli* isolated from conventional systems attached to quartz at statistically higher levels than those from organic systems ($p < 0.001$). Statistical analysis showed that a significant relationship did not exist between antibiotic resistance levels and attachment in *E. coli* from conventional systems, but did for organic systems ($p < 0.001$). Better quantification of these relationships is critical to understanding the behavior of *E. coli* in the environment and preventing exposure of human populations to antibiotic-resistant bacteria. Results may also be important in making manure recommendations to farmers as they pertain to application timing and incorporation.

Key words: Antibiotic resistance, bacteria attachment, *Escherichia coli*

3.1 Introduction

Antibiotic resistance is a mechanism employed by indigenous antibiotic-producing bacteria to protect themselves against their own products, as well as by other bacteria to protect against those attacks (Chadwick and Goode, 1997). Antibiotic resistance can be spontaneously acquired or transferred via horizontal or vertical gene transfer (Levy, 1998). Subtherapeutic use of antibiotics as feed additives in animal production agriculture results in an increased likelihood of resistance developing in both pathogenic and commensal bacterial populations (Levy, 2002; Levy and Marshall, 2004).

The United States swine industry is a lucrative business and Iowa ranked first in conventional pork production in the United States in 2014 producing more than 20.9 million hogs and pigs, with a collective value of approximately $6.8 billion (United States Department of Agriculture National Agricultural Statistics Service, 2014). An additional $2.67 million was added to Iowa's economy by the production and sale of organically produced swine (United States Department of Agriculture National Agricultural Statistics Service, 2011). According to some estimates antibiotics were added to the diets of approximately 40 percent of swine produced on small-enterprise operations, regardless of class (USDA Animal and Plant Health Inspection Service, 2012). The amount of swine being fed antibiotics in 2006 was 88 percent, an increase of 13 percent from 2002 (USDA Animal and Plant Health Inspection Service, 2002; USDA Animal and Plant Health Inspection Service, 2006). However, some experts expect to see a reduction in the amount of antibiotics fed at sub-therapeutic levels to swine in the 2015 USDA report set to be released fall of 2015.

Only a fraction of the antibiotics administered orally are metabolized *in vivo*; upwards of 90 percent may pass through the animal unchanged into manure, or with little alteration in chemical structure (Onan and LaPara, 2003). Swine manure and slurry is often stored in collection pits and lagoons and is periodically land-applied serving as a nutrient source for plants. This practice, however, can lead to contamination of ground and surface waters, soils, and crops by antibiotics and antibiotic resistant bacteria (ARB; Chee-Sanford et al., 2009; Jindal et al., 2006) and ultimately may pose a risk to human health. Once in the environment, antibiotics can apply selective pressure to bacteria, contributing to the development and dissemination of antibiotic resistance (Parveen et al., 2006; Sapkota et al., 2007; Sayah et al., 2005). However, it should be noted that antibiotic resistance in the environment can arise via spontaneous mutations in the bacterial genome as well as from the application of antibiotics in human health (King et al., 2002; Perez-Trallero et al., 2001).

One important but poorly understood pathway for exposure to ARB is through water systems. *E. coli* is an important fecal indicator bacteria (FIB) currently used by the U.S. EPA to determine if a risk to human health is present due to exposure to pathogens. Because of this, many studies have investigated the fate and transport of *E. coli* in the environment (U.S. EPA, 2012). *E. coli* been shown to preferentially attach to particulate matter (Auer and Niehaus, 1993; Fries et al., 2006; Ling et al., 2002; Liao et al, *in press*) and, therefore, this attachment may aid in the survival and transport of bacteria within the environment (Burton et al., 1987; Gerba and McLeod, 1976; Pommepuy et al., 1992). The attached fraction of *E. coli* from runoff has been reported to range from greater than one percent to >49% (Muirhead et al., 2005; Soupir and Mostaghimi, 2011). In 2005, Jeng et al. found attachment levels of *E. coli* isolated from stormwater to soil of 80% (silt fraction), 18% (clay) and 2% (sand). While Smyth et al. (1978) and Boerlin et al. (2005) stated that differences in the propensity for attachment might vary between pathogenic and non-pathogenic strains of *E. coli*. Others found no related patterns existed in the sorption of *E. coli* exposed to antibiotics, but rather that attachment is highly variable and related to environmental conditions (Luppens, et al., 2008; Petrova and Sauer, 2012; Gallagher et al., 2013).

While particle-mediated transport of FIB in the environment is clearly important (Liao et al., in press) studies examining relationships between attachment and antibiotic resistance are limited. Liu et al. (2011) evaluated 203 porcine isolates of *E. coli* in an effort to determine if a relationship between attachment to quartz and antibiotic resistance exists. The researchers found that quartz attachment is related to the presence of the Type I attachment factor as well as to resistance to streptomycin (STP), chlortetracycline (CTC), tetracycline (TET) and tylosin (TYL). In the same study, Type I, P-pili, and Ag43 were also reported to be associated with resistance to neomycin (NEO) and amoxicillin (AMX), leading to the hypothesis that encoding of resistance and virulence factors is likely due to a single mobile genetic element, such as a plasmid. Other work has been primarily performed using clinical isolates in the presence of biomaterials. These studies have shown that antibiotic resistance and the presence of genes which encode for adhesion have been implicated in the persistence and infection rates by bacteria in humans (Arisoy et al., 2008; Hagberg et al., 1983; Karami et al., 2008; Wullt et al., 2000). Given the reported genetic relationship between genes encoding attachment and antibiotic resistance it is not unexpected that such a relationship does exist (Nowrouzian et al., 2001).

Data has been reported describing the preferential attachment of bacteria to certain surfaces and a few efforts have indicated a relationship between attachment and antibiotic resistance (Liu et al., 2011; Pachepsky et al., 2008). However, very little research has been conducted to examine these relationships when environmental isolates are collected form swine facilities with varying antibiotic use practices. The objectives of this study were to (1) detect and quantify the fraction of bacteria isolated from manure collected from conventional and organic swine production facilities in Iowa showing preferential attachment to quartz; (2) quantify the resistance (susceptible, intermediate, or resistant) levels of isolates collected from conventional and organic swine production facilities to AMX, ampicillin (AMP), chloramphenicol (CMP), CTC, erythromycin (ERY), gentamycin (GEN), kanamycin (KAN), nalidixic acid (NAL), NEO, TET, TYL, STP, and sulfamethazine (SMZ); and, (3) statistically quantify relationships between antibiotic resistance and attachment under different management practices (conventional and organic).

3.2 Materials and Methods

3.2.1 Collection and Enumeration

Manure samples were collected from six farms—two were managed organically and four were managed conventionally, feeding antibiotics at subtherapeutic levels (Table 1). Samples were collected between the fall of 2008 and spring of 2009. Four locations—A, C, D, and E—were fresh manure samples; two, B and F were collected from a deep pit and lagoon, respectively. Following this research, a subset of random resistant isolates from this study was further utilized in an attachment marker study by Liu et al. (2011).

Samples were collected in sterile 1-L containers, transported and stored at <4°C and processed within 12-h of collection. A mortar pestle were used to homogenize samples from each location under sterile conditions and 1-g of manure was mixed in 9-ml of phosphate buffered water for ten minutes, in triplicate. Serial dilutions were made and *Escherichia coli* were enumerated using EPA Method 1603 (U.S. Environmental Protection Agency, 2009).

From each location 100 typical and atypical (pale yellow) *E. coli* colonies were selected and grown individually in 2-ml test tubes containing a 1.5-ml glucose and 2% Luria-Bertani (LB) solution; glucose was added to insure that growth was not limited. Stab inoculations of each strain were prepared for storage at 4°C in LB plus 1.5% agar, and also separately maintained in 25% glycerol frozen stocks at -70°C (Liu, et al., 2011).

3.2.2 Attachment

The approximate size of a single *E. coli* (0.5-μm x 2.5-μm) and the largest surface area per bacterium (1.5 x 10^6 mm^2) that could attach was used to calculate the mass of sand needed for each sample such that adequate sand surface area was non-limiting during the attachment assay. Very fine silica sand (74 – 177 μm) was rinsed in distilled water and dried at 105°C for 1 h. The mass of sand needed per sample was determined as described previously by Liu et al. (2011). Sand was added to each 50-ml conical tube using aseptic technique.

Individual strains were aseptically transferred to 15-ml conical tubes containing Mueller Hinton broth (MHB; Difco™, Detroit, MI) and placed for 12-h in a reciprocal shaking water bath (Thermo Scientific, Waltham, MA) at 37°C. Samples were removed from the water bath and centrifuged at 280 x g for five minutes in a refrigerated centrifuge (Eppendorf® model 5702 R, Hauppauge, NY) at 4°C. The supernatant was discarded. Ten milliliters of phosphate buffered water was added to the remaining pellet and bacteria were re-suspended. Phosphate buffered water was used to dilute bacterial cultures to a 0.5 McFarland standard (1.0 x 10^8 cfu/ml; Clinical and Laboratory Standards Institute (CLSI), 2006a).

Forty milliliters of the diluted bacteria cultures were aseptically added to the 50-ml conical tubes containing sand. The sand-bacteria suspensions were vortexed briefly to mix and placed horizontally on an orbital shaker for 20 minutes at 80 rpm. Twenty minutes was selected because it is the doubling time for *E. coli* under optimal conditions. After shaking the conical tubes were placed vertically in racks and the sand particles were allowed to settle via gravity for five minutes. Stokes' law was used to calculate the settling time of the sand in the attachment assay. For this calculation a dynamic viscosity and density of water of 1.002 x 10^{-3} pa·s and 1000 kg/m^3, respectively, were used, as was an average particle radius of 3.7 x 10^{-5}-m and density of 2.43 x 10^{11} kg/m^3 for sand. The resulting average settling velocity computed was 0.724 m·s^{-1}.

Following settling, 1-ml of supernatant was serially diluted to 1 x 10^6 using phosphate buffered water. The total number of *E. coli* in the supernatant determined using EPA Method 1603 and recorded as the unattached population. A mass balance equation was used to evaluate the attached fraction of *E. coli* in each sample.

3.2.3 Antibiotic Resistance

Antibiotic susceptibility was determined by agar dilution procedures (CLSI, 2006) using standard powders of the following antimicrobial agents from Sigma Aldrich (St. Louis, MO): AMX and AMP (penicillins); CTC and TET (tetracyclines); ERY and TYL (macrolides); GEN, KAN, NEO and STP (aminoglycosides); NAL (quinolones); SMZ (sulfonamides); and CMP (other). CMP is functionally similar to a macrolide in that it affects the 50S ribosomal subunit (Thompson, et.

al, 2002). With the exception of TYL, CMP, and ERY the antibiotics used in this study are important in the treatment of infections caused by gram positive bacteria such as *E. coli*.

Guidelines from the CLSI (formerly the National Committee for Clinical Laboratory Standards) were used to prepare and dilute all antimicrobial agents, except TYL which was dissolved in methanol and adjusted to pH of 7.9 using 0.1 M phosphate buffer (Kaukas et al., 1988). The antimicrobials were tested using susceptible, intermediate, and resistant minimum inhibitory concentrations (MICs; Table 2). Five hundred fifty-six *E. coli* isolates were tested in triplicate as were ATCC 29522™ a gram negative control strain (CLSI, 2006b; Wiegand et al., 2008), *E. coli* K12 MG1655 a wild-type strain, and MG1655 with pPAP plasmid (Arisoy, 2008). All antibiotics tested fell within the MIC quality control ranges established by the CLSI for *E. coli* ATCC 29522. Dilution plates were made and stored for 48 hours at 4°C until inoculation. Prior to inoculation plates were removed from the cooler and allowed to come to room temperature.

Individual strains were grown in 10-mL of Mueller Hinton broth (MHB; Difco™, Detroit, MI) placed in 15-mL conical tubes at 37°C in a reciprocating shaker water bath (Thermo Scientific, Waltham, MA), overnight. Prior to inoculation of antibiotic dilution plates, strains were diluted to a 0.5 McFarland standard with phosphate buffered water. One-µl of each strain was aseptically transferred to plates containing one of each of the 13 antimicrobial agents at the three MIC levels. All strains were tested in triplicate and plated on Mueller Hinton Agar and Mueller Hinton Agar II, as controls, per CLSI guidelines. Strains were allowed to dry and inverted for incubation at 37°C for 20 (+/- 2) hours. Strains were recorded as present or absent following incubation.

3.2.4 Statistical Analyses

Percent resistant and susceptible *E. coli* for each antibiotic was calculated as the ratio of resistant to the total number analyzed multiplied by 100. Statistical analyses were performed using SPSS (version 20) and SAS® (version 9.2) software. Pairwise deletions were used in dealing with missing data, rather than imputation since the total percentage of missing data was less than five percent and imputation might have introduced bias into the results (Fink, 2006; McKnight et al., 2007; and, Tabachnick and Fidell, 2007).

Independent samples t-test and chi-square tests of independence were performed on the resulting data. Normality and equal variance were assumed for the independent samples t-test. Levene's test was used to test for equal variance between the groups of conventionally and organically managed isolate groups for attachment. Since the variances were determined to not be equal and the equal variance assumption was not met ($p < 0.001$) an adjusted independent t-test value was calculated and utilized. Chi-square tests of independence included adjusted standardized residuals for each value in the cross-tabulation table. The adjusted standardized residual used was a z-score, a measurement of standard deviation from the expected value of an actual value in the chi-square contingency table. Therefore, adjusted standardized residuals of the absolute value of three or greater were considered to be contributing a significant amount to the chi-square value (Agresti, 2002). SPSS v.20 was used to perform t-tests and chi-square tests of independence and SAS v9.2 was used to perform the Breslow-Day and the Cochran-Mantel Haensel omnibus tests. A 95% level of significance (significance for p-values < 0.05) was set for all analyses.

3.3 Results and Discussion

3.3.1 Attachment

A total of 6,383 records were collected for analysis, which included a total of 491 records for each of the 13 antibiotic types. Conventionally managed systems accounted for 62.5% of all records and organically managed systems for 37.5%.

E. coli isolates from conventionally managed swine systems showed significantly higher ($p < 0.001$) levels of attachment when compared to those from organically managed systems. Although independent samples t-tests are often used to compare percentages between independent groups, the test is, in theory, for use with interval data, not percentages (Tabachnick and Fidell, 2007). Therefore, in addition to the independent samples t-test, a chi-square test of independence was performed to investigate differences in the attached and unattached isolate counts by management system (Table 3). Results were statistically significant ($p < 0.001$), indicating differences in the proportions of attached and unattached isolates for the two management groups. The conventionally managed group had a greater proportion of attached isolates than expected while the organically managed isolates had a lesser number than expected of attached isolates. These results, therefore, indicate that there was sufficient evidence to conclude that *E coli* isolates from manure produced under conventionally managed swine systems exhibit higher levels of attachment to quartz than isolates from manure produced under organically managed swine systems.

Differences in attachment among isolates while significant were not surprising. Research has been performed in recent years to elucidate the factors contributing to or limiting bacterial attachment in a porous media such as quartz. These factors include, but are not limited to cellular dynamics such as conditions for growth (Walker et al., 2005; Yang et al., 2006), composition of the polymeric compounds in the cell matrix (Haznedaroglu et al., 2008; Bolster et al., 2009), cellular surface charge and hydrophobicity (Bolster et al. 2010; Foppen et al., 2009; Lutterodt et al., 2009; Walczak et al. 2011) and presence of genetic attachment factors and motility (Yang et al. 2008; Lutterodt et al., 2009; Liu et al., 2011). Other important factors include acclimation time of cells (Castro and Tufenkji, 2007; Haznedaroglu et al., 2008), temperature (Castro and Tufenkji, 2007), ionic strength (Bolster, et al., 2006), as well as media characteristics such as particle size and composition (Bradford et al., 2006; Bolster et al., 2009), hydraulic conductivity (Levy et al., 2007), and moisture content (Foppen and Schijven, 2006; Jiang et al., 2007).

Results of this research support those reported by others. Of particular importance is the recent research that has shown there is great diversity in cellular properties of bacteria and the proclivity for transport among distinct *E. coli* isolates. While sample size has varied among studies, differences in bacterial deposition rates have been reported (Liao et al., in press; Pachepsky et al., 2008).

3.3.2 Antibiotic Resistance

The frequency of isolates and their corresponding level of resistance to each of the 13 antibiotics are presented (Table 3; N=6,383). Overall, more than half (54%) of the records (*n* = 2,146) for conventional systems were classified as resistant and among isolates from organic systems a greater percentage were classified as susceptible (49%; *n* = 1,168) than resistant (44%; *n* = 1,063). The total percentage of isolates resistant to more than one antibiotic was also tabulated for the 557 isolates tested (Table 4). All isolates—despite management system classification—found to be resistant displayed resistance to more than one antibiotic. For example, of the 557 isolates tested, 15% were resistant to AMX, and of those AMX-resistant isolates 88% were also resistant to AMP and 91% were also resistant to CMP.

Prior to performing a series of individual chi-square analyses for each of the 13 antibiotic types, SAS v9.2 statistical software was used to perform two omnibus tests, the Breslow-Day test, and the Cochran-Mantel Haensel test to investigate overall effects of antibiotic resistance. The Breslow-Day procedure was used to test the null hypothesis that all of the odds ratios for management system verses resistance level were the same for all 13 antibiotic types (i.e., that the distributions between management system and level of resistance were the same for all 13 antibiotic types). Results were statistically significant ($p < 0.0001$), the null was rejected, and therefore there was sufficient evidence to indicate that the odds ratios differed between the 13 antibiotic types. The Cochran-Mantel Haensel procedure tested the null hypothesis that the odds ratios between management systems and resistance level for all 13 antibiotic types equaled one (i.e., there was no evidence of partial association between management system and level of resistance when controlling for antibiotic type). The test was statistically significant ($p < 0.0001$) and again the null hypothesis was rejected. Sufficient evidence existed to indicate at least one of the odds ratios differed significantly from one, and therefore, a partial association was present between management system and level of resistance when controlling for antibiotic type.

To investigate differences in the counts of the three resistance levels to antibiotics for isolates, by management system, a series of chi-square tests of independence were performed. One chi-square test of independence was performed for each of the 13 antibiotic types (Table

3). Sufficient evidence exists to indicate that *E. coli* isolates from manure produced under conventional management swine systems conferred higher levels of resistance to AMX, AMP, CTC, ERY, KAN, NEO, STP, TET, and TYL. However, chi-square tests of independence were not statistically significant for CMP, GEN, and SMZ. Additionally, the analysis of isolates for NAL resistance levels indicated that the conventional management system had significantly less proportion than expected of resistant isolates.

NAL is classified as a quinolone. This class of antibiotics has historically been reserved for use on more resistant strains of bacteria (Emmerson and Jones, 2003). Significant resistance to NAL would be cause for concern; however, it is still important to delve further into the mechanisms for resistance for those isolates conferring resistance, as well as the possibility of a link between NAL resistance and resistance to other antibiotics. The frequency of resistance to NAL found in this study was less than that reported in a 2005 study conducted by the National Antimicrobial Resistance Monitoring System (NARMS; 5.5% and 9.3%, respectively). In a more recent NARMS report (2012) the frequency of resistance to NAL was much lower, however it should be noted that this report on gives observations for *E. coli* OH157 only and not for all *E. coli* isolates as in 2005. The current study also found that the frequency of resistance to AMX and KAN were significantly higher than those reported by NARMS (31.2% vs 4.2% and 44.8% vs 0%, respectively). It should be noted that the criteria used for determining antibiotic resistance here were more rigorous than those utilized in the NARMS report (2005). Results of this study are consistent with findings by Moore et al (2010) who reported resistance levels of GEN (17%), TET (75%), and ERY (75%) compared to the current study (GEN, 17%; TET, 85%; ERY, 86%).

Of the 13 antibiotic groups tested, 12 had higher percentages of resistant attachment under conventional management than for organic management, supporting a potential genetic linkage between antibiotic resistance and attachment (Table 3). Results are presented according to antibiotic type and cross-tabulations for each management system (Table 5a and 5b). There were however, some exceptions. Neither GEN nor CMP showed a significant difference in resistant attachment for conventional or organic management systems (17% vs. 21% and 16% vs 20%, respectively). For most antibiotic groups, a majority of records were classified as susceptible for both conventional and organic management. CTC was the exception with 80% of the isolates tested classified as resistant from the conventionally managed system. Given the prolific therapeutic and subtherapeutic use of tetracyclines, as well as their ubiquitous presence in soil, this finding was not surprising. In order to ensure the effectiveness of this class of antibiotics going forward, research has been performed to identify inhibitors of tetracycline resistance, as well as to identify new classes for use in treatment (Nelson, et al. 1993; Nelson and Levy, 1999). A majority of isolates from both the conventional and organic management system were classified as resistant to ERY (92% and 76%, respectively) and TYL (94% and 88%, respectively). Neither ERY nor TYL are traditionally utilized to treat infections caused by gram-negative bacteria; therefore, high levels of resistance to ERY and TYL were expected.

3.3.3 Antibiotic Resistance and Attachment by Management

As previously discussed herein, two omnibus tests were performed to investigate the overall effects. Results from the Breslow-Day procedure—testing that the odds ratios for management system vs. level of resistance were the same for both management systems—

were statistically significant ($p = 0.001$), therefore there was sufficient evidence to indicate the odds ratio differed between the two management groups. The Cochran-Mantel Haensel procedure was used to test whether there was evidence of partial association between attachment and level of resistance when controlling for management system. The test was not statistically significant ($p = 0.290$), therefore, no evidence for a partial association existed.

In order to investigate differences in the isolate counts of each MIC level per antibiotic by attachment classification, a series of chi-square tests of independence were performed—one for each of the two management system types. No significant relationship between level of resistance and isolate attachment for the conventional management system was found ($p = 0.266$), indicating that there were no significant differences in the proportions of isolates resistant to antibiotics for the isolate attachment groups (Table 5). However, significant differences were detected between the level of resistance and isolate attachment for the organic management system ($p = 0.002$). The unattached and attached groups both had a greater proportion of resistant level isolates than expected.

There was sufficient evidence to indicate that a statistical relationship exists between the levels of resistance to antibiotics and attachment of *E. coli* isolates collected from swine manure produced under conventional and organic management systems. While the mechanism(s) responsible for the correlation between antibiotic resistance and attachment were not investigated for this paper, Liu et al (2011) reported a significant correlation between the Type I attachment factor and resistance to STP, CTC, TET and TYL on a sub-set of the isolates used in this study. A correlation was also reported between AMP resistance and the presence of the P pili attachment factor (Liu et al., 2011). These results may support the supposition that resistance and attachment factors could be conferred on the same mobile genetic element. In studies using clinical isolates, ARB have been shown to preferentially attach due to the coupling of resistance genes and attachment factors on the same mobile genetic elements, such as a genetic cassette (Gallant et al., 2005; Teodosio et al., 2012). However, Teh et al (2013) noted that the number of virulence genes carried by isolates may not directly impact their ability to attach or form biofilms. Notably, however, further research will be needed to not only identify the mechanisms responsible for attachment to quartz and other environmental particles, but also the mechanisms linking attachment and resistance to antibiotics.

3.4 Conclusions

Swine systems in the U.S. routinely add broad spectrum antibiotics to feed rations for prophylaxis and to promote growth, potentially exacerbating the development and persistence of ARB. Results from this study found:

- *E. coli* isolates from conventional management systems had a greater level of attachment to quartz than organic management system isolates;
- Isolates from conventional management systems conferred higher levels of resistance to AMP, AMX, CTC, ERY, KAN, NEO, STP, TET and TYL when compared to organic management systems;
- No significant difference in antibiotic resistance levels and attachment groups from *E. coli* produced under conventional management; and,
- Among isolates from organic management systems, a greater proportion of resistant isolates and a greater proportion of susceptible level isolate from organic managed systems were in the attached and unattached fractions, respectively.

While further research is needed to understand the genetic relationship between bacterial attachment factors and antibiotic resistance as well elucidation of the mechanism(s) behind resistance to multiple classes of antibiotics, the most likely approach to reducing the occurrence of ARB in the environment is to recommend discontinuation of the use of antibiotics for growth promotion and prophylaxis within swine production.

3.5 Acknowledgements

Funding for this work was provided by Iowa State University. The authors would like to thank Bridget Huss, Molly Zwonitzer, Pagie Dugal Arve and David Westhoff for assistance with sample collection and analysis, and ISU research farms and other private farms for providing access to manure samples.

3.6 References

Agresti, A. 2002. Categorical Data Analysis. 2nd edition. John Wiley & Sons, Inc. Hoboken, New Jersey.

Arisoy, M., A.Y. Rad, A. Akin, and N. Akar. 2008. Relationship between susceptibility to antimicrobials and virulence factors in paediatric *Escherichia coli* isolates. Int. J. of Antimicrob. Agents 318:S4-S8.

Auer, M.T., and S.L. Niehaus. 1993. Modeling fecal coliform bacteria. I. Field and laboratory determination of loss kinetics. Water Res. 27:693-701.

Boerlin, P., R. Travis, C.L. Gyles, R. Reid-Smith, N. Janecko, H. Lim, V. Nicholson, S.A. McEwen, R. Friendship, and M. Archambault. 2005. Antimicrobial resistance and virulence genes of *Escherichia coli* isolates from swine in Ontario. Appl. Environ. Microbiol. 71:6753-6761.

Bolster, C.H., S.L. Walker, and K.L. Cook. 2006. Comparison of *Escherichia coli* and *Campylobacter jejuni* transport in saturated porous media. J. Environ. Qual. 35:1018-1025.

Bolster, C.H., B.Z. Haznedaroglu, and S.L. Walker. 2009. Diversity in cell properties and transport behavior among 12 different environmental *Escherichia coli* isolates. J. Environ. Qual. 38:465-472.

Bolster, C.H., K.L. Cook. I.M. Marcus, B.Z. Haznedaroglu, and S.L. Walker. 2010. Correlating transport behavior with cell properties for eight porcine *Escherichia coli* isolates. Environ. Sci. Technol. 44:5008-5014.

Bradford, S.A, J. Simunek, and S.L Walker. 2006, Transport and straining of *E. coli* O157:H7 in saturated porous media. Water Resour. Res. 42:W12S12.

Burton, J., G.A., D. Gunnison, and G.R. Lanza. 1987. Survival of pathogenic bacteria in various freshwater sediments. Appl. Environ. Microbiol. 53:633-638.

Castro, F.D. and N. Tufenkji. 2007. Relevance of nontoxigenic strains as surrogates for *Escherichia coli* O157:H7 in groundwater contamination potential: role of temperature and cell acclimation time. Environ. Sci. Technol. 41:4332-4338.

Chadwick, D.J. and J. Goode. 1997. Antibiotic resistance: Origins, evolution, selection and spread. John Wiley & Sons, Inc. New York, NY.

Chee-Sanford, J.C., R.I. Mackie, S. Koike, I.G. Krapac, Y.F. Lin, A.C. Yannarell, S. Maxwell, and R.I. Aminov. 2009. Fate and transport of antibiotic residues and antibiotic resistance genes following land application of manure waste. J. Environ. Qual. 38:1086-1108.

Clinical and Laboratory Standards Institute. 2006a. Methods for dilution antimicrobial susceptibility tests for bacteria that grow aerobically; approved standard. 7th ed. Clinical and Laboratory Standards Institute, Wayne, Pennsylvania.

Clinical and Laboratory Standards Institute. 2006b. Performance standards for antimicrobial susceptibility testing. 16th ed. Clinical and Laboratory Standards Institute, Wayne, Pennsylvania.

Emmerson, A.M. and A.M. Jones. 2003. The quinolones: decades of development and use. J. Antimicrob. Chemother. 51(S1):13-20.

Fink, A. 2006. How to conduct surveys: A step-by-step guide. Sage Publications. Thousand Oaks, CA.

Foppen, J.W., G. Lutterodt, W.F.M. Foling, and S. Uhlenbrook. 2009. Towards understanding inter-strain attachment variations of *Escherichia coli* during transport in saturated quartz sand. Water Res. 44(4):1202-1210.

Foppen, J.W. A. and J.F. Schijven. 2006. Evaluation of data form the literature on the transport and survival of *Escherichia coli* and thermotolerant coliforms in aquifers under saturated conditions. Water Res. 40:401-426.

Fries, J.S., G.W. Characklis, and R.T. Noble. 2006. Attachement of fecal indicator bacteria to particles in the Neuse River Estuary, NC. J. Environ. Eng.-ASCE. 132:1338-1345.

Gallagher, D.L., K. Largo, C. Hagedorn, and A.M. Dietrich. 2013. Effects of strain type and water quality on soil-associated *Escherichia coli*. Int. J. Environ. Sci. Dev. 4(1):25-31.

Gallant, C.V., C. Daniels, J.M. Leung, A.S. Ghosh, K.D. Young, L.P. Kotra, and L.L. Burrows. 2005. Common β-lactamases inhibit bacterial biofilm formation. Mol. Microbiol. 25(4):1012-1024.

Gerba, C.P., and J.S. McLeod. 1976. Effect of sediments on the survival of *Escherichia coli* in marine waters. Appl. Environ. Microbiol. 32:114-120.

Hagberg, L., R. Hull, S. Hull, S. Falkow, R. Freter, and C. Svanborg Eden. 1983. Contribution of adhesion to bacterial persistence in the mouse urinary tract. Infect. Immun. 40:265-272.

Haznedaroglu , B.Z., C.H. Bolster, and S.L. Walker. 2008. The role of starvation on *Escherichia coli* adhesion and transport in saturated porous media. Water Res. 42:1547-1554.

Jeng, H.C., A.J.H. England, and H.B. Bradford. 2005. Indicator organisms associated with stormwater suspended particles and estuarine sediment. J. Environ. Sci. Health. 40:779-791.

Jiang, G. M.J. Noonan, G.D. Buchan, and N. Smith. 2007. Transport of *Escherichia coli* through variably saturated sand columns and modeling approaches. J. Contam. Hydrol. 93:2-20.

Jindal, A., S. Kocherginskaya, A. Mehboob, M. Robert, R.I. Mackie, L. Raskin, and J.L. Zilles. 2006. Antimicrobial use and resistance in swine waste treatment systems. Appl. Environ. Microbiol. 72:7813-7820.

Karami, N., C. Hannoun, I. Adlerberth, and A.E. Wold. 2008. Colonization dynamics of ampicillin-resistant *Escherichia coli* in the infantile colonic microbiota. J. Antimicrob. Chemo. 62:703-708.

King, A., T. Bathgate, and I. Phillips. 2002. Erythromycin susceptibility of viridans streptococci from the normal throat flora of patients treated with azithromycin or clarithromycin. Clin. Microbiol. Infect. 8:85-92.

Kaukas, A., M. Hinton, and A.H. Linton. 1988. The effect of growth-promoting antibiotics on the fecal enterococci of healthy-young chickens. J. of Appl. Bacteriol. 64:57-64.

Levy, S.B. 1998. Antibiotic resistance: an ecological imbalance. In: Chadwick, D.J. and J. Goode, editors, Antibiotic Resistance: Origins, Evolution, Selection and Spread. John Wiley & Sons, Inc. Hoboken, New Jersey. p. 1-14.

Levy, S.B. 1998. The challenge of antibiotic resistance. Sci. Am. p. 47-53.

Levy, S.B. 2002. The Antibiotic Paradox: How misuse of antibiotics destroys their curative powers. Second ed. Perseus, Cambridge, MA.

Levy, S.B., and B. Marshall. 2004. Antibacterial resistance worldwide: causes, challenges and responses. Nat. Med. 10:S122-S129.

Levy, J., K. Sun, R.H. Findlay, F.T. Farruggia, J. Porter, K.L. Mumy, J. Tomaras, and A. Tomaras. 2007. Transport of *Escherichia coli* bacteria through laboratory columns of glacial-outwash sediments: estimating model parameter values based on sediment characteristics. J. contam. Hydrol. 89:71-106.

Ling, T.Y., E.C. Achberger, C.M. Drapcho, and R.L. Bengtson. 2002. Quantifying adsorption of an indicator bacteria in a soil-water system. Trans. ASAE. 45:669-674.

Liao, C., X. Liang, M.L. Soupir, and L.R. Jarboe. (in press) Cellular, particle and environmental properties influencing attachment in waters: A review. J. Appl. Microbiol.

Liu, P., M.L. Soupir, M. Zwonitzer, B. Huss, and L.R. Jarboe. 2011. Antibiotic resistance in agricultural *E. coli* isolates is associated with attachment to quartz. Appl. Environ. Microbiol. 77(19):6945-6953.

Luppens, S.B., K.D. Bandounas, M.J. Jonker, F.R. Wittink, O. Bruning, T.M. Breit, J.M. Ten Cate, and V. Crielaard. 2008. Effect of *Veillonella parvula* on the antimicrobial resistance and gene expression of Streptococcus mutans grown in a dual-species biofilm. Oral Microbiol. Immunol. 23(3):183-189.

Lutterodt, G., M. Basnet, J.W.A. Foppen, and S. Uhlenbrook. 2009. The effect of surface characteristics on the transport of multiple *Escherichia coli* isolates in large scale columns of quartz sand. Water Res. 43:595-604.

McKnight, P.R., K. McKnight, S. Souraya, and A.J. Figueredo. 2007. Missing data: A gentle introduction. Guilford Press. New York, NY.

Moore, J. E., J. R. Rao, P. J. A. Moore, B. C. Millar, C. E. Goldsmith, A. Loughrey, and P. J. Rooney. 2010. Determination of total antibiotic resistance in waterborne bacteria in rivers and streams in Northern Ireland: Can antibiotic-resistant bacteria be an indicator of ecological change? Aquat. Ecol. 44:349-358.

Muirhead, R. W., R. P. Collins, and P. J. Bremer. 2005. Erosion and subsequent transport state of *Escherichia coli* from cowpats. Appl. Environ. Microbiol. 71(6):2875-2879.

NARMS. 2005. National Antimicrobial Resistance Monitoring System: Enteric bacteria 2005 Human isolates final report. http://www.cdc.gov/narms/annual/2005/NARMSAnnualReport2005.pdf. (accessed 12 March 2009).

NARMS. 2012. National Antimicrobial Resistance Monitoring System: Enteric bacteria, 2012, Human isolates final report. http://www.cdc.gov/narms/pdf/2012-annual-report-narms-508c.pdf. (accessed 13 May 2015).

Nelson M.L., Park B.H., Andrew J.S., Georgian V.A., Thomas B.C., and S.B. Levy. 1993. Inhibition of the tetracycline efflux antiport protein by 13-thio-substituted 5-hydroxy-6-deoxytetracyclines. J. Med. Chem. 36:370–377.

Nelson M. L. and S.B. Levy. 1999. Reversal of tetracycline resistance mediated by different bacterial tetracycline resistance determinants by an inhibitor of the Tet(B) antiport protein. Antimicrob. Agents Chemo. 43:1719–1724.

Nowrouzian, F., I. Adlerberth, and A.E. Wold. 2001. P fimbriae, sapsule and aerobactin characterize colonic resident *Escherichia coli*. Epidemiol. Infect. 126:11-18.

Onan, L.J., and T.M. LaPara. 2003. Tylosin-resistant bacteria cultivated from agricultural soil. FEMS Microbiol. Lett. 220:15-20.

Pachepsky, Y.A., O. Yu, J.S. Karns, D.R. Shelton, A.K. Guber, and J.S. van Kessel. 2008. Strain-dependent variations in attachment of *E. coli* to soil particles of different sizes. Int. Agrophys. 22:61-66.

Parveen, S., J. Lukasik, T.M. Scott, M.L. Tamplin, K.M. Portier, S. Sheperd, K. Braun, and S.R. Farrah. 2006. Geographical variation in antibiotic resistance profiles of *Eschericha coli* isolated from swine, poultry, beef and dairy cattle farm water retention ponds in Florida. J. Appl. Microbiol. 100:50-57.

Perez-Trallero, E., D. Vicente, M. Montes, J.M. Marimon, and L. Pineiro. 2001. High proportion of pharyngeal carriers of commensal streptococci resistant to erythromycin in Spanish Adults. J. Antimicrob. Chemo. 48:225-229.

Petrova, O.E. and K. Sauer. 2012. Sticky situations: key components that control bacterial surface attachment. J. Bacteriol. 194(10):2413-2425.

Pommepuy, M., J.F. Guillaud, E. Dupray, A. Derrien, F. LeGuyadoer, and M. Crormier. 1992. Enteric bacterial survival factors. Wat. Sci. Technol. 25:93-103.

Sapkota, A.R., F.C. Curriero, K.E. Gibson, and K.J. Schwab. 2007. Antibiotic-resistant enterococci and fecal indicators in surface water and groundwater impacted by a concentrated swine feeding operation. Environ. Health Perspect. 115:1040-1045.

Sayah, R.S., J.B. Kaneene, Y. Johnson, and R. Miller. 2005. Patterns of antimicrobial resistance observed in *Escherichia coli* isolates obtained from domestic- and wild-animal fecal samples, human septage, and surface water. Appl. Environ. Microbiol. 71:1394-1404.

Smyth, C.J., P. Johnsson, E. Olsson, O. Soderlind, J. Rosengren, S. Hjerten, and T. Waldstrom. 1978. Differences in hydrophobic surface characteristis of porcine enteropathogenic *Escherichia coli* with or without K88 antigen as revealed by hydrophobic interaction chromatography. Infect. Immu. 22:462-472.

Soupir, M.L. and S. Mostaghimi. 2011. *Escherichia coli* and enterococci attachment to particles in runoff from highly and sparsely vegetated grassland. Water, Air, Soil Pollut. 216:167-178.

Tabachnick, B.G. and L.S. Fidell. 2007. Using multivariate statistics. Pearson Education, Inc. Boston, MA.

Teh, A.H.T., Y. Wang, and G.A. Dykes. 2013. The influence of antibiotic resistance gene carriage on biofilm formation by two *Escherichia coli* strains associated with urinary tract infections. Can. J. Microbiol. 60(2):105-111.

Teodosio, J.S., M. Simoes and F.J. Mergulhao. 2012. The influence of nonconjugative Escherichia coli plasmids on biofilm formation and resistance. J. Appl. Microbiol. 113(2):373–382

Thompson, J. M. O'Connor, J.A. Mills and A.E. Dahlberg. 2002. The protein synthesis inhibitors, oxazolidinones and chloramphenicol, cause extensive translational inaccuracy *in vivo*. J. Mol. Biol. 332(2):273-279.

United States Department of Agriculture National Agricultural Statistics Service. 2011. 2011 Certified organic production survey.

United States Department of Agriculture National Agricultural Statistics Service. 2014. Agricultural Statistics 2014.

U.S. Environmental Protection Agency. 2009. Method 1603: *Escherichia coli* (*E. coli*) in water by membrane filtration using modified membrane-thermotolerant *Escherichia coli a*gar (modified mTEC). EPA Publication No. 821-R-09-007. Rockville, MD: U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency. 2012. Recreational water quality criteria. Office of Water 820-F-12-058. http://water.epa.gov/scitech/swguidance/standards/criteria/health/recreation/upload/RWQC2012.pdf. Accessed: 24 May 2015.

USDA Animal and Plant Health Inspection Service. 2002. NAHMS swine 2000: feed management of swine.

USDA Animal and Plant Health Inspection Service. 2006. Swine 2006 Part III: Reference of swine health, productivity, and general management in the United States.

USDA Animal and Plant Health Inspection Service. 2012. Swine 2012: Reference of management practices on Small-enterprise swine operations in the United States.

Walczak, J.J., L. Wang, S.L. Brady, L. Feriancikova, J. Li, and S. Xu. 2011. The effects of starvation on the transport of Escherichia coli in saturated porous media are dependent on pH and ionic strength. Colloids Surf. B. 90:129-136.

Walker, S.L., J.E. Hill, J.A. Redman, and M. Elimelech. 2005. Influence of growth phase on adhesion kinetics of *Escherichia coli* D21g. Appl. Environ. Microbil. 71:3093-3099.

Wiegand, I., K. Hilpert, and R.E.W. Hancock. 2008. Agar and broth dilution methods to determine the minimal inhibitory concentration (MIC) of antimicrobial substances. Nat. Protoc. 3(2):163-175.

Wullt, B., G. Bergsten, H. Connell, P. Rollano, N. Gebretsadik, R. Hull, and C. Svanborg. 2000. P fimbriae enhance the early establishment of *Escherichia coli* in the human urinary tract. Mol. Microbiol. 38:456-464.

Yang, H.-H., J.B. Morrow, D. Grasso, R.T. Vinopal, and B.F. Smets. 2006. Intestinal versus external growth conditions change the surficial properties in a collection of environmental *Escherichia coli* isolates. Environ. Sci. Technol. 40:6976-6982.

Yang, H.-H., J.B. Morrow, D. Grasso, R.T. Vinopal, A. Dechsne, and B.F. Smets. 2008. Antecedent growth conditions alter retention of environmental *Escherichia coli* isolates in transiently wetted porous media. Environ. Sci. Technol. 42:9310-9316.

Table 1. Description of research farms for manure collection used in selecting and enumeration of bacterial isolates. Description includes: operation location, type, date of collection of manure, type of waste management system, reported antibiotics given or fed.

Farm	Location	Farm Type	Date of Collection	Waste Management	Antibiotic Practice	Reported Antibiotic Use
A	Ames, IA	Breeding	04/09	Lagoon	Conventional	NT-80
B	Nashua, IA	Finishing	04/09	Deep Pit	Conventional	Tylan
C	New Hampton, IA	Finishing	04/09	Bedding	Organic	None
D	Ames, IA	Farrowing	05/09	Deep Pit	Organic	None
E	Ames, IA	Finishing	05/09	Deep Pit	Conventional	Tylan
F	Manning, IA	Finishing	05/09	Deep Pit	Conventional	NT-80

Table 2. Minimum inhibitory concentrations (MICs) for antimicrobial agents tested[†] as against 556 *Escherichia coli* isolates and three control isolates[‡].

Antimicrobial Agent	MIC (µg/ml)		
	MIC Range	MIC_{50}	MIC_{90}
Amoxicillin	16-48	32	48
Ampicillin	16-48	32	48
Chloramphenicol	16-48	32	48
Chlortetracycline	16-48	32	48
Erythromycin	15-30	20	30
Gentamycin	8-24	16	24
Kanamycin	32-96	64	96
Nalidixic Acid	16-48	32	48
Neomycin	8-24	16	24
Tetracycline	8-24	16	24
Tylosin	16-48	32	48
Streptomycin	12-22.5	15	22.5
Sulfamethazine	256-768	512	768

[†] MIC levels for all antibiotics, except Tylosin, were set according to the Clinical and Laboratory Standards Institute (2006) and Tylosin was prepared according to Kaukas et al. (1988).

[‡] ATCC 29522™ (a gram negative control strain), *E. coli* K12 MG1655 (wild-type), and MG1655 (positive for pPAP)

Table 3. Chi-square tests of independence were performed to investigate differences in the number isolates for each of the three levels of resistance (Susceptible (S), Intermediate (I), and Resistant (R)) to the thirteen antibiotics for isolates, by management system (Conventional vs. Organic).

Antibiotic	Management System	Resistance Level Frequency S	I	R	X^2	*p*-value
Amoxicillin	Conventional	178	6	123	30.28	*<0.0005*
	Organic	149	5	30		
Ampicillin	Conventional	161	9	137	18.02	*<0.005*
	Organic	131	6	47		
Chloramphenicol	Conventional	236	18	53	2.26	*0.323*
	Organic	137	7	40		
Chlortetracycline	Conventional	55	7	245	28.3	*<0.005*
	Organic	70	8	105		
Erythromycin	Conventional	16	9	282	41.65	*<0.005*
	Organic	44	0	140		
Gentamycin	Conventional	250	9	48	2.12	*0.347*
	Organic	140	8	36		
Kanamycin	Conventional	127	17	157	20.16	*<0.005*
	Organic	116	5	63		
Nalidixic Acid	Conventional	223	45	23	36.74	*<0.005*
	Organic	117	16	51		
Neomycin	Conventional	174	35	98	11.57	*0.003*
	Organic	132	11	41		
Streptomycin	Conventional	35	21	217	57.59	*<0.0005*
	Organic	36	54	79		
Sulfamethazine	Conventional	54	5	203	0.01	*0.994*
	Organic	41	3	125		
Tetracycline	Conventional	30	5	272	9.65	*0.008*
	Organic	33	7	144		
Tylosin	Conventional	15	4	288	10.45	*0.005*
	Organic	22	0	162		

Table 4. Percentage of total (n = 557) isolates displaying resistance to each of the 13 antibiotics tested, as well as the percentage of those isolates which are resistant to multiple antibiotics. For example, of the 557 isolates tested 15% were resistant to Amoxicillin and of that 15 percent 88%, 91%, and 77% were also resistant to Ampicillin, Chloramphenicol and Chlortetracycline, respectively.

n=557	Amoxicillin	Ampicillin	Chloramphenicol	Chlortetracycline	Erythromycin	Gentamycin	Kanamycin	Naladixic Acid	Neomycin	Tetracycline	Tylosin	Streptomycin	Sulfamethazine
Amoxicillin	**15**												
Ampicillin	88	**33**											
Chloramphenicol	90	90	**83**										
Chlortetracycline	77	69	66	**59**									
Erythromycin	58	63	41	48	**39**								
Gentamycin	100	93	97	98	60	**80**							
Kanamycin	90	95	80	88	89	90	**72**						
Naladixic Acid	61	76	28	30	37	32	35	**31**					
Neomycin	82	86	74	80	75	77	78	73	**58**				
Tetracycline	52	46	28	31	57	31	33	34	36	**25**			
Tylosin	35	21	13	14	20	15	17	17	12	18	**21**		
Streptomycin	89	83	62	73	74	64	69	68	80	83	33	**50**	
Sulfamethazine	70	40	20	23	25	21	22	30	26	37	24	28	**17**

Table 5a. Crosstabulation of isolate attachment vs. resistance level for isolates collected under the conventional management system.

Attachment	Resistance Level			Total
	S	I	R	
Attached (frequency)	1039	126	1469	2634
Expected Count	1060.7	128.0	1445.3	---
% Total	26.6	3.2	37.6	67.3
Adj. std. residual	-1.5	-0.3	1.6	---
Unattached (frequency)	536	64	677	1277
Expected Count	514.3	62.0	700.7	---
% Total	13.7	1.6	17.3	32.7
Adj std. residual	1.5	0.3	-1.6	---
Total (frequency)	1575	190	2146	3911
Expected Count	---	---	---	---
% Total	40.3	4.9	54.9	100.0

$X^2(2) = 2.647$, $p = .266$

Note. S = Susceptible; I = Intermediate; R = Resistant; Adj. std. residual = Adjusted Standardized Residual.

Table 5b. Crosstabulation of isolate attachment vs. resistance level for isolates collected under the organic management system.

Attachment	Resistance Level			Total
	S	I	R	
Attached (frequency)	686	70	547	1303
Expected Count	644.6	71.7	586.7	---
% Total	29.1	3.0	23.2	55.2
Adj. std. residual	3.4	-0.3	-3.3	---
Unattached (frequency)	482	60	516	1058
Expected Count	523.4	58.3	476.3	---
% Total	20.4	2.5	21.9	44.8
Adj std. residual	-3.4	0.3	3.3	---
Total (frequency)	1168	130	1063	2361
Expected Count	---	---	---	---
% Total	49.5	5.5	45.0	100.0

$X^2(2) = 12.009$, $p = .002$

Note. S = Susceptible; I = Intermediate; R = Resistant' Adj. std. residual = Adjusted Standardized Residual.

CHAPTER 4: GENERAL CONCLUSIONS

4.1 General Discussion and Conclusions

Laboratory studies were used to assess attachment and levels of antibiotic resistance for *E. coli* isolates collected from six swine production facilities, four conventionally managed and two organically managed. The objectives of this study were to: 1) detect and quantify the fraction of bacteria isolated from manure collected from conventional and organic swine production facilities in Iowa showing preferential attachment to quartz; 2) quantify the levels of resistance (susceptible, intermediate, or resistant) of isolates collected from conventional and organic swine production facilities to amoxicillin (AMX), ampicillin (AMP), chloramphenicol (CMP), chlortetracycline (CTC), erythromycin (ERY), gentamycin (GEN), kanamycin (KAN), nalidixic acid (NAL), neomycin (NEO), tetracycline (TET), tylosin (TYL), streptomycin (STP), and sulfamethazine (SMZ); and, 3) statistically quantify relationships between antibiotic resistance and attachment under different management practices (conventional and organic).

First, attachment of *E. coli* was evaluated using an attachment assay utilizing fine sand particles. Attachment was determined using a mass balance equation. The attached fraction was computed as the total starting cfu minus the *E. coli* unattached cfu (from the supernatant), and was recorded as a percentage. Second, antibiotic resistance level—susceptible, intermediate, resistant—was tested using 13 antibiotics that are important for both human and animal health. Antibiotic susceptibility testing was performed in triplicate by agar dilution procedures outlined by the Clinical Laboratory and Standards Institute. The antimicrobials were tested using susceptible, intermediate, and resistant minimum inhibitory concentrations. Resistance level was assigned for an isolate if results from all three replications were in agreement. Lastly, statistical analysis was used to determine if there was a relationship between antibiotic resistance and attachment for each of the two management systems.

Results from this study demonstrated:

- *E. coli* isolates from manure produced from conventionally managed swine systems have significantly higher levels of attachment to quartz than isolates from *E. coli* from organically managed swine systems.
- *E. coli* isolates from conventionally managed swine systems confer higher levels of antibiotic resistance to AMX, AMP, CTC, ERY, KAN, NEO, STP, TET, and TYL.
- *E. coli* from conventional management systems were significantly more susceptible to NAL than those from organic management systems.
- No relationship exists between level of resistance and attachment of isolates for the conventional management system, and therefore, no significant differences in the proportions of isolate antibiotic resistance for attachment groups.
- A relationship exists between levels of antibiotic resistance and isolate attachment for organic management systems—the unattached fraction had higher levels of resistance to antibiotics while the attached fraction had higher levels of susceptibility.

4.2 Implications and Recommendation for Future Research

The knowledge gained from this research broadens our knowledge of the relationship between attachment to quartz and antibiotic resistance in *E.coli* isolates collected under different management systems. While no statistical relationship existed between antibiotic resistance and attachment in *E. coli* produced under conventionally managed systems, this research still showed that bacteria do possess the ability to attach to quartz (fine sand) and will, therefore, be transported along with quartz within the environment. Since antibiotics are known to persist within the environment, and antibiotic resistance genes have been found in the environment antibiotic resistance may be conferred in the environment as particles and bacteria move. Understanding the specific features on the bacterial surface responsible for attachment will be essential for understanding the transport of bacteria through the environment as well as for reducing exposure

This research did find a statistical relationship between resistance to antibiotics utilized in human health and veterinary medicine and production systems that utilize antibiotics at sub-therapeutic levels. Several of these findings are not surprising because the antibiotic tested were not designed to target gram-negative bacteria like *E. coli,* however, the majority of resistance was to gram-negative-targeting antibiotics. Further research will be necessary to understand the mechanisms responsible for resistance, and in understanding the genes conferring resistance antibiotics. Research will also be needed to determine the exact genetic relationship between antibiotic resistance genes and attachment genes, and the stability of these genes.

While most swine systems take precautions in the storage and spreading of manure, producers will need to be cognizant that when they spread manure it is done so at the right time and is applied at the right rate for plant utilization and uptake in order to decrease pollution and reduce transport of antibiotic resistant bacteria through the environment.

APPENDIX A: RAW DATA

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
1	Inorganic	273585000000	100000000000	63.45
2	Inorganic	141000000000	56000000000	60.28
3	Inorganic	8500000000	940000000	88.94
4	Inorganic	26000000000	3000000000	88.46
5	Inorganic	21000000000	6600000000	68.57
6	Inorganic	9500000000	3900000000	58.95
7	Inorganic	1100000000	11400000000	0.00
8	Inorganic	18700000000	191000000000	0.00
9	Inorganic	940000000	1020000000	0.00
10	Inorganic	720000000	39000000000	0.00
11	Inorganic	19956666667	10900000000	45.38
12	Inorganic	16770000000	560000000	96.66
13	Inorganic	4566666667	1860000000	59.27
14	Inorganic	10800000000	1600000000	85.19
15	Inorganic	4566666667	1370000000	70.00
16	Inorganic	5166666667	1120000000	78.32
17	Inorganic	21066666667	1480000000	92.97
19	Inorganic	10000000000	28000000000	0.00
20	Inorganic	2000000000	11000000000	0.00
21	Inorganic	8000000000	28000000000	0.00
22	Inorganic	10100000000	10000000000	0.99
24	Inorganic	94000000000	11000000000	88.30
25	Inorganic	32500000000	2000000000	93.85
27	Inorganic	4900000000	1080000000	77.96
28	Inorganic	9900000000	1420000000	85.66
29	Inorganic	19900000000	810000000	95.93
30	Inorganic	20200000000	2000000000	90.10
31	Inorganic	155000000000	200000000	99.87
32	Inorganic	2900000000	90000000	96.90
33	Inorganic	19500000000	16300000000	16.41
34	Inorganic	54000000000	1070000000	98.02
35	Inorganic	10300000000	1310000000	87.28
36	Inorganic	18100000000	950000000	94.75
37	Inorganic	20700000000	81000000000	0.00
38	Inorganic	57000000000	3300000000	94.21
39	Inorganic	40000000000	2360000000	94.10
40	Inorganic	5000000000	1500000000	70.00
41	Inorganic	74000000000	2020000000	97.27

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
42	Inorganic	33000000000	6600000000	80.00
43	Inorganic	171000000000	16500000000	90.35
44	Inorganic	100000000000	12100000000	87.90
46	Inorganic	17000000000	5000000000	70.59
47	Inorganic	167000000000	830000000	99.50
48	Inorganic	89000000000	14200000000	84.04
49	Inorganic	3000000000	5300000000	0.00
50	Inorganic	233000000000	490000000	99.79
51	Inorganic	5000000000	770000000	84.60
52	Inorganic	8000000000	10900000000	0.00
53	Inorganic	7000000000	20900000000	0.00
54	Inorganic	14000000000	2600000000	81.43
55	Inorganic	12000000000	1620000000	86.50
57	Inorganic	17000000000	620000000	96.35
58	Inorganic	40000000	720000000	0.00
59	Inorganic	71000000	620000000	0.00
60	Inorganic	80000000	8000000	90.00
61	Inorganic	13000000000	46700000000	0.00
62	Inorganic	11000000000	13000000000	0.00
63	Inorganic	7000000000	35100000000	0.00
64	Inorganic	5600000000	15000000000	0.00
65	Inorganic	2000000000	17000000000	0.00
66	Inorganic	14800000000	8300000000	43.92
67	Inorganic	3000000000	28200000000	0.00
68	Inorganic	12200000000	20400000000	0.00
69	Inorganic	20600000000	9600000000	53.40
70	Inorganic	46000000000	18500000000	59.78
71	Inorganic	3000000000	32700000000	0.00
72	Inorganic	5750000000	7500000000	0.00
73	Inorganic	3000000000	18300000000	0.00
74	Inorganic	4375000000	21500000000	0.00
75	Inorganic	3000000000	12700000000	0.00
76	Inorganic	6000000000	1000000000	83.33
77	Inorganic	27000000000	2000000000	92.59
79	Inorganic	15500000000	1500000000	90.32
82	Inorganic	120000000000	30000000000	75.00
84	Inorganic	40000000000	6000000000	85.00
88	Inorganic	140000000000	1000000000	99.29
89	Inorganic	194000000000	1000000000	99.48
90	Inorganic	74000000	60000000	18.92
91	Inorganic	97037000000	530000000	99.45

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
93	Inorganic	100000000000	10000000000	90.00
96	Inorganic	17000000000	1000000000	94.12
101	Inorganic	115000000000	1000000000	99.13
102	Inorganic	33000000000	10000000000	69.70
103	Inorganic	220000000000	189000000000	14.09
104	Inorganic	129000000000	82000000000	36.43
105	Inorganic	103000000000	110000000000	0.00
106	Inorganic	103000000000	47000000000	54.37
107	Inorganic	117000000000	37000000000	68.38
108	Inorganic	84000000000	29000000000	65.48
109	Inorganic	99000000000	27000000000	72.73
110	Inorganic	104000000000	47000000000	54.81
111	Inorganic	117000000000	43000000000	63.25
112	Inorganic	72000000000	46000000000	36.11
113	Inorganic	146000000000	39000000000	73.29
114	Inorganic	157000000000	34000000000	78.34
115	Inorganic	94000000000	37000000000	60.64
116	Inorganic	136000000000	39000000000	71.32
117	Inorganic	124000000000	38000000000	69.35
118	Inorganic	66000000000	104000000000	0.00
119	Inorganic	452000000000	57000000000	87.39
120	Inorganic	105000000	87000000	17.14
121	Inorganic	120000000000	52000000000	56.67
122	Inorganic	67000000	55000000	17.91
123	Inorganic	58033500000	24527500000	57.74
124	Inorganic	29050250000	12291250000	57.69
126	Inorganic	66000000	60000000	9.09
130	Inorganic	60000000	43000000	28.33
131	Inorganic	61000000	42000000	31.15
133	Inorganic	50000000	32000000	36.00
134	Inorganic	55250000	37250000	32.58
136	Inorganic	38000000	35000000	7.89
138	Inorganic	100000000	91000000	9.00
139	Inorganic	70000000	65000000	7.14
140	Inorganic	42000000	21000000	50.00
141	Inorganic	52000000	39000000	25.00
142	Inorganic	111000000	90000000	18.92
143	Inorganic	72000000	40000000	44.44
144	Inorganic	152000000	113000000	25.66
147	Inorganic	61000000	54000000	11.48
148	Inorganic	128000000	82000000	35.94

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
149	Inorganic	94500000	68000000	28.04
151	Inorganic	141000000	120000000	14.89
153	Inorganic	88000000	24000000	72.73
154	Inorganic	101750000	64500000	36.61
155	Inorganic	83000000	78000000	6.02
156	Inorganic	92375000	71250000	22.87
158	Inorganic	101000000	69000000	31.68
159	Inorganic	102000000	69000000	32.35
161	Inorganic	63000000	24000000	61.90
162	Inorganic	60000000	24000000	60.00
163	Inorganic	217000000	128000000	41.01
164	Inorganic	103000000	94000000	8.74
166	Inorganic	145000000	127000000	12.41
167	Inorganic	142000000	113000000	20.42
168	Inorganic	123000000	223000000	0.00
169	Inorganic	100000000	113000000	0.00
170	Inorganic	143000000	151000000	0.00
171	Inorganic	97000000	91000000	6.19
172	Inorganic	153000000	122000000	20.26
173	Inorganic	102000000	109000000	0.00
174	Inorganic	121000000	29000000	76.03
175	Inorganic	57000000	60000000	0.00
176	Inorganic	67000000	82000000	0.00
177	Inorganic	37000000	41000000	0.00
178	Inorganic	110000000	141000000	0.00
179	Inorganic	25000000	14000000	44.00
180	Inorganic	92000000	64000000	30.43
181	Inorganic	100000000	107000000	0.00
182	Inorganic	200000000	113000000	43.50
183	Inorganic	150000000	110000000	26.67
184	Inorganic	215000000000	200000000	99.91
185	Inorganic	253500000000	25000000	99.99
186	Inorganic	126000000000	54000000000	57.14
187	Inorganic	90000000000	64000000000	28.89
189	Inorganic	113500000000	67000000000	40.97
190	Inorganic	80500000000	76000000000	5.59
191	Inorganic	78000000000	65000000000	16.67
192	Inorganic	45000000000	10000000000	77.78
197	Inorganic	100000000	82000000	18.00
199	Inorganic	101000000	82000000	18.81
200	Inorganic	160000000	132000000	17.50

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
201	Organic	68800000	43100000	37.35
202	Organic	18200000	13200000	27.47
203	Organic	28700000	26400000	8.01
204	Organic	57000000	44700000	21.58
205	Organic	40600000	31700000	21.92
206	Organic	50000000	44900000	10.20
207	Organic	60400000	44600000	26.16
208	Organic	32400000	32100000	0.93
209	Organic	76000000	51600000	32.11
210	Organic	47800000	45800000	4.18
211	Organic	48100000	49000000	0.00
212	Organic	41300000	60000000	0.00
213	Organic	46900000	63200000	0.00
214	Organic	1900000	2300000	0.00
215	Organic	37900000	45200000	0.00
216	Organic	35000000	40700000	0.00
217	Organic	40300000	41100000	0.00
218	Organic	12300000	21200000	0.00
219	Organic	35300000	37500000	0.00
220	Organic	42700000	70800000	0.00
221	Organic	152000000	129000000	15.13
222	Organic	86000000	79000000	8.14
224	Organic	109000000	116000000	0.00
225	Organic	37700000	60000000	0.00
227	Organic	89000000	88000000	1.12
228	Organic	43000000	55200000	0.00
229	Organic	30900000	40000000	0.00
230	Organic	36600000	53800000	0.00
231	Organic	96000000	86000000	10.42
232	Organic	222000000	134000000	39.64
233	Organic	69000000	90000000	0.00
234	Organic	100000000	105000000	0.00
235	Organic	77000000	61000000	20.78
236	Organic	116000000	160000000	0.00
237	Organic	344000000	91000000	73.55
238	Organic	89000000	116000000	0.00
239	Organic	125000000	154000000	0.00
240	Organic	95000000	67000000	29.47
241	Organic	99000000	109000000	0.00
242	Organic	114000000	95000000	16.67
243	Organic	182000000	58000000	68.13

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
244	Organic	85000000	22000000	74.12
245	Organic	140000000	294000000	0.00
246	Organic	83000000	99000000	0.00
247	Organic	100000000	95000000	5.00
248	Organic	85000000	82000000	3.53
249	Organic	98000000	105000000	0.00
250	Organic	103000000	163000000	0.00
251	Organic	110000000	116000000	0.00
252	Organic	109000000	104000000	4.59
253	Organic	76000000	101000000	0.00
254	Organic	97000000	95000000	2.06
255	Organic	50000000	63000000	0.00
256	Organic	93000000	85000000	8.60
257	Organic	66000000	84000000	0.00
258	Organic	62000000	98000000	0.00
259	Organic	138000000	108000000	21.74
260	Organic	246000000	75000000	69.51
261	Organic	126000000	81000000	35.71
262	Organic	81000000	85000000	0.00
263	Organic	132000000	92000000	30.30
264	Organic	241000000	127000000	47.30
265	Organic	114000000	61000000	46.49
266	Organic	51000000	79000000	0.00
267	Organic	59000000	2000000	96.61
268	Organic	89000000	105000000	0.00
269	Organic	106000000	194000000	0.00
270	Organic	58000000	80000000	0.00
271	Organic	36000000	116000000	0.00
272	Organic	29000000	77000000	0.00
273	Organic	30000000	41000000	0.00
275	Organic	29750000	50000000	0.00
276	Organic	103000000	101000000	1.94
277	Organic	95000000	82000000	13.68
278	Organic	35000000	96000000	0.00
279	Organic	95000000	212000000	0.00
280	Organic	79000000	73000000	7.59
281	Organic	84000000	75000000	10.71
282	Organic	140000000	137000000	2.14
283	Organic	29000000	45000000	0.00
284	Organic	71000000	83000000	0.00
285	Organic	71000000	114000000	0.00

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
286	Organic	111000000	76000000	31.53
287	Organic	81000000	74000000	8.64
288	Organic	78000000	122000000	0.00
289	Organic	110000000	85000000	22.73
290	Organic	130000000	114000000	12.31
292	Organic	85000000	46000000	45.88
293	Organic	129000000	103000000	20.16
294	Organic	63000000	74000000	0.00
295	Organic	146000000	76000000	47.95
296	Organic	79000000	50000000	36.71
297	Organic	112000000	121000000	0.00
298	Organic	84000000	89000000	0.00
299	Organic	68000000	77000000	0.00
300	Organic	71000000	72000000	0.00
301	Organic	73000000	71000000	2.74
302	Organic	101000000	79000000	21.78
303	Organic	83000000	104000000	0.00
304	Organic	75000000	82000000	0.00
305	Organic	62000000	72000000	0.00
306	Organic	86000000	70000000	18.60
307	Organic	82000000	78000000	4.88
308	Organic	97000000	90000000	7.22
309	Organic	68000000	69000000	0.00
310	Organic	119000000	41000000	65.55
311	Organic	86000000	97000000	0.00
312	Organic	61000000	50000000	18.03
313	Organic	105000000	82000000	21.90
314	Organic	58000000	56000000	3.45
315	Organic	81500000	69000000	15.34
316	Organic	69750000	62500000	10.39
317	Organic	3000000	2000000	33.33
318	Organic	36375000	32250000	11.34
319	Organic	70000000	57000000	18.57
320	Organic	100000000	94000000	6.00
321	Organic	85000000	75500000	11.18
324	Organic	87000000	85000000	2.30
325	Organic	114000000	104000000	8.77
326	Organic	60000000	34000000	43.33
327	Organic	11000000	9000000	18.18
328	Organic	35000000	25000000	28.57
329	Organic	112000000	53000000	52.68

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
330	Organic	70000000	62000000	11.43
331	Organic	91000000	57000000	37.36
332	Organic	60000000	47000000	21.67
333	Organic	75500000	52000000	31.13
336	Organic	78000000	63000000	19.23
337	Organic	7000000	6500000	7.14
338	Organic	8000000	2000000	75.00
339	Organic	51000000	60000000	0.00
341	Organic	124000000	115000000	7.26
342	Organic	98000000	86000000	12.24
343	Organic	100000000	64000000	36.00
344	Organic	98000000	87000000	11.22
345	Organic	90000000	108000000	0.00
346	Organic	78000000	81000000	0.00
348	Organic	68000000	65000000	4.41
349	Organic	114000000	113000000	0.88
350	Organic	109000000	113000000	0.00
351	Organic	111000000	79000000	28.83
353	Organic	96000000	162000000	0.00
354	Organic	101000000	148000000	0.00
355	Organic	115000000	126000000	0.00
356	Organic	86000000	80000000	6.98
357	Organic	93000000	94000000	0.00
358	Organic	106000000	80000000	24.53
359	Organic	106000000	147000000	0.00
360	Organic	253000000	203000000	19.76
361	Organic	281000000	167000000	40.57
362	Organic	5000000	4000000	20.00
363	Organic	101000000	109000000	0.00
364	Organic	77000000	85000000	0.00
365	Organic	91000000	86000000	5.49
366	Organic	75000000	64000000	14.67
367	Organic	105000000	101000000	3.81
368	Organic	120000000	128000000	0.00
369	Organic	93000000	134000000	0.00
370	Organic	59000000	77000000	0.00
371	Organic	1000000	1100000	0.00
372	Organic	9000000	10000000	0.00
373	Organic	360000000	107000000	70.28
374	Organic	51000000	54000000	0.00
375	Organic	87000000	100000000	0.00

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
376	Organic	60000000	116000000	0.00
378	Organic	81000000	76000000	6.17
379	Organic	77000000	93000000	0.00
380	Organic	75000000	94000000	0.00
381	Organic	78000000	108000000	0.00
382	Organic	106000000	90000000	15.09
384	Organic	119000000	118000000	0.84
385	Organic	93000000	117000000	0.00
386	Organic	124000000	110000000	11.29
388	Organic	388000000	370000000	4.64
389	Organic	110000000	113000000	0.00
390	Organic	83000000	135000000	0.00
391	Organic	102000000	86000000	15.69
392	Organic	104000000	104000000	0.00
393	Organic	80000000	72000000	10.00
394	Organic	6000000	2000000	66.67
397	Organic	93000000	87000000	6.45
398	Organic	87000000	91000000	0.00
399	Organic	56000000	71000000	0.00
400	Organic	116000000	115000000	0.86
401	Inorganic	59000000	82000000	0.00
402	Inorganic	92000000	55000000	40.22
403	Inorganic	72000000	58000000	19.44
404	Inorganic	62000000	72000000	0.00
405	Inorganic	44000000	42000000	4.55
406	Inorganic	123000000	104000000	15.45
407	Inorganic	120000000	81000000	32.50
409	Inorganic	39000000	59000000	0.00
410	Inorganic	94000000	61000000	35.11
411	Inorganic	68000000	56000000	17.65
412	Inorganic	81000000	58500000	27.78
414	Inorganic	77000000	43750000	43.18
415	Inorganic	37000000	31000000	16.22
416	Inorganic	-	-	-
417	Inorganic	110000000	85000000	22.73
418	Inorganic	91000000	51000000	43.96
419	Inorganic	111000000	85000000	23.42
420	Inorganic	2000000	3000000	0.00
421	Inorganic	85000000	65000000	23.53
423	Inorganic	79000000	52000000	34.18
425	Inorganic	85000000	74000000	12.94

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
426	Inorganic	103000000	86000000	16.50
427	Inorganic	89000000	89000000	0.00
430	Inorganic	78000000	80000000	0.00
431	Inorganic	95000000	108000000	0.00
433	Inorganic	3000000	3000000	0.00
434	Inorganic	98000000	83000000	15.31
435	Inorganic	102000000	106000000	0.00
436	Inorganic	113000000	94000000	16.81
437	Inorganic	100000000	90000000	10.00
438	Inorganic	112000000	90000000	19.64
439	Inorganic	79000000	70000000	11.39
440	Inorganic	89000000	79000000	11.24
441	Inorganic	90000000	92000000	0.00
442	Inorganic	74000000	114000000	0.00
443	Inorganic	49000000	78000000	0.00
444	Inorganic	87000000	104000000	0.00
445	Inorganic	75000000	117000000	0.00
446	Inorganic	73000000	42000000	42.47
447	Inorganic	89000000	44000000	50.56
448	Inorganic	77000000	102000000	0.00
449	Inorganic	86000000	89000000	0.00
450	Inorganic	101000000	85000000	15.84
451	Inorganic	41000000	30000000	26.83
452	Inorganic	84000000	67000000	20.24
453	Inorganic	74000000	97000000	0.00
454	Inorganic	98000000	102000000	0.00
455	Inorganic	2500000	2000000	20.00
456	Inorganic	122000000	105000000	13.93
457	Inorganic	50000000	17000000	66.00
458	Inorganic	119000000	120000000	0.00
459	Inorganic	49000000	42000000	14.29
460	Inorganic	72000000	106000000	0.00
462	Inorganic	79000000	75000000	0.00
463	Inorganic	59000000	83000000	0.00
464	Inorganic	106000000	133000000	0.00
465	Inorganic	107000000	140000000	0.00
466	Inorganic	106500000	82000000	23.00
467	Inorganic	89000000	82000000	7.87
468	Inorganic	108000000	92000000	14.81
469	Inorganic	89000000	102000000	0.00
470	Inorganic	370000000	125000000	66.22

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
471	Inorganic	1000000	8300000	0.00
472	Inorganic	97000000	106000000	0.00
473	Inorganic	91000000	84000000	7.69
474	Inorganic	78000000	116000000	0.00
475	Inorganic	70000000	91000000	0.00
476	Inorganic	54000000	65000000	0.00
477	Inorganic	62000000	78000000	0.00
478	Inorganic	56000000	38000000	32.14
479	Inorganic	2000000	14000000	0.00
480	Inorganic	54000000	66000000	0.00
481	Inorganic	73000000	95000000	0.00
482	Inorganic	89000000	102000000	0.00
483	Inorganic	1000000	3000000	0.00
484	Inorganic	1000000	4000000	0.00
485	Inorganic	97000000	155000000	0.00
486	Inorganic	106000000	269000000	0.00
487	Inorganic	87000000	147000000	0.00
488	Inorganic	21000000	103000000	0.00
489	Inorganic	90000000	191000000	0.00
490	Inorganic	3000000	90000000	0.00
491	Inorganic	258000000	141000000	45.35
492	Inorganic	104000000	85000000	18.27
493	Inorganic	83000000	84000000	0.00
494	Inorganic	109000000	113000000	0.00
495	Inorganic	101000000	98000000	2.97
497	Inorganic	95000000	89000000	6.32
498	Inorganic	86000000	104000000	0.00
499	Inorganic	118000000	107000000	9.32
500	Inorganic	98000000	66000000	32.65
501	Inorganic	84000000	61000000	27.38
502	Inorganic	64000000	52000000	18.75
503	Inorganic	81000000	180000000	0.00
504	Inorganic	102000000	80000000	21.57
505	Inorganic	75000000	70000000	6.67
506	Inorganic	65000000	63000000	3.08
507	Inorganic	82000000	60000000	26.83
508	Inorganic	2000000	1700000	15.00
509	Inorganic	100000000	52000000	48.00
510	Inorganic	81000000	59000000	27.16
511	Inorganic	75000000	58000000	22.67
512	Inorganic	257000000	32000000	87.55

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
513	Inorganic	32000000	6000000	81.25
514	Inorganic	9000000	55000000	0.00
515	Inorganic	130000000	98000000	24.62
516	Inorganic	59000000	67000000	0.00
517	Inorganic	30000000	34000000	0.00
518	Inorganic	73000000	71000000	2.74
519	Inorganic	88000000	81000000	7.95
520	Inorganic	26000000	34000000	0.00
521	Inorganic	23000000	32000000	0.00
522	Inorganic	38000000	40000000	0.00
523	Inorganic	1000000	900000	10.00
525	Inorganic	47000000	40000000	14.89
526	Inorganic	89000000	94000000	0.00
527	Inorganic	4000000	3500000	12.50
528	Inorganic	43000000	34000000	20.93
529	Inorganic	23500000	2000000	91.49
530	Inorganic	1000000	900000	10.00
531	Inorganic	46000000	36000000	21.74
532	Inorganic	42000000	38000000	9.52
533	Inorganic	85000000	90000000	0.00
534	Inorganic	39000000	36000000	7.69
535	Inorganic	36000000	38000000	0.00
536	Inorganic	65000000	56000000	13.85
537	Inorganic	50500000	47000000	6.93
538	Inorganic	57750000	51500000	10.82
539	Inorganic	54125000	49250000	9.01
540	Inorganic	1000000	9800000	0.00
541	Inorganic	1000000	1010000	0.00
542	Inorganic	47000000	50000000	0.00
543	Inorganic	51000000	59000000	0.00
544	Inorganic	57000000	48000000	15.79
545	Inorganic	54000000	68000000	0.00
546	Inorganic	51000000	48000000	5.88
547	Inorganic	65000000	74000000	0.00
548	Inorganic	81000000	190000000	0.00
549	Inorganic	64000000	64000000	0.00
550	Inorganic	72500000	127000000	0.00
551	Inorganic	66000000	42000000	36.36
552	Inorganic	105000000	82000000	21.90
553	Inorganic	78000000	83000000	0.00
554	Inorganic	96000000	81000000	15.63

Sample ID	Management	Total Average cfu/mL	Unattached Average cfu/mL	% Attachment
556	Inorganic	49000000	56000000	0.00

Sample ID	Management	GEN			
		S/I/R	S	I	R
1	Inorganic	S	1	0	0
2	Inorganic	S	1	0	0
3	Inorganic	S	1	0	0
4	Inorganic	S	1	0	0
5	Inorganic	S	1	0	0
6	Inorganic	S	1	0	0
7	Inorganic	S	1	0	0
8	Inorganic	S	1	0	0
9	Inorganic	S	1	0	0
10	Inorganic	S	1	0	0
11	Inorganic	S	1	0	0
12	Inorganic	S	1	0	0
13	Inorganic	S	1	0	0
14	Inorganic	S	1	0	0
15	Inorganic	S	1	0	0
16	Inorganic	S	1	0	0
17	Inorganic	S	1	0	0
19	Inorganic	S	1	0	0
20	Inorganic	S	1	0	0
21	Inorganic	S	1	0	0
22	Inorganic	S	1	0	0
24	Inorganic	S	1	0	0
25	Inorganic	S	1	0	0
27	Inorganic	S	1	0	0
28	Inorganic	S	1	0	0

Sample ID	Management	GEN			
		S/I/R	S	I	R
29	Inorganic	S	1	0	0
30	Inorganic	S	1	0	0
31	Inorganic	S	1	0	0
32	Inorganic	S	1	0	0
33	Inorganic	S	1	0	0
34	Inorganic	S	1	0	0
35	Inorganic	S	1	0	0
36	Inorganic	S	1	0	0
37	Inorganic	S	1	0	0
38	Inorganic	S	1	0	0
39	Inorganic	S	1	0	0
40	Inorganic	S	1	0	0
41	Inorganic	S	1	0	0
42	Inorganic	S	1	0	0
43	Inorganic	S	1	0	0
44	Inorganic	S	1	0	0
46	Inorganic	S	1	0	0
47	Inorganic	S	1	0	0
48	Inorganic	S	1	0	0
49	Inorganic	S	1	0	0
50	Inorganic	S	1	0	0
51	Inorganic	S	1	0	0
52	Inorganic	S	1	0	0
53	Inorganic	S	1	0	0
54	Inorganic	R		0	1
54 dup	Inorganic	R		0	1
55	Inorganic	S	1	0	0
57	Inorganic	S	1	0	0
58	Inorganic	R		0	1
59	Inorganic	S	1	0	0
60	Inorganic	S	1	0	0
61	Inorganic	S	1	0	0
62	Inorganic	S	1	0	0
63	Inorganic	S	1	0	0
64	Inorganic	S	1	0	0
65	Inorganic	S	1	0	0
66	Inorganic	S	1	0	0
67	Inorganic	S	1	0	0
68	Inorganic	S	1	0	0
69	Inorganic	S	1	0	0
70	Inorganic	S	1	0	0

Sample ID	Management	GEN			
		S/I/R	S	I	R
71	Inorganic	S	1	0	0
72	Inorganic	S	1	0	0
73	Inorganic	S	1	0	0
74	Inorganic	S	1	0	0
75	Inorganic	S	1	0	0
76	Inorganic	S	1	0	0
77	Inorganic	S	1	0	0
79	Inorganic	S	1	0	0
82	Inorganic	S	1	0	0
84	Inorganic	S	1	0	0
88	Inorganic	S	1	0	0
89	Inorganic	S	1	0	0
90	Inorganic	S	1	0	0
91	Inorganic	S	1	0	0
93	Inorganic	S	1	0	0
96	Inorganic	S	1	0	0
101	Inorganic	R	0	0	1
102	Inorganic	R	0	0	1
103	Inorganic	R	0	0	1
104	Inorganic	S	1	0	0
105	Inorganic	R	0	0	1
106	Inorganic	R	0	0	1
107	Inorganic	R	0	0	1
108	Inorganic	R	0	0	1
109	Inorganic	R	0	0	1
110	Inorganic	R	0	0	1
111	Inorganic	R	0	0	1
112	Inorganic	R	0	0	1
113	Inorganic	R	0	0	1
114	Inorganic	R	0	0	1
115	Inorganic	R	0	0	1
116	Inorganic	R	0	0	1
117	Inorganic	R	0	0	1
118	Inorganic	R	0	0	1
119	Inorganic	R	0	0	1
120	Inorganic	R	0	0	1
121	Inorganic	R	0	0	1
122	Inorganic	S	1	0	0
123	Inorganic	S	1	0	0
124	Inorganic	S	1	0	0
126	Inorganic	R	0	0	1

Sample ID	Management	GEN			
		S/I/R	S	I	R
130	Inorganic	S	1	0	0
131	Inorganic	S	1	0	0
133	Inorganic	S	1	0	0
134	Inorganic	S	1	0	0
136	Inorganic	R	0	0	1
138	Inorganic	S	1	0	0
139	Inorganic	S	1	0	0
140	Inorganic	S	1	0	0
141	Inorganic	S	1	0	0
142	Inorganic	S	1	0	0
143	Inorganic	S	1	0	0
144	Inorganic	R	0	0	1
147	Inorganic	S	1	0	0
148	Inorganic	S	1	0	0
149	Inorganic	S	1	0	0
151	Inorganic	S	1	0	0
153	Inorganic	S	1	0	0
154	Inorganic	S	1	0	0
155	Inorganic	S	1	0	0
156	Inorganic	S	1	0	0
158	Inorganic	S	1	0	0
159	Inorganic	S	1	0	0
161	Inorganic	S	1	0	0
162	Inorganic	S	1	0	0
163	Inorganic	S	1	0	0
164	Inorganic	S	1	0	0
166	Inorganic	S	1	0	0
167	Inorganic	S	1	0	0
168	Inorganic	S	1	0	0
169	Inorganic	S	1	0	0
170	Inorganic	S	1	0	0
171	Inorganic	S	1	0	0
172	Inorganic	S	1	0	0
173	Inorganic	S	1	0	0
174	Inorganic	S	1	0	0
175	Inorganic	S	1	0	0
176	Inorganic	S	1	0	0
177	Inorganic	S	1	0	0
178	Inorganic	S	1	0	0
179	Inorganic	S	1	0	0
180	Inorganic	S	1	0	0

Sample ID	Management	GEN			
		S/I/R	S	I	R
181	Inorganic	S	1	0	0
182	Inorganic	S	1	0	0
183	Inorganic	S	1	0	0
184	Inorganic	S	1	0	0
185	Inorganic	S	1	0	0
186	Inorganic	S	1	0	0
187	Inorganic	S	1	0	0
189	Inorganic	S	1	0	0
190	Inorganic	S	1	0	0
191	Inorganic	S	1	0	0
192	Inorganic	S	1	0	0
197	Inorganic	S	1	0	0
199	Inorganic	S	1	0	0
200	Inorganic	S	1	0	0
201	Organic	S	1	0	0
202	Organic	S	1	0	0
203	Organic	S	1	0	0
204	Organic	S	1	0	0
205	Organic	S	1	0	0
206	Organic	S	1	0	0
207	Organic	S	1	0	0
208	Organic	I	0	1	0
209	Organic	S	1	0	0
210	Organic	S	1	0	0
211	Organic	S	1	0	0
212	Organic	S	1	0	0
213	Organic	S	1	0	0
214	Organic	S	1	0	0
215	Organic	S	1	0	0
216	Organic	S	1	0	0
217	Organic	S	1	0	0
218	Organic	S	1	0	0
219	Organic	S	1	0	0
220	Organic	S	1	0	0
221	Organic	S	1	0	0
222	Organic	S	1	0	0
224	Organic	S	1	0	0
225	Organic	S	1	0	0
227	Organic	S	1	0	0
228	Organic	S	1	0	0
229	Organic	S	1	0	0

Sample ID	Management	GEN			
		S/I/R	S	I	R
230	Organic	S	1	0	0
231	Organic	S	1	0	0
232	Organic	R	0	0	1
233	Organic	S	1	0	0
234	Organic	S	1	0	0
235	Organic	S	1	0	0
236	Organic	S	1	0	0
237	Organic	S	1	0	0
238	Organic	S	1	0	0
239	Organic	S	1	0	0
240	Organic	S	1	0	0
241	Organic	R	0	0	1
242	Organic	I	0	1	0
243	Organic	S	1	0	0
244	Organic	S	1	0	0
245	Organic	R	0	0	1
246	Organic	S	1	0	0
247	Organic	S	1	0	0
248	Organic	I	0	1	0
249	Organic	S	1	0	0
250	Organic	R	0	0	1
251	Organic	S	1	0	0
252	Organic	S	1	0	0
253	Organic	S	1	0	0
254	Organic	S	1	0	0
255	Organic	I	0	1	0
256	Organic	S	1	0	0
257	Organic	R	0	0	1
258	Organic	S	1	0	0
259	Organic	S	1	0	0
260	Organic	S	1	0	0
261	Organic	S	1	0	0
262	Organic	S	1	0	0
263	Organic	S	1	0	0
264	Organic	S	1	0	0
265	Organic	S	1	0	0
266	Organic	S	1	0	0
267	Organic	S	1	0	0
268	Organic	S	1	0	0
269	Organic	I	0	1	0
270	Organic	S	1	0	0

Sample ID	Management	GEN			
		S/I/R	S	I	R
271	Organic	S	1	0	0
272	Organic	S	1	0	0
273	Organic	S	1	0	0
275	Organic	S	1	0	0
276	Organic	I	0	1	0
277	Organic	S	1	0	0
278	Organic	I	0	1	0
279	Organic	S	1	0	0
280	Organic	S	1	0	0
281	Organic	R	0	0	1
282	Organic	S	1	0	0
283	Organic	S	1	0	0
284	Organic	I	0	1	0
285	Organic	S	1	0	0
286	Organic	S	1	0	0
287	Organic	S	1	0	0
288	Organic	S	1	0	0
289	Organic	S	1	0	0
290	Organic	S	1	0	0
292	Organic	S	1	0	0
293	Organic	S	1	0	0
294	Organic	S	1	0	0
295	Organic	S	1	0	0
296	Organic	S	1	0	0
297	Organic	S	1	0	0
298	Organic	S	1	0	0
299	Organic	S	1	0	0
300	Organic	S	1	0	0
301	Organic	S	1	0	0
302	Organic	S	1	0	0
303	Organic	S	1	0	0
304	Organic	S	1	0	0
305	Organic	S	1	0	0
306	Organic	S	1	0	0
307	Organic	S	1	0	0
308	Organic	S	1	0	0
309	Organic	S	1	0	0
310	Organic	S	1	0	0
311	Organic	S	1	0	0
312	Organic	S	1	0	0
313	Organic	S	1	0	0

Sample ID	Management	GEN			
		S/I/R	S	I	R
314	Organic	S	1	0	0
315	Organic	S	1	0	0
316	Organic	S	1	0	0
317	Organic	S	1	0	0
318	Organic	S	1	0	0
319	Organic	S	1	0	0
320	Organic	S	1	0	0
321	Organic	S	1	0	0
324	Organic	R	0	0	1
325	Organic	S	1	0	0
326	Organic	S	1	0	0
327	Organic	S	1	0	0
328	Organic	S	1	0	0
329	Organic	S	1	0	0
330	Organic	S	1	0	0
331	Organic	S	1	0	0
332	Organic	R	0	0	1
333	Organic	S	1	0	0
336	Organic	S	1	0	0
337	Organic	S	1	0	0
338	Organic	S	1	0	0
339	Organic	S	1	0	0
341	Organic	S	1	0	0
342	Organic	S	1	0	0
343	Organic	S	1	0	0
344	Organic	S	1	0	0
345	Organic	S	1	0	0
346	Organic	S	1	0	0
348	Organic	R	0	0	1
349	Organic	S	1	0	0
350	Organic	S	1	0	0
351	Organic	R	0	0	1
353	Organic	R	0	0	1
354	Organic	R	0	0	1
355	Organic	R	0	0	1
356	Organic	R	0	0	1
357	Organic	R	0	0	1
358	Organic	R	0	0	1
359	Organic	R	0	0	1
360	Organic	R	0	0	1
361	Organic	R	0	0	1

Sample ID	Management	GEN			
		S/I/R	S	I	R
362	Organic	R	0	0	1
363	Organic	R	0	0	1
364	Organic	R	0	0	1
365	Organic	R	0	0	1
366	Organic	R	0	0	1
367	Organic	R	0	0	1
368	Organic	R	0	0	1
369	Organic	R	0	0	1
370	Organic	R	0	0	1
371	Organic	R	0	0	1
372	Organic	S	1	0	0
373	Organic	R	0	0	1
374	Organic	R	0	0	1
375	Organic	R	0	0	1
376	Organic	R	0	0	1
378	Organic	S	1	0	0
379	Organic	R	0	0	1
380	Organic	R	0	0	1
381	Organic	S	1	0	0
382	Organic	S	1	0	0
384	Organic	S	1	0	0
385	Organic	S	1	0	0
386	Organic	S	1	0	0
388	Organic	S	1	0	0
389	Organic	S	1	0	0
390	Organic	R	0	0	1
391	Organic	S	1	0	0
392	Organic	S	1	0	0
393	Organic	S	1	0	0
394	Organic	S	1	0	0
397	Organic	S	1	0	0
398	Organic	S	1	0	0
399	Organic	S	1	0	0
400	Organic	S	1	0	0
401	Inorganic	S	1	0	0
402	Inorganic	S	1	0	0
403	Inorganic	S	1	0	0
404	Inorganic	S	1	0	0
405	Inorganic	S	1	0	0
406	Inorganic	S	1	0	0
407	Inorganic	R	0	0	1

Sample ID	Management	GEN			
		S/I/R	S	I	R
409	Inorganic	S	1	0	0
410	Inorganic	S	1	0	0
411	Inorganic	S	1	0	0
412	Inorganic	S	1	0	0
414	Inorganic	R		0	1
415	Inorganic	S	1	0	0
416	Inorganic	S	1	0	0
417	Inorganic	S	1	0	0
418	Inorganic	S	1	0	0
419	Inorganic	S	1	0	0
420	Inorganic	S	1	0	0
421	Inorganic	S	1	0	0
423	Inorganic	S	1	0	0
425	Inorganic	S	1	0	0
426	Inorganic	S	1	0	0
427	Inorganic	S	1	0	0
430	Inorganic	S	1	0	0
431	Inorganic	S	1	0	0
433	Inorganic	S	1	0	0
434	Inorganic	S	1	0	0
435	Inorganic	S	1	0	0
436	Inorganic	S	1	0	0
437	Inorganic	S	1	0	0
438	Inorganic	S	1	0	0
439	Inorganic	S	1	0	0
440	Inorganic	S	1	0	0
441	Inorganic	R	0	0	1
442	Inorganic	S	1	0	0
443	Inorganic	S	1	0	0
444	Inorganic	S	1	0	0
445	Inorganic	S	1	0	0
446	Inorganic	S	1	0	0
447	Inorganic	S	1	0	0
448	Inorganic	S	1	0	0
449	Inorganic	S	1	0	0
450	Inorganic	S	1	0	0
451	Inorganic	S	1	0	0
452	Inorganic	S	1	0	0
453	Inorganic	S	1	0	0
454	Inorganic	S	1	0	0
455	Inorganic	S	1	0	0

Sample ID	Management	GEN			
		S/I/R	S	I	R
456	Inorganic	S	1	0	0
457	Inorganic	S	1	0	0
458	Inorganic	S	1	0	0
459	Inorganic	S	1	0	0
460	Inorganic	S	1	0	0
462	Inorganic	S	1	0	0
463	Inorganic	S	1	0	0
464	Inorganic	S	1	0	0
465	Inorganic	S	1	0	0
466	Inorganic	S	1	0	0
467	Inorganic	R	0	0	1
468	Inorganic	R	0	0	1
469	Inorganic	S	1	0	0
470	Inorganic	S	1	0	0
471	Inorganic	S	1	0	0
472	Inorganic	S	1	0	0
473	Inorganic	R	0	0	1
474	Inorganic	S	1	0	0
475	Inorganic	S	1	0	0
476	Inorganic	S	1	0	0
477	Inorganic	S	1	0	0
478	Inorganic	S	1	0	0
479	Inorganic	R	0	0	1
480	Inorganic	R	0	0	1
481	Inorganic	S	1	0	0
482	Inorganic	S	1	0	0
483	Inorganic	S	1	0	0
484	Inorganic	S	1	0	0
485	Inorganic	R	0	0	1
486	Inorganic	R	0	0	1
487	Inorganic	S	1	0	0
488	Inorganic	S	1	0	0
489	Inorganic	S	1	0	0
490	Inorganic	S	1	0	0
491	Inorganic	R	0	0	1
492	Inorganic	S	1	0	0
493	Inorganic	S	1	0	0
494	Inorganic	S	1	0	0
495	Inorganic	S	1	0	0
497	Inorganic	S	1	0	0
498	Inorganic	R	0	0	1

Sample ID	Management	GEN			
		S/I/R	S	I	R
499	Inorganic	I	0	1	0
500	Inorganic	S	1	0	0
501	Inorganic	S	1	0	0
502	Inorganic	S	1	0	0
503	Inorganic	S	1	0	0
504	Inorganic	R	0	0	1
505	Inorganic	R	0	0	1
506	Inorganic	I	0	1	0
507	Inorganic	S	1	0	0
508	Inorganic	S	1	0	0
509	Inorganic	S	1	0	0
510	Inorganic	S	1	0	0
511	Inorganic	R	0	0	1
512	Inorganic	S	1	0	0
513	Inorganic	S	1	0	0
514	Inorganic	S	1	0	0
515	Inorganic	S	1	0	0
516	Inorganic	S	1	0	0
517	Inorganic	S	1	0	0
518	Inorganic	R	0	0	1
519	Inorganic	S	1	0	0
520	Inorganic	S	1	0	0
521	Inorganic	S	1	0	0
522	Inorganic	S	1	0	0
523	Inorganic	R	0	0	1
525	Inorganic	R	0	0	1
526	Inorganic	R	0	0	1
527	Inorganic	S	1	0	0
528	Inorganic	S	1	0	0
529	Inorganic	S	1	0	0
530	Inorganic	S	1	0	0
531	Inorganic	S	1	0	0
532	Inorganic	S	1	0	0
533	Inorganic	I	0	1	0
534	Inorganic	S	1	0	0
535	Inorganic	S	1	0	0
536	Inorganic	S	1	0	0
537	Inorganic	S	1	0	0
538	Inorganic	S	1	0	0
539	Inorganic	I	0	1	0
540	Inorganic	R	0	0	1

Sample ID	Management	GEN			
		S/I/R	S	I	R
541	Inorganic	I	0	0	0
542	Inorganic	I	0	1	0
543	Inorganic	S	1	0	0
544	Inorganic	S	1	0	0
545	Inorganic	R	0	0	1
546	Inorganic	S	1	0	0
547	Inorganic	I	0	1	0
548	Inorganic	I	0	1	0
549	Inorganic	I	0	1	0
550	Inorganic	S	1	0	0
551	Inorganic	S	1	0	0
552	Inorganic	S	1	0	0
553	Inorganic	S	1	0	0
554	Inorganic	S	1	0	0
556	Inorganic	R	0	0	1

Sample ID	Management	AMP			
		S/I/R	S	I	R
1	Inorganic	S	1	0	0
2	Inorganic	S	1	0	0
3	Inorganic	R	0	0	1
4	Inorganic	S	1	0	0
5	Inorganic	S	1	0	0
6	Inorganic	R	0	0	1
7	Inorganic	R	0	0	1
8	Inorganic	S	1	0	0
9	Inorganic	R	0	0	1
10	Inorganic	R	0	0	1
11	Inorganic	S	1	0	0
12	Inorganic	S	1	0	0
13	Inorganic	S	1	0	0
14	Inorganic	S	1	0	0
15	Inorganic	R	0	0	1
16	Inorganic	R	0	0	1
17	Inorganic	S	1	0	0
19	Inorganic	S	1	0	0
20	Inorganic	R	0	0	1
21	Inorganic	R	0	0	1
22	Inorganic	R	0	0	1
24	Inorganic	S	1	0	0
25	Inorganic	S	1	0	0
27	Inorganic	S	1	0	0
28	Inorganic	R	0	0	1
29	Inorganic	S	1	0	0
30	Inorganic	S	1	0	0
31	Inorganic	S	1	0	0
32	Inorganic	R	0	0	1
33	Inorganic	R	0	0	1
34	Inorganic	S	1	0	0
35	Inorganic	R	0	0	1
36	Inorganic	S	1	0	0
37	Inorganic	S	1	0	0
38	Inorganic	S	1	0	0
39	Inorganic	S	1	0	0
40	Inorganic	S	1	0	0
41	Inorganic	R	0	0	1
42	Inorganic	R	0	0	1
43	Inorganic	S	1	0	0
44	Inorganic	S	1	0	0

Sample ID	Management	AMP			
		S/I/R	S	I	R
46	Inorganic	S	1	0	0
47	Inorganic	S	1	0	0
48	Inorganic	S	1	0	0
49	Inorganic	S	1	0	0
50	Inorganic	S	1	0	0
51	Inorganic	S	1	0	0
52	Inorganic	S	1	0	0
53	Inorganic	S	1	0	0
54	Inorganic	R	0	0	1
54 dup	Inorganic	R	0	0	1
55	Inorganic	S	1	0	0
57	Inorganic	R	0	0	1
58	Inorganic	R	0	0	1
59	Inorganic	S	1	0	0
60	Inorganic	S	1	0	0
61	Inorganic	S	1	0	0
62	Inorganic	S	1	0	0
63	Inorganic	S	1	0	0
64	Inorganic	S	1	0	0
65	Inorganic	R	0	0	1
66	Inorganic	S	1	0	0
67	Inorganic	S	1	0	0
68	Inorganic	S	1	0	0
69	Inorganic	S	1	0	0
70	Inorganic	S	1	0	0
71	Inorganic	R	0	0	1
72	Inorganic	S	1	0	0
73	Inorganic	S	1	0	0
74	Inorganic	R	0	0	1
75	Inorganic	S	1	0	0
76	Inorganic	S	1	0	0
77	Inorganic	S	1	0	0
79	Inorganic	S	1	0	0
82	Inorganic	S	1	0	0
84	Inorganic	S	1	0	0
88	Inorganic	S	1	0	0
89	Inorganic	S	1	0	0
90	Inorganic	S	1	0	0
91	Inorganic	S	1	0	0
93	Inorganic	S	1	0	0
96	Inorganic	S	1	0	0

Sample ID	Management	AMP			
		S/I/R	S	I	R
101	Inorganic	R	0	0	1
102	Inorganic	R	0	0	1
103	Inorganic	R	0	0	1
104	Inorganic	I	0	1	0
105	Inorganic	R	0	0	1
106	Inorganic	R	0	0	1
107	Inorganic	R	0	0	1
108	Inorganic	R	0	0	1
109	Inorganic	R	0	0	1
110	Inorganic	R	0	0	1
111	Inorganic	R	0	0	1
112	Inorganic	R	0	0	1
113	Inorganic	R	0	0	1
114	Inorganic	R	0	0	1
115	Inorganic	R	0	0	1
116	Inorganic	R	0	0	1
117	Inorganic	R	0	0	1
118	Inorganic	R	0	0	1
119	Inorganic	R	0	0	1
120	Inorganic	R	0	0	1
121	Inorganic	R	0	0	1
122	Inorganic	S	1	0	0
123	Inorganic	S	1	0	0
124	Inorganic	R	0	0	1
126	Inorganic	R	0	0	1
130	Inorganic	R	0	0	1
131	Inorganic	R	0	0	1
133	Inorganic	R	0	0	1
134	Inorganic	R	0	0	1
136	Inorganic	R	0	0	1
138	Inorganic	R	0	0	1
139	Inorganic	R	0	0	1
140	Inorganic	R	0	0	1
141	Inorganic	R	0	0	1
142	Inorganic	R	0	0	1
143	Inorganic	R	0	0	1
144	Inorganic	S	1	0	0
147	Inorganic	R	0	0	1
148	Inorganic	S	1	0	0
149	Inorganic	R	0	0	1
151	Inorganic	I	0	1	0

Sample ID	Management	AMP			
		S/I/R	S	I	R
153	Inorganic	R	0	0	1
154	Inorganic	R	0	0	1
155	Inorganic	R	0	0	1
156	Inorganic	S	1	0	0
158	Inorganic	R	0	0	1
159	Inorganic	I	0	1	0
161	Inorganic	R	0	0	1
162	Inorganic	R	0	0	1
163	Inorganic	R	0	0	1
164	Inorganic	S	1	0	0
166	Inorganic	S	1	0	0
167	Inorganic	S	1	0	0
168	Inorganic	R	0	0	1
169	Inorganic	R	0	0	1
170	Inorganic	S	1	0	0
171	Inorganic	I	0	1	0
172	Inorganic	S	1	0	0
173	Inorganic	S	1	0	0
174	Inorganic	S	1	0	0
175	Inorganic	R	0	0	1
176	Inorganic	S	1	0	0
177	Inorganic	S	1	0	0
178	Inorganic	R	0	0	1
179	Inorganic	R	0	0	1
180	Inorganic	R	0	0	1
181	Inorganic	R	0	0	1
182	Inorganic	R	0	0	1
183	Inorganic	I	0	1	0
184	Inorganic	R	0	0	1
185	Inorganic	S	1	0	0
186	Inorganic	S	1	0	0
187	Inorganic	S	1	0	0
189	Inorganic	S	1	0	0
190	Inorganic	S	1	0	0
191	Inorganic	S	1	0	0
192	Inorganic	S	1	0	0
197	Inorganic	S	1	0	0
199	Inorganic	S	1	0	0
200	Inorganic	S	1	0	0
201	Organic	S	1	0	0
202	Organic	S	1	0	0

Sample ID	Management	AMP			
		S/I/R	S	I	R
203	Organic	S	1	0	0
204	Organic	S	1	0	0
205	Organic	S	1	0	0
206	Organic	S	1	0	0
207	Organic	S	1	0	0
208	Organic	R	0	0	1
209	Organic	R	0	0	1
210	Organic	S	1	0	0
211	Organic	S	1	0	0
212	Organic	S	1	0	0
213	Organic	I	0	1	0
214	Organic	S	1	0	0
215	Organic	S	1	0	0
216	Organic	S	1	0	0
217	Organic	S	1	0	0
218	Organic	S	1	0	0
219	Organic	S	1	0	0
220	Organic	S	1	0	0
221	Organic	S	1	0	0
222	Organic	S	1	0	0
224	Organic	S	1	0	0
225	Organic	S	1	0	0
227	Organic	S	1	0	0
228	Organic	S	1	0	0
229	Organic	S	1	0	0
230	Organic	I	0	1	0
231	Organic	S	1	0	0
232	Organic	I	0	1	0
233	Organic	S	1	0	0
234	Organic	I	0	1	0
235	Organic	S	1	0	0
236	Organic	S	1	0	0
237	Organic	S	1	0	0
238	Organic	S	1	0	0
239	Organic	S	1	0	0
240	Organic	S	1	0	0
241	Organic	R	0	0	1
242	Organic	S	1	0	0
243	Organic	S	1	0	0
244	Organic	S	1	0	0
245	Organic	R	0	0	1

Sample ID	Management	AMP			
		S/I/R	S	I	R
246	Organic	S	1	0	0
247	Organic	I	0	1	0
248	Organic	S	1	0	0
249	Organic	S	1	0	0
250	Organic	R	0	0	1
251	Organic	S	1	0	0
252	Organic	S	1	0	0
253	Organic	S	1	0	0
254	Organic	S	1	0	0
255	Organic	S	1	0	0
256	Organic	S	1	0	0
257	Organic	R	0	0	1
258	Organic	S	1	0	0
259	Organic	S	1	0	0
260	Organic	S	1	0	0
261	Organic	R	0	0	1
262	Organic	S	1	0	0
263	Organic	S	1	0	0
264	Organic	S	1	0	0
265	Organic	S	1	0	0
266	Organic	S	1	0	0
267	Organic	S	1	0	0
268	Organic	S	1	0	0
269	Organic	S	1	0	0
270	Organic	I	0	1	0
271	Organic	S	1	0	0
272	Organic	S	1	0	0
273	Organic	S	1	0	0
275	Organic	S	1	0	0
276	Organic	S	1	0	0
277	Organic	S	1	0	0
278	Organic	S	1	0	0
279	Organic	S	1	0	0
280	Organic	S	1	0	0
281	Organic	R	0	0	1
282	Organic	S	1	0	0
283	Organic	S	1	0	0
284	Organic	S	1	0	0
285	Organic	S	1	0	0
286	Organic	S	1	0	0
287	Organic	S	1	0	0

Sample ID	Management	AMP			
		S/I/R	S	I	R
288	Organic	S	1	0	0
289	Organic	S	1	0	0
290	Organic	S	1	0	0
292	Organic	S	1	0	0
293	Organic	R	0	0	1
294	Organic	S	1	0	0
295	Organic	S	1	0	0
296	Organic	S	1	0	0
297	Organic	S	1	0	0
298	Organic	R	0	0	1
299	Organic	S	1	0	0
300	Organic	S	1	0	0
301	Organic	R	0	0	1
302	Organic	S	1	0	0
303	Organic	S	1	0	0
304	Organic	S	1	0	0
305	Organic	S	1	0	0
306	Organic	S	1	0	0
307	Organic	S	1	0	0
308	Organic	S	1	0	0
309	Organic	S	1	0	0
310	Organic	S	1	0	0
311	Organic	S	1	0	0
312	Organic	S	1	0	0
313	Organic	S	1	0	0
314	Organic	S	1	0	0
315	Organic	S	1	0	0
316	Organic	S	1	0	0
317	Organic	S	1	0	0
318	Organic	S	1	0	0
319	Organic	S	1	0	0
320	Organic	S	1	0	0
321	Organic	S	1	0	0
324	Organic	R	0	0	1
325	Organic	S	1	0	0
326	Organic	S	1	0	0
327	Organic	S	1	0	0
328	Organic	S	1	0	0
329	Organic	S	1	0	0
330	Organic	S	1	0	0
331	Organic	R	0	0	1

Sample ID	Management	AMP			
		S/I/R	S	I	R
332	Organic	R	0	0	1
333	Organic	S	1	0	0
336	Organic	S	1	0	0
337	Organic	S	1	0	0
338	Organic	S	1	0	0
339	Organic	S	1	0	0
341	Organic	S	1	0	0
342	Organic	S	1	0	0
343	Organic	R	0	0	1
344	Organic	R	0	0	1
345	Organic	S	1	0	0
346	Organic	S	1	0	0
348	Organic	R	0	0	1
349	Organic	S	1	0	0
350	Organic	S	1	0	0
351	Organic	R	0	0	1
353	Organic	R	0	0	1
354	Organic	R	0	0	1
355	Organic	R	0	0	1
356	Organic	R	0	0	1
357	Organic	R	0	0	1
358	Organic	R	0	0	1
359	Organic	R	0	0	1
360	Organic	R	0	0	1
361	Organic	R	0	0	1
362	Organic	R	0	0	1
363	Organic	R	0	0	1
364	Organic	R	0	0	1
365	Organic	R	0	0	1
366	Organic	R	0	0	1
367	Organic	R	0	0	1
368	Organic	R	0	0	1
369	Organic	R	0	0	1
370	Organic	R	0	0	1
371	Organic	R	0	0	1
372	Organic	S	1	0	0
373	Organic	R	0	0	1
374	Organic	R	0	0	1
375	Organic	R	0	0	1
376	Organic	R	0	0	1
378	Organic	R	0	0	1

Sample ID	Management	AMP			
		S/I/R	S	I	R
379	Organic	R	0	0	1
380	Organic	S	1	0	0
381	Organic	S	1	0	0
382	Organic	S	1	0	0
384	Organic	S	1	0	0
385	Organic	S	1	0	0
386	Organic	S	1	0	0
388	Organic	R	0	0	1
389	Organic	R	0	0	1
390	Organic	R	0	0	1
391	Organic	S	1	0	0
392	Organic	R	0	0	1
393	Organic	S	1	0	0
394	Organic	S	1	0	0
397	Organic	S	1	0	0
398	Organic	S	1	0	0
399	Organic	S	1	0	0
400	Organic	S	1	0	0
401	Inorganic	S	1	0	0
402	Inorganic	S	1	0	0
403	Inorganic	R	0	0	1
404	Inorganic	S	1	0	0
405	Inorganic	S	1	0	0
406	Inorganic	S	1	0	0
407	Inorganic	R	0	0	1
409	Inorganic	I	0	1	0
410	Inorganic	R	0	0	1
411	Inorganic	S	1	0	0
412	Inorganic	S	1	0	0
414	Inorganic	R	0	0	1
415	Inorganic	S	1	0	0
416	Inorganic	I	0	1	0
417	Inorganic	S	1	0	0
418	Inorganic	S	1	0	0
419	Inorganic	S	1	0	0
420	Inorganic	S	1	0	0
421	Inorganic	S	1	0	0
423	Inorganic	S	1	0	0
425	Inorganic	S	1	0	0
426	Inorganic	S	1	0	0
427	Inorganic	S	1	0	0

Sample ID	Management	AMP			
		S/I/R	S	I	R
430	Inorganic	S	1	0	0
431	Inorganic	S	1	0	0
433	Inorganic	R	0	0	1
434	Inorganic	I	0	1	0
435	Inorganic	R	0	0	1
436	Inorganic	R	0	0	1
437	Inorganic	R	0	0	1
438	Inorganic	R	0	0	1
439	Inorganic	R	0	0	1
440	Inorganic	R	0	0	1
441	Inorganic	R	0	0	1
442	Inorganic	R	0	0	1
443	Inorganic	S	1	0	0
444	Inorganic	R	0	0	1
445	Inorganic	S	1	0	0
446	Inorganic	S	1	0	0
447	Inorganic	R	0	0	1
448	Inorganic	S	1	0	0
449	Inorganic	S	1	0	0
450	Inorganic	S	1	0	0
451	Inorganic	S	1	0	0
452	Inorganic	S	1	0	0
453	Inorganic	R	0	0	1
454	Inorganic	R	0	0	1
455	Inorganic	S	1	0	0
456	Inorganic	S	1	0	0
457	Inorganic	S	1	0	0
458	Inorganic	R	0	0	1
459	Inorganic	S	1	0	0
460	Inorganic	R	0	0	1
462	Inorganic	S	1	0	0
463	Inorganic	S	1	0	0
464	Inorganic	R	0	0	1
465	Inorganic	R	0	0	1
466	Inorganic	R	0	0	1
467	Inorganic	S	1	0	0
468	Inorganic	S	1	0	0
469	Inorganic	R	0	0	1
470	Inorganic	S	1	0	0
471	Inorganic	R	0	0	1
472	Inorganic	R	0	0	1

Sample ID	Management	AMP			
		S/I/R	S	I	R
473	Inorganic	R	0	0	1
474	Inorganic	S	1	0	0
475	Inorganic	R	0	0	1
476	Inorganic	R	0	0	1
477	Inorganic	R	0	0	1
478	Inorganic	R	0	0	1
479	Inorganic	R	0	0	1
480	Inorganic	R	0	0	1
481	Inorganic	R	0	0	1
482	Inorganic	R	0	0	1
483	Inorganic	R	0	0	1
484	Inorganic	R	0	0	1
485	Inorganic	R	0	0	1
486	Inorganic	R	0	0	1
487	Inorganic	R	0	0	1
488	Inorganic	R	0	0	1
489	Inorganic	R	0	0	1
490	Inorganic	R	0	0	1
491	Inorganic	R	0	0	1
492	Inorganic	R	0	0	1
493	Inorganic	S	1	0	0
494	Inorganic	S	1	0	0
495	Inorganic	R	0	0	1
497	Inorganic	R	0	0	1
498	Inorganic	R	0	0	1
499	Inorganic	R	0	0	1
500	Inorganic	S	1	0	0
501	Inorganic	S	1	0	0
502	Inorganic	S	1	0	0
503	Inorganic	S	1	0	0
504	Inorganic	S	1	0	0
505	Inorganic	R	0	0	1
506	Inorganic	S	1	0	0
507	Inorganic	S	1	0	0
508	Inorganic	S	1	0	0
509	Inorganic	R	0	0	1
510	Inorganic	S	1	0	0
511	Inorganic	S	1	0	0
512	Inorganic	S	1	0	0
513	Inorganic	S	1	0	0
514	Inorganic	R	0	0	1

Sample ID	Management	AMP			
		S/I/R	S	I	R
515	Inorganic	R	0	0	1
516	Inorganic	S	1	0	0
517	Inorganic	S	1	0	0
518	Inorganic	S	1	0	0
519	Inorganic	R	0	0	1
520	Inorganic	S	1	0	0
521	Inorganic	S	1	0	0
522	Inorganic	S	1	0	0
523	Inorganic	R	0	0	1
525	Inorganic	R	0	0	1
526	Inorganic	S	1	0	0
527	Inorganic	R	0	0	1
528	Inorganic	S	1	0	0
529	Inorganic	R	0	0	1
530	Inorganic	R	0	0	1
531	Inorganic	I	0	1	0
532	Inorganic	R	0	0	1
533	Inorganic	S	1	0	0
534	Inorganic	S	1	0	0
535	Inorganic	R	0	0	1
536	Inorganic	S	1	0	0
537	Inorganic	S	1	0	0
538	Inorganic	S	1	0	0
539	Inorganic	S	1	0	0
540	Inorganic	R	0	0	1
541	Inorganic	S	1	0	0
542	Inorganic	S	1	0	0
543	Inorganic	S	1	0	0
544	Inorganic	S	1	0	0
545	Inorganic	S	1	0	0
546	Inorganic	S	1	0	0
547	Inorganic	S	1	0	0
548	Inorganic	S	1	0	0
549	Inorganic	S	1	0	0
550	Inorganic	S	1	0	0
551	Inorganic	S	1	0	0
552	Inorganic	R	0	0	1
553	Inorganic	S	1	0	0
554	Inorganic	S	1	0	0
556	Inorganic	R	0	0	1

Sample ID	Management	TET			
		S/I/R	S	I	R
1	Inorganic	R	0	0	1
2	Inorganic	R	0	0	1
3	Inorganic	R	0	0	1
4	Inorganic	R	0	0	1
5	Inorganic	R	0	0	1
6	Inorganic	R	0	0	1
7	Inorganic	R	0	0	1
8	Inorganic	R	0	0	1
9	Inorganic	R	0	0	1
10	Inorganic	R	0	0	1
11	Inorganic	R	0	0	1
12	Inorganic	R	0	0	1
13	Inorganic	R	0	0	1
14	Inorganic	R	0	0	1
15	Inorganic	R	0	0	1
16	Inorganic	R	0	0	1
17	Inorganic	R	0	0	1
19	Inorganic	R	0	0	1
20	Inorganic	R	0	0	1
21	Inorganic	R	0	0	1
22	Inorganic	R	0	0	1
24	Inorganic	R	0	0	1
25	Inorganic	R	0	0	1
27	Inorganic	R	0	0	1
28	Inorganic	R	0	0	1
29	Inorganic	R	0	0	1
30	Inorganic	R	0	0	1
31	Inorganic	R	0	0	1
32	Inorganic	R	0	0	1
33	Inorganic	R	0	0	1
34	Inorganic	R	0	0	1
35	Inorganic	R	0	0	1
36	Inorganic	R	0	0	1
37	Inorganic	R	0	0	1
38	Inorganic	R	0	0	1
39	Inorganic	S	1	0	0
40	Inorganic	S	1	0	0
41	Inorganic	R	0	0	1
42	Inorganic	R	0	0	1
43	Inorganic	R	0	0	1
44	Inorganic	R	0	0	1

Sample ID	Management	TET			
		S/I/R	S	I	R
46	Inorganic	R	0	0	1
47	Inorganic	I	0	1	0
48	Inorganic	R	0	0	1
49	Inorganic	R	0	0	1
50	Inorganic	R	0	0	1
51	Inorganic	I	0	1	0
52	Inorganic	R	0	0	1
53	Inorganic	R	0	0	1
54	Inorganic	R	0	0	1
54 dup	Inorganic	R	0	0	1
55	Inorganic	R	0	0	1
57	Inorganic	R	0	0	1
58	Inorganic	R	0	0	1
59	Inorganic	R	0	0	1
60	Inorganic	R	0	0	1
61	Inorganic	R	0	0	1
62	Inorganic	I	0	1	0
63	Inorganic	R	0	0	1
64	Inorganic	R	0	0	1
65	Inorganic	R	0	0	1
66	Inorganic	R	0	0	1
67	Inorganic	I	0	1	0
68	Inorganic	R	0	0	1
69	Inorganic	R	0	0	1
70	Inorganic	R	0	0	1
71	Inorganic	R	0	0	1
72	Inorganic	I	0	1	0
73	Inorganic	R	0	0	1
74	Inorganic	R	0	0	1
75	Inorganic	R	0	0	1
76	Inorganic	R	0	0	1
77	Inorganic	R	0	0	1
79	Inorganic	R	0	0	1
82	Inorganic	S	1	0	0
84	Inorganic	R	0	0	1
88	Inorganic	R	0	0	1
89	Inorganic	R	0	0	1
90	Inorganic	R	0	0	1
91	Inorganic	R	0	0	1
93	Inorganic	R	0	0	1
96	Inorganic	R	0	0	1

Sample ID	Management	TET			
		S/I/R	S	I	R
101	Inorganic	R	0	0	1
102	Inorganic	R	0	0	1
103	Inorganic	R	0	0	1
104	Inorganic	S	1	0	0
105	Inorganic	R	0	0	1
106	Inorganic	R	0	0	1
107	Inorganic	R	0	0	1
108	Inorganic	R	0	0	1
109	Inorganic	R	0	0	1
110	Inorganic	R	0	0	1
111	Inorganic	R	0	0	1
112	Inorganic	R	0	0	1
113	Inorganic	R	0	0	1
114	Inorganic	R	0	0	1
115	Inorganic	R	0	0	1
116	Inorganic	R	0	0	1
117	Inorganic	R	0	0	1
118	Inorganic	R	0	0	1
119	Inorganic	R	0	0	1
120	Inorganic	R	0	0	1
121	Inorganic	R	0	0	1
122	Inorganic	R	0	0	1
123	Inorganic	R	0	0	1
124	Inorganic	R	0	0	1
126	Inorganic	R	0	0	1
130	Inorganic	R	0	0	1
131	Inorganic	R	0	0	1
133	Inorganic	R	0	0	1
134	Inorganic	R	0	0	1
136	Inorganic	R	0	0	1
138	Inorganic	R	0	0	1
139	Inorganic	R	0	0	1
140	Inorganic	R	0	0	1
141	Inorganic	R	0	0	1
142	Inorganic	R	0	0	1
143	Inorganic	R	0	0	1
144	Inorganic	R	0	0	1
147	Inorganic	R	0	0	1
148	Inorganic	R	0	0	1
149	Inorganic	R	0	0	1
151	Inorganic	R	0	0	1

Sample ID	Management	TET			
		S/I/R	S	I	R
153	Inorganic	R	0	0	1
154	Inorganic	R	0	0	1
155	Inorganic	R	0	0	1
156	Inorganic	R	0	0	1
158	Inorganic	R	0	0	1
159	Inorganic	R	0	0	1
161	Inorganic	R	0	0	1
162	Inorganic	R	0	0	1
163	Inorganic	R	0	0	1
164	Inorganic	R	0	0	1
166	Inorganic	R	0	0	1
167	Inorganic	R	0	0	1
168	Inorganic	R	0	0	1
169	Inorganic	R	0	0	1
170	Inorganic	R	0	0	1
171	Inorganic	S	1	0	0
172	Inorganic	R	0	0	1
173	Inorganic	R	0	0	1
174	Inorganic	R	0	0	1
175	Inorganic	R	0	0	1
176	Inorganic	R	0	0	1
177	Inorganic	R	0	0	1
178	Inorganic	R	0	0	1
179	Inorganic	R	0	0	1
180	Inorganic	R	0	0	1
181	Inorganic	R	0	0	1
182	Inorganic	R	0	0	1
183	Inorganic	R	0	0	1
184	Inorganic	R	0	0	1
185	Inorganic	R	0	0	1
186	Inorganic	R	0	0	1
187	Inorganic	R	0	0	1
189	Inorganic	R	0	0	1
190	Inorganic	R	0	0	1
191	Inorganic	R	0	0	1
192	Inorganic	R	0	0	1
197	Inorganic	R	0	0	1
199	Inorganic	R	0	0	1
200	Inorganic	R	0	0	1
201	Organic	R	0	0	1
202	Organic	R	0	0	1

Sample ID	Management	TET			
		S/I/R	S	I	R
203	Organic	S	1	0	0
204	Organic	R	0	0	1
205	Organic	R	0	0	1
206	Organic	R	0	0	1
207	Organic	R	0	0	1
208	Organic	R	0	0	1
209	Organic	R	0	0	1
210	Organic	I	0	1	0
211	Organic	R	0	0	1
212	Organic	I	0	1	0
213	Organic	R	0	0	1
214	Organic	R	0	0	1
215	Organic	R	0	0	1
216	Organic	R	0	0	1
217	Organic	R	0	0	1
218	Organic	R	0	0	1
219	Organic	R	0	0	1
220	Organic	R	0	0	1
221	Organic	R	0	0	1
222	Organic	R	0	0	1
224	Organic	R	0	0	1
225	Organic	R	0	0	1
227	Organic	R	0	0	1
228	Organic	R	0	0	1
229	Organic	S	1	0	0
230	Organic	R	0	0	1
231	Organic	R	0	0	1
232	Organic	R	0	0	1
233	Organic	R	0	0	1
234	Organic	R	0	0	1
235	Organic	R	0	0	1
236	Organic	R	0	0	1
237	Organic	R	0	0	1
238	Organic	R	0	0	1
239	Organic	R	0	0	1
240	Organic	R	0	0	1
241	Organic	R	0	0	1
242	Organic	R	0	0	1
243	Organic	R	0	0	1
244	Organic	I	0	1	0
245	Organic	R	0	0	1

Sample ID	Management	TET			
		S/I/R	S	I	R
246	Organic	S	1	0	0
247	Organic	S	1	0	0
248	Organic	R	0	0	1
249	Organic	R	0	0	1
250	Organic	R	0	0	1
251	Organic	R	0	0	1
252	Organic	R	0	0	1
253	Organic	R	0	0	1
254	Organic	S	1	0	0
255	Organic	R	0	0	1
256	Organic	R	0	0	1
257	Organic	R	0	0	1
258	Organic	R	0	0	1
259	Organic	R	0	0	1
260	Organic	R	0	0	1
261	Organic	R	0	0	1
262	Organic	R	0	0	1
263	Organic	R	0	0	1
264	Organic	R	0	0	1
265	Organic	R	0	0	1
266	Organic	S	1	0	0
267	Organic	S	1	0	0
268	Organic	S	1	0	0
269	Organic	R	0	0	1
270	Organic	R	0	0	1
271	Organic	R	0	0	1
272	Organic	R	0	0	1
273	Organic	S	1	0	0
275	Organic	R	0	0	1
276	Organic	R	0	0	1
277	Organic	R	0	0	1
278	Organic	R	0	0	1
279	Organic	R	0	0	1
280	Organic	R	0	0	1
281	Organic	R	0	0	1
282	Organic	R	0	0	1
283	Organic	R	0	0	1
284	Organic	R	0	0	1
285	Organic	R	0	0	1
286	Organic	R	0	0	1
287	Organic	R	0	0	1

Sample ID	Management	TET			
		S/I/R	S	I	R
288	Organic	R	0	0	1
289	Organic	R	0	0	1
290	Organic	R	0	0	1
292	Organic	R	0	0	1
293	Organic	R	0	0	1
294	Organic	R	0	0	1
295	Organic	R	0	0	1
296	Organic	R	0	0	1
297	Organic	R	0	0	1
298	Organic	R	0	0	1
299	Organic	R	0	0	1
300	Organic	R	0	0	1
301	Organic	S	1	0	0
302	Organic	R	0	0	1
303	Organic	R	0	0	1
304	Organic	R	0	0	1
305	Organic	R	0	0	1
306	Organic	R	0	0	1
307	Organic	R	0	0	1
308	Organic	R	0	0	1
309	Organic	R	0	0	1
310	Organic	R	0	0	1
311	Organic	R	0	0	1
312	Organic	S	1	0	0
313	Organic	S	1	0	0
314	Organic	R	0	0	1
315	Organic	R	0	0	1
316	Organic	R	0	0	1
317	Organic	R	0	0	1
318	Organic	I	0	1	0
319	Organic	I	0	1	0
320	Organic	I	0	1	0
321	Organic	I	0	1	0
324	Organic	S	1	0	0
325	Organic	S	1	0	0
326	Organic	R	0	0	1
327	Organic	R	0	0	1
328	Organic	R	0	0	1
329	Organic	R	0	0	1
330	Organic	S	1	0	0
331	Organic	S	1	0	0

Sample ID	Management	TET			
		S/I/R	S	I	R
332	Organic	S	1	0	0
333	Organic	S	1	0	0
336	Organic	R	0	0	1
337	Organic	R	0	0	1
338	Organic	S	1	0	0
339	Organic	R	0	0	1
341	Organic	S	1	0	0
342	Organic	R	0	0	1
343	Organic	R	0	0	1
344	Organic	S	1	0	0
345	Organic	R	0	0	1
346	Organic	S	1	0	0
348	Organic	R	0	0	1
349	Organic	S	1	0	0
350	Organic	S	1	0	0
351	Organic	R	0	0	1
353	Organic	R	0	0	1
354	Organic	R	0	0	1
355	Organic	R	0	0	1
356	Organic	R	0	0	1
357	Organic	R	0	0	1
358	Organic	R	0	0	1
359	Organic	R	0	0	1
360	Organic	R	0	0	1
361	Organic	R	0	0	1
362	Organic	R	0	0	1
363	Organic	R	0	0	1
364	Organic	R	0	0	1
365	Organic	R	0	0	1
366	Organic	R	0	0	1
367	Organic	R	0	0	1
368	Organic	R	0	0	1
369	Organic	R	0	0	1
370	Organic	R	0	0	1
371	Organic	R	0	0	1
372	Organic	R	0	0	1
373	Organic	R	0	0	1
374	Organic	R	0	0	1
375	Organic	R	0	0	1
376	Organic	R	0	0	1
378	Organic	R	0	0	1

Sample ID	Management	TET			
		S/I/R	S	I	R
379	Organic	R	0	0	1
380	Organic	R	0	0	1
381	Organic	S	1	0	0
382	Organic	R	0	0	1
384	Organic	R	0	0	1
385	Organic	R	0	0	1
386	Organic	R	0	0	1
388	Organic	R	0	0	1
389	Organic	S	1	0	0
390	Organic	R	0	0	1
391	Organic	S	1	0	0
392	Organic	S	1	0	0
393	Organic	S	1	0	0
394	Organic	S	1	0	0
397	Organic	S	1	0	0
398	Organic	R	0	0	1
399	Organic	S	1	0	0
400	Organic	S	1	0	0
401	Inorganic	S	1	0	0
402	Inorganic	S	1	0	0
403	Inorganic	R	0	0	1
404	Inorganic	R	0	0	1
405	Inorganic	S	1	0	0
406	Inorganic	S	1	0	0
407	Inorganic	S	1	0	0
409	Inorganic	R	0	0	1
410	Inorganic	R	0	0	1
411	Inorganic	R	0	0	1
412	Inorganic	R	0	0	1
414	Inorganic	S	1	0	0
415	Inorganic	R	0	0	1
416	Inorganic	R	0	0	1
417	Inorganic	R	0	0	1
418	Inorganic	R	0	0	1
419	Inorganic	R	0	0	1
420	Inorganic	R	0	0	1
421	Inorganic	S	1	0	0
423	Inorganic	R	0	0	1
425	Inorganic	R	0	0	1
426	Inorganic	R	0	0	1
427	Inorganic	R	0	0	1

Sample ID	Management	TET			
		S/I/R	S	I	R
430	Inorganic	R	0	0	1
431	Inorganic	R	0	0	1
433	Inorganic	R	0	0	1
434	Inorganic	R	0	0	1
435	Inorganic	R	0	0	1
436	Inorganic	R	0	0	1
437	Inorganic	S	1	0	0
438	Inorganic	R	0	0	1
439	Inorganic	R	0	0	1
440	Inorganic	R	0	0	1
441	Inorganic	S	1	0	0
442	Inorganic	R	0	0	1
443	Inorganic	S	1	0	0
444	Inorganic	S	1	0	0
445	Inorganic	R	0	0	1
446	Inorganic	R	0	0	1
447	Inorganic	S	1	0	0
448	Inorganic	S	1	0	0
449	Inorganic	S	1	0	0
450	Inorganic	S	1	0	0
451	Inorganic	R	0	0	1
452	Inorganic	R	0	0	1
453	Inorganic	R	0	0	1
454	Inorganic	R	0	0	1
455	Inorganic	R	0	0	1
456	Inorganic	R	0	0	1
457	Inorganic	S	1	0	0
458	Inorganic	R	0	0	1
459	Inorganic	R	0	0	1
460	Inorganic	R	0	0	1
462	Inorganic	R	0	0	1
463	Inorganic	S	1	0	0
464	Inorganic	S	1	0	0
465	Inorganic	R	0	0	1
466	Inorganic	R	0	0	1
467	Inorganic	R	0	0	1
468	Inorganic	R	0	0	1
469	Inorganic	R	0	0	1
470	Inorganic	R	0	0	1
471	Inorganic	R	0	0	1
472	Inorganic	R	0	0	1

Sample ID	Management	TET			
		S/I/R	S	I	R
473	Inorganic	R	0	0	1
474	Inorganic	R	0	0	1
475	Inorganic	R	0	0	1
476	Inorganic	R	0	0	1
477	Inorganic	R	0	0	1
478	Inorganic	R	0	0	1
479	Inorganic	R	0	0	1
480	Inorganic	R	0	0	1
481	Inorganic	R	0	0	1
482	Inorganic	R	0	0	1
483	Inorganic	R	0	0	1
484	Inorganic	R	0	0	1
485	Inorganic	R	0	0	1
486	Inorganic	R	0	0	1
487	Inorganic	R	0	0	1
488	Inorganic	R	0	0	1
489	Inorganic	R	0	0	1
490	Inorganic	R	0	0	1
491	Inorganic	R	0	0	1
492	Inorganic	R	0	0	1
493	Inorganic	R	0	0	1
494	Inorganic	R	0	0	1
495	Inorganic	R	0	0	1
497	Inorganic	R	0	0	1
498	Inorganic	R	0	0	1
499	Inorganic	R	0	0	1
500	Inorganic	R	0	0	1
501	Inorganic	R	0	0	1
502	Inorganic	R	0	0	1
503	Inorganic	R	0	0	1
504	Inorganic	R	0	0	1
505	Inorganic	R	0	0	1
506	Inorganic	R	0	0	1
507	Inorganic	R	0	0	1
508	Inorganic	S	1	0	0
509	Inorganic	R	0	0	1
510	Inorganic	R	0	0	1
511	Inorganic	R	0	0	1
512	Inorganic	R	0	0	1
513	Inorganic	R	0	0	1
514	Inorganic	R	0	0	1

Sample ID	Management	TET			
		S/I/R	S	I	R
515	Inorganic	R	0	0	1
516	Inorganic	R	0	0	1
517	Inorganic	S	1	0	0
518	Inorganic	R	0	0	1
519	Inorganic	R	0	0	1
520	Inorganic	R	0	0	1
521	Inorganic	R	0	0	1
522	Inorganic	R	0	0	1
523	Inorganic	S	1	0	0
525	Inorganic	S	1	0	0
526	Inorganic	R	0	0	1
527	Inorganic	R	0	0	1
528	Inorganic	R	0	0	1
529	Inorganic	R	0	0	1
530	Inorganic	S	1	0	0
531	Inorganic	R	0	0	1
532	Inorganic	R	0	0	1
533	Inorganic	R	0	0	1
534	Inorganic	R	0	0	1
535	Inorganic	S	1	0	0
536	Inorganic	R	0	0	1
537	Inorganic	R	0	0	1
538	Inorganic	R	0	0	1
539	Inorganic	R	0	0	1
540	Inorganic	R	0	0	1
541	Inorganic	R	0	0	1
542	Inorganic	R	0	0	1
543	Inorganic	R	0	0	1
544	Inorganic	R	0	0	1
545	Inorganic	R	0	0	1
546	Inorganic	R	0	0	1
547	Inorganic	R	0	0	1
548	Inorganic	R	0	0	1
549	Inorganic	R	0	0	1
550	Inorganic	R	0	0	1
551	Inorganic	R	0	0	1
552	Inorganic	R	0	0	1
553	Inorganic	R	0	0	1
554	Inorganic	R	0	0	1
556	Inorganic	S	1	0	0

Sample ID	Management	SMZ			
		S/I/R	S	I	R
1	Inorganic	R	0	0	1
2	Inorganic	R	0	0	1
3	Inorganic	.	.	.	.
4	Inorganic	.	.	.	.
5	Inorganic	.	.	.	.
6	Inorganic	.	.	.	.
7	Inorganic	R	0	0	1
8	Inorganic	R	0	0	1
9	Inorganic	.	.	.	.
10	Inorganic	R	0	0	1
11	Inorganic	R	0	0	1
12	Inorganic	R	0	0	1
13	Inorganic	S	1	0	0
14	Inorganic	R	0	0	1
15	Inorganic	R	0	0	1
16	Inorganic	R	0	0	1
17	Inorganic	R	0	0	1
19	Inorganic	S	1	0	0
20	Inorganic	R	0	0	1
21	Inorganic	.	.	.	.
22	Inorganic	.	.	.	.
24	Inorganic	.	.	.	.
25	Inorganic	.	.	.	.
27	Inorganic	R	0	0	1
28	Inorganic	R	0	0	1
29	Inorganic	R	0	0	1
30	Inorganic	R	0	0	1
31	Inorganic	.	.	.	.
32	Inorganic	.	.	.	.
33	Inorganic	R	0	0	1
34	Inorganic	S	1	0	0
35	Inorganic	R	0	0	1
36	Inorganic	.	.	.	.
37	Inorganic	.	.	.	.
38	Inorganic	R	0	0	1
39	Inorganic	S	1	0	0
40	Inorganic	R	0	0	1
41	Inorganic	R	0	0	1
42	Inorganic	R	0	0	1
43	Inorganic	.	.	.	.
44	Inorganic	R	0	0	1

Sample ID	Management	SMZ			
		S/I/R	S	I	R
46	Inorganic	R	0	0	1
47	Inorganic	S	1	0	0
48	Inorganic	R	0	0	1
49	Inorganic	S	1	0	0
50	Inorganic	R	0	0	1
51	Inorganic	S	1	0	0
52	Inorganic	R	0	0	1
53	Inorganic	S	1	0	0
54	Inorganic	S	1	0	0
54 dup	Inorganic	S	1	0	0
55	Inorganic	R	0	0	1
57	Inorganic	R	0	0	1
58	Inorganic	S	1	0	0
59	Inorganic	.	.	.	.
60	Inorganic	.	.	.	.
61	Inorganic	R	0	0	1
62	Inorganic	R	0	0	1
63	Inorganic	R	0	0	1
64	Inorganic	I	0	1	0
65	Inorganic	.	.	.	.
66	Inorganic	S	1	0	0
67	Inorganic	R	0	0	1
68	Inorganic	.	.	.	.
69	Inorganic	.	.	.	.
70	Inorganic	.	.	.	.
71	Inorganic	.	.	.	.
72	Inorganic	S	1	0	0
73	Inorganic	R	0	0	1
74	Inorganic	R	0	0	1
75	Inorganic	R	0	0	1
76	Inorganic	R	0	0	1
77	Inorganic	.	.	.	.
79	Inorganic	S	1	0	0
82	Inorganic	R	0	0	1
84	Inorganic	R	0	0	1
88	Inorganic	R	0	0	1
89	Inorganic	R	0	0	1
90	Inorganic	R	0	0	1
91	Inorganic	R	0	0	1
93	Inorganic	S	1	0	0
96	Inorganic	R	0	0	1

Sample ID	Management	SMZ			
		S/I/R	S	I	R
101	Inorganic	R	0	0	1
102	Inorganic	R	0	0	1
103	Inorganic	R	0	0	1
104	Inorganic	S	1	0	0
105	Inorganic	R	0	0	1
106	Inorganic	R	0	0	1
107	Inorganic	R	0	0	1
108	Inorganic	R	0	0	1
109	Inorganic	S	1	0	0
110	Inorganic	R	0	0	1
111	Inorganic	R	0	0	1
112	Inorganic	R	0	0	1
113	Inorganic	R	0	0	1
114	Inorganic	R	0	0	1
115	Inorganic	R	0	0	1
116	Inorganic	R	0	0	1
117	Inorganic	R	0	0	1
118	Inorganic	R	0	0	1
119	Inorganic	R	0	0	1
120	Inorganic	R	0	0	1
121	Inorganic	R	0	0	1
122	Inorganic	R	0	0	1
123	Inorganic	R	0	0	1
124	Inorganic	R	0	0	1
126	Inorganic	R	0	0	1
130	Inorganic	R	0	0	1
131	Inorganic	R	0	0	1
133	Inorganic	R	0	0	1
134	Inorganic	R	0	0	1
136	Inorganic	R	0	0	1
138	Inorganic	R	0	0	1
139	Inorganic	R	0	0	1
140	Inorganic	R	0	0	1
141	Inorganic	R	0	0	1
142	Inorganic	R	0	0	1
143	Inorganic	R	0	0	1
144	Inorganic	R	0	0	1
147	Inorganic	R	0	0	1
148	Inorganic	R	0	0	1
149	Inorganic	R	0	0	1
151	Inorganic	R	0	0	1

Sample ID	Management	SMZ			
		S/I/R	S	I	R
153	Inorganic	R	0	0	1
154	Inorganic	R	0	0	1
155	Inorganic	R	0	0	1
156	Inorganic	R	0	0	1
158	Inorganic	R	0	0	1
159	Inorganic	R	0	0	1
161	Inorganic	R	0	0	1
162	Inorganic	R	0	0	1
163	Inorganic	R	0	0	1
164	Inorganic	R	0	0	1
166	Inorganic	R	0	0	1
167	Inorganic	R	0	0	1
168	Inorganic	R	0	0	1
169	Inorganic	R	0	0	1
170	Inorganic	R	0	0	1
171	Inorganic	R	0	0	1
172	Inorganic	R	0	0	1
173	Inorganic	R	0	0	1
174	Inorganic	R	0	0	1
175	Inorganic	R	0	0	1
176	Inorganic	R	0	0	1
177	Inorganic	S	1	0	0
178	Inorganic	R	0	0	1
179	Inorganic	R	0	0	1
180	Inorganic	R	0	0	1
181	Inorganic	R	0	0	1
182	Inorganic	R	0	0	1
183	Inorganic	R	0	0	1
184	Inorganic	R	0	0	1
185	Inorganic	R	0	0	1
186	Inorganic	R	0	0	1
187	Inorganic	R	0	0	1
189	Inorganic	0	0	0	0
190	Inorganic	R	0	0	1
191	Inorganic	R	0	0	1
192	Inorganic	R	0	0	1
197	Inorganic	R	0	0	1
199	Inorganic	R	0	0	1
200	Inorganic	.	.	.	.
201	Organic	R	0	0	1
202	Organic	S	1	0	0

Sample ID	Management	SMZ			
		S/I/R	S	I	R
203	Organic	R	0	0	1
204	Organic	R	0	0	1
205	Organic	S	1	0	0
206	Organic	R	0	0	1
207	Organic	R	0	0	1
208	Organic	S	1	0	0
209	Organic	R	0	0	1
210	Organic	R	0	0	1
211	Organic	R	0	0	1
212	Organic	S	1	0	0
213	Organic	R	0	0	1
214	Organic	R	0	0	1
215	Organic	R	0	0	1
216	Organic	R	0	0	1
217	Organic	R	0	0	1
218	Organic	R	0	0	1
219	Organic	R	0	0	1
220	Organic	.	.	.	.
221	Organic	R	0	0	1
222	Organic	S	1	0	0
224	Organic	R	0	0	1
225	Organic	R	0	0	1
227	Organic	R	0	0	1
228	Organic	I	0	1	0
229	Organic	R	0	0	1
230	Organic	R	0	0	1
231	Organic	R	0	0	1
232	Organic	R	0	0	1
233	Organic	R	0	0	1
234	Organic	R	0	0	1
235	Organic	R	0	0	1
236	Organic	R	0	0	1
237	Organic	R	0	0	1
238	Organic	R	0	0	1
239	Organic	R	0	0	1
240	Organic	R	0	0	1
241	Organic	R	0	0	1
242	Organic	R	0	0	1
243	Organic	R	0	0	1
244	Organic	R	0	0	1
245	Organic	S	1	0	0

Sample ID	Management	SMZ			
		S/I/R	S	I	R
246	Organic	R	0	0	1
247	Organic	R	0	0	1
248	Organic	R	0	0	1
249	Organic	S	1	0	0
250	Organic	R	0	0	1
251	Organic	R	0	0	1
252	Organic	R	0	0	1
253	Organic	R	0	0	1
254	Organic	R	0	0	1
255	Organic	R	0	0	1
256	Organic	R	0	0	1
257	Organic	R	0	0	1
258	Organic	R	0	0	1
259	Organic	R	0	0	1
260	Organic	R	0	0	1
261	Organic	R	0	0	1
262	Organic	R	0	0	1
263	Organic	R	0	0	1
264	Organic	S	1	0	0
265	Organic	S	1	0	0
266	Organic	R	0	0	1
267	Organic	S	1	0	0
268	Organic	R	0	0	1
269	Organic	R	0	0	1
270	Organic	R	0	0	1
271	Organic	R	0	0	1
272	Organic	S	1	0	0
273	Organic	S	1	0	0
275	Organic	S	1	0	0
276	Organic	R	0	0	1
277	Organic	R	0	0	1
278	Organic	R	0	0	1
279	Organic	R	0	0	1
280	Organic	R	0	0	1
281	Organic	R	0	0	1
282	Organic	S	1	0	0
283	Organic	R	0	0	1
284	Organic	R	0	0	1
285	Organic	R	0	0	1
286	Organic	R	0	0	1
287	Organic	R	0	0	1

Sample ID	Management	SMZ			
		S/I/R	S	I	R
288	Organic	R	0	0	1
289	Organic	R	0	0	1
290	Organic	R	0	0	1
292	Organic	R	0	0	1
293	Organic	R	0	0	1
294	Organic	R	0	0	1
295	Organic	R	0	0	1
296	Organic	R	0	0	1
297	Organic	R	0	0	1
298	Organic	R	0	0	1
299	Organic	R	0	0	1
300	Organic	R	0	0	1
301	Organic	.	.	.	.
302	Organic	R	0	0	1
303	Organic	R	0	0	1
304	Organic	R	0	0	1
305	Organic	R	0	0	1
306	Organic	R	0	0	1
307	Organic	R	0	0	1
308	Organic	R	0	0	1
309	Organic	R	0	0	1
310	Organic	R	0	0	1
311	Organic	R	0	0	1
312	Organic	S	1	0	0
313	Organic	S	1	0	0
314	Organic	S	1	0	0
315	Organic	S	1	0	0
316	Organic	S	1	0	0
317	Organic	S	1	0	0
318	Organic	S	1	0	0
319	Organic	S	1	0	0
320	Organic	S	1	0	0
321	Organic	S	1	0	0
324	Organic	.	.	.	.
325	Organic	S	1	0	0
326	Organic	S	1	0	0
327	Organic	S	1	0	0
328	Organic	S	1	0	0
329	Organic	S	1	0	0
330	Organic	S	1	0	0
331	Organic	S	1	0	0

Sample ID	Management	SMZ			
		S/I/R	S	I	R
332	Organic	.	.	.	.
333	Organic	.	.	.	.
336	Organic	R	0	0	1
337	Organic	R	0	0	1
338	Organic	.	.	.	.
339	Organic	R	0	0	1
341	Organic	.	.	.	.
342	Organic	R	0	0	1
343	Organic	R	0	0	1
344	Organic	.	.	.	.
345	Organic	R	0	0	1
346	Organic	.	.	.	.
348	Organic	R	0	0	1
349	Organic	.	.	.	.
350	Organic	S	1	0	0
351	Organic	S	1	0	0
353	Organic	R	0	0	1
354	Organic	R	0	0	1
355	Organic	R	0	0	1
356	Organic	I	0	1	0
357	Organic	I	0	1	0
358	Organic	R	0	0	1
359	Organic	R	0	0	1
360	Organic	R	0	0	1
361	Organic	R	0	0	1
362	Organic	R	0	0	1
363	Organic	R	0	0	1
364	Organic	R	0	0	1
365	Organic	R	0	0	1
366	Organic	R	0	0	1
367	Organic	R	0	0	1
368	Organic	R	0	0	1
369	Organic	R	0	0	1
370	Organic	R	0	0	1
371	Organic	R	0	0	1
372	Organic	R	0	0	1
373	Organic	R	0	0	1
374	Organic	R	0	0	1
375	Organic	R	0	0	1
376	Organic	S	1	0	0
378	Organic	.	.	.	.

Sample ID	Management	SMZ			
		S/I/R	S	I	R
379	Organic	R	0	0	1
380	Organic	S	1	0	0
381	Organic	S	1	0	0
382	Organic	S	1	0	0
384	Organic	R	0	0	1
385	Organic	R	0	0	1
386	Organic	S	1	0	0
388	Organic	.	.	.	.
389	Organic	.	.	.	.
390	Organic	.	.	.	.
391	Organic	R	0	0	1
392	Organic	.	.	.	.
393	Organic	S	1	0	0
394	Organic	R	0	0	1
397	Organic	R	0	0	1
398	Organic	R	0	0	1
399	Organic	S	1	0	0
400	Organic	S	1	0	0
401	Inorganic	S	1	0	0
402	Inorganic	R	0	0	1
403	Inorganic	R	0	0	1
404	Inorganic	R	0	0	1
405	Inorganic	S	1	0	0
406	Inorganic	S	1	0	0
407	Inorganic	.	.	.	.
409	Inorganic	S	1	0	0
410	Inorganic	S	1	0	0
411	Inorganic	S	1	0	0
412	Inorganic	S	1	0	0
414	Inorganic	.	.	.	.
415	Inorganic	S	1	0	0
416	Inorganic	S	1	0	0
417	Inorganic	S	1	0	0
418	Inorganic	S	1	0	0
419	Inorganic	R	0	0	1
420	Inorganic	R	0	0	1
421	Inorganic	.	.	.	.
423	Inorganic	S	1	0	0
425	Inorganic	S	1	0	0
426	Inorganic	R	0	0	1
427	Inorganic	R	0	0	1

Sample ID	Management	SMZ			
		S/I/R	S	I	R
430	Inorganic	S	1	0	0
431	Inorganic	S	1	0	0
433	Inorganic	S	1	0	0
434	Inorganic	R	0	0	1
435	Inorganic	R	0	0	1
436	Inorganic	R	0	0	1
437	Inorganic	R	0	0	1
438	Inorganic	S	1	0	0
439	Inorganic	I	0	1	0
440	Inorganic	R	0	0	1
441	Inorganic	S	1	0	0
442	Inorganic	R	0	0	1
443	Inorganic	R	0	0	1
444	Inorganic	R	0	0	1
445	Inorganic	S	1	0	0
446	Inorganic	S	1	0	0
447	Inorganic	S	1	0	0
448	Inorganic	S	1	0	0
449	Inorganic	R	0	0	1
450	Inorganic	I	0	1	0
451	Inorganic	S	1	0	0
452	Inorganic	S	1	0	0
453	Inorganic	S	1	0	0
454	Inorganic	S	1	0	0
455	Inorganic	R	0	0	1
456	Inorganic	R	0	0	1
457	Inorganic	S	1	0	0
458	Inorganic	S	1	0	0
459	Inorganic	S	1	0	0
460	Inorganic	S	1	0	0
462	Inorganic	R	0	0	1
463	Inorganic	S	1	0	0
464	Inorganic	S	1	0	0
465	Inorganic	S	1	0	0
466	Inorganic	S	1	0	0
467	Inorganic	R	0	0	1
468	Inorganic	R	0	0	1
469	Inorganic	R	0	0	1
470	Inorganic	R	0	0	1
471	Inorganic	S	1	0	0
472	Inorganic	S	1	0	0

Sample ID	Management	SMZ			
		S/I/R	S	I	R
473	Inorganic	R	0	0	1
474	Inorganic	.	.	.	.
475	Inorganic	R	0	0	1
476	Inorganic	R	0	0	1
477	Inorganic	S	1	0	0
478	Inorganic	S	1	0	0
479	Inorganic	R	0	0	1
480	Inorganic	R	0	0	1
481	Inorganic	R	0	0	1
482	Inorganic	S	1	0	0
483	Inorganic	S	1	0	0
484	Inorganic	S	1	0	0
485	Inorganic	R	0	0	1
486	Inorganic	R	0	0	1
487	Inorganic	R	0	0	1
488	Inorganic	R	0	0	1
489	Inorganic	R	0	0	1
490	Inorganic	R	0	0	1
491	Inorganic	R	0	0	1
492	Inorganic	R	0	0	1
493	Inorganic	R	0	0	1
494	Inorganic	R	0	0	1
495	Inorganic	R	0	0	1
497	Inorganic	R	0	0	1
498	Inorganic	R	0	0	1
499	Inorganic	R	0	0	1
500	Inorganic	R	0	0	1
501	Inorganic	R	0	0	1
502	Inorganic	R	0	0	1
503	Inorganic	R	0	0	1
504	Inorganic	R	0	0	1
505	Inorganic	R	0	0	1
506	Inorganic	R	0	0	1
507	Inorganic	R	0	0	1
508	Inorganic	.	.	.	.
509	Inorganic	R	0	0	1
510	Inorganic	R	0	0	1
511	Inorganic	R	0	0	1
512	Inorganic	R	0	0	1
513	Inorganic	R	0	0	1
514	Inorganic	S	1	0	0

Sample ID	Management	SMZ			
		S/I/R	S	I	R
515	Inorganic	R	0	0	1
516	Inorganic	S	1	0	0
517	Inorganic	.	.	.	.
518	Inorganic	R	0	0	1
519	Inorganic	R	0	0	1
520	Inorganic	S	1	0	0
521	Inorganic	R	0	0	1
522	Inorganic	S	1	0	0
523	Inorganic	.	.	.	.
525	Inorganic	S	1	0	0
526	Inorganic	R	0	0	1
527	Inorganic	R	0	0	1
528	Inorganic	R	0	0	1
529	Inorganic	R	0	0	1
530	Inorganic	.	.	.	.
531	Inorganic	R	0	0	1
532	Inorganic	R	0	0	1
533	Inorganic	R	0	0	1
534	Inorganic	R	0	0	1
535	Inorganic	.	.	.	.
536	Inorganic	R	0	0	1
537	Inorganic	I	0	1	0
538	Inorganic	I	0	1	0
539	Inorganic	R	0	0	1
540	Inorganic	R	0	0	1
541	Inorganic	R	0	0	1
542	Inorganic	R	0	0	1
543	Inorganic	R	0	0	1
544	Inorganic	R	0	0	1
545	Inorganic	R	0	0	1
546	Inorganic	R	0	0	1
547	Inorganic	R	0	0	1
548	Inorganic	R	0	0	1
549	Inorganic	R	0	0	1
550	Inorganic	R	0	0	1
551	Inorganic	R	0	0	1
552	Inorganic	S	1	0	0
553	Inorganic	R	0	0	1
554	Inorganic	R	0	0	1
556	Inorganic	.	.	.	.

Sample ID	Management	KAN			
		S/I/R	S	I	R
1	Inorganic	S	1	0	0
2	Inorganic	S	1	0	0
3	Inorganic	.	.	.	.
4	Inorganic	.	.	.	.
5	Inorganic	.	.	.	.
6	Inorganic	.	.	.	.
7	Inorganic	S	1	0	0
8	Inorganic	S	1	0	0
9	Inorganic	S	1	0	0
10	Inorganic	S	1	0	0
11	Inorganic	S	1	0	0
12	Inorganic	S	1	0	0
13	Inorganic	S	1	0	0
14	Inorganic	S	1	0	0
15	Inorganic	S	1	0	0
16	Inorganic	S	1	0	0
17	Inorganic	S	1	0	0
19	Inorganic	S	1	0	0
20	Inorganic	S	1	0	0
21	Inorganic	S	1	0	0
22	Inorganic	S	1	0	0
24	Inorganic	S	1	0	0
25	Inorganic	I	0	1	I
27	Inorganic	S	1	0	0
28	Inorganic	S	1	0	0
29	Inorganic	S	1	0	0
30	Inorganic	S	1	0	0
31	Inorganic	I	0	1	I
32	Inorganic	S	1	0	0
33	Inorganic	S	1	0	0
34	Inorganic	S	1	0	0
35	Inorganic	S	1	0	0
36	Inorganic	S	1	0	0
37	Inorganic	R	0	0	1
38	Inorganic	R	0	0	1
39	Inorganic	S	1	0	0
40	Inorganic	S	1	0	0
41	Inorganic	S	1	0	0
42	Inorganic	S	1	0	0
43	Inorganic	S	1	0	0
44	Inorganic	S	1	0	0

Sample ID	Management	KAN			
		S/I/R	S	I	R
46	Inorganic	S	1	0	0
47	Inorganic	S	1	0	0
48	Inorganic	S	1	0	0
49	Inorganic	S	1	0	0
50	Inorganic	S	1	0	0
51	Inorganic	S	1	0	0
52	Inorganic	S	1	0	0
53	Inorganic	S	1	0	0
54	Inorganic	S	1	0	0
54 dup	Inorganic	S	1	0	0
55	Inorganic	S	1	0	0
57	Inorganic	S	1	0	0
58	Inorganic	S	1	0	0
59	Inorganic	S	1	0	0
60	Inorganic	S	1	0	0
61	Inorganic	S	1	0	0
62	Inorganic	S	1	0	0
63	Inorganic	S	1	0	0
64	Inorganic	S	1	0	0
65	Inorganic	S	1	0	0
66	Inorganic	S	1	0	0
67	Inorganic	S	1	0	0
68	Inorganic	S	1	0	0
69	Inorganic	S	1	0	0
70	Inorganic	S	1	0	0
71	Inorganic	R	0	0	1
72	Inorganic	S	1	0	0
73	Inorganic	S	1	0	0
74	Inorganic	S	1	0	0
75	Inorganic	S	1	0	0
76	Inorganic	S	1	0	0
77	Inorganic	S	1	0	0
79	Inorganic	S	1	0	0
82	Inorganic	R	0	0	1
84	Inorganic	R	0	0	1
88	Inorganic	S	1	0	0
89	Inorganic	S	1	0	0
90	Inorganic	S	1	0	0
91	Inorganic	R	0	0	1
93	Inorganic	R	0	0	1
96	Inorganic	R	0	0	1

Sample ID	Management	KAN			
		S/I/R	S	I	R
101	Inorganic	R	0	0	1
102	Inorganic	I	0	1	I
103	Inorganic	I	0	1	I
104	Inorganic	R	0	0	1
105	Inorganic	R	0	0	1
106	Inorganic	I	0	1	I
107	Inorganic	R	0	0	1
108	Inorganic	I	0	1	I
109	Inorganic	I	0	1	I
110	Inorganic	I	0	1	I
111	Inorganic	I	0	1	I
112	Inorganic	R	0	0	1
113	Inorganic	I	0	1	I
114	Inorganic	I	0	1	I
115	Inorganic	S	1	0	0
116	Inorganic	R	0	0	1
117	Inorganic	I	0	1	I
118	Inorganic	I	0	1	I
119	Inorganic	I	0	1	I
120	Inorganic	I	0	1	I
121	Inorganic	S	1	0	0
122	Inorganic	R	0	0	1
123	Inorganic	R	0	0	1
124	Inorganic	R	0	0	1
126	Inorganic	R	0	0	1
130	Inorganic	R	0	0	1
131	Inorganic	R	0	0	1
133	Inorganic	R	0	0	1
134	Inorganic	R	0	0	1
136	Inorganic	R	0	0	1
138	Inorganic	R	0	0	1
139	Inorganic	R	0	0	1
140	Inorganic	R	0	0	1
141	Inorganic	R	0	0	1
142	Inorganic	R	0	0	1
143	Inorganic	R	0	0	1
144	Inorganic	R	0	0	1
147	Inorganic	R	0	0	1
148	Inorganic	R	0	0	1
149	Inorganic	R	0	0	1
151	Inorganic	S	1	0	0

Sample ID	Management	KAN			
		S/I/R	S	I	R
153	Inorganic	R	0	0	1
154	Inorganic	R	0	0	1
155	Inorganic	R	0	0	1
156	Inorganic	R	0	0	1
158	Inorganic	S	1	0	0
159	Inorganic	R	0	0	1
161	Inorganic	R	0	0	1
162	Inorganic	R	0	0	1
163	Inorganic	R	0	0	1
164	Inorganic	R	0	0	1
166	Inorganic	R	0	0	1
167	Inorganic	R	0	0	1
168	Inorganic	R	0	0	1
169	Inorganic	R	0	0	1
170	Inorganic	R	0	0	1
171	Inorganic	S	1	0	0
172	Inorganic	R	0	0	1
173	Inorganic	R	0	0	1
174	Inorganic	R	0	0	1
175	Inorganic	R	0	0	1
176	Inorganic	R	0	0	1
177	Inorganic	S	1	0	0
178	Inorganic	R	0	0	1
179	Inorganic	R	0	0	1
180	Inorganic	R	0	0	1
181	Inorganic	R	0	0	1
182	Inorganic	R	0	0	1
183	Inorganic	R	0	0	1
184	Inorganic	R	0	0	1
185	Inorganic	R	0	0	1
186	Inorganic	S	1	0	0
187	Inorganic	S	1	0	0
189	Inorganic	S	1	0	0
190	Inorganic	R	0	0	1
191	Inorganic	S	1	0	0
192	Inorganic	S	1	0	0
197	Inorganic	S	1	0	0
199	Inorganic	S	1	0	0
200	Inorganic	R	0	0	1
201	Organic	S	1	0	0
202	Organic	S	1	0	0

Sample ID	Management	KAN			
		S/I/R	S	I	R
203	Organic	S	1	0	0
204	Organic	S	1	0	0
205	Organic	S	1	0	0
206	Organic	S	1	0	0
207	Organic	S	1	0	0
208	Organic	S	1	0	0
209	Organic	S	1	0	0
210	Organic	S	1	0	0
211	Organic	S	1	0	0
212	Organic	S	1	0	0
213	Organic	S	1	0	0
214	Organic	S	1	0	0
215	Organic	S	1	0	0
216	Organic	S	1	0	0
217	Organic	S	1	0	0
218	Organic	S	1	0	0
219	Organic	S	1	0	0
220	Organic	S	1	0	0
221	Organic	S	1	0	0
222	Organic	S	1	0	0
224	Organic	S	1	0	0
225	Organic	S	1	0	0
227	Organic	R	0	0	1
228	Organic	S	1	0	0
229	Organic	S	1	0	0
230	Organic	S	1	0	0
231	Organic	S	1	0	0
232	Organic	S	1	0	0
233	Organic	S	1	0	0
234	Organic	S	1	0	0
235	Organic	S	1	0	0
236	Organic	R	0	0	1
237	Organic	S	1	0	0
238	Organic	S	1	0	0
239	Organic	S	1	0	0
240	Organic	R	0	0	1
241	Organic	S	1	0	0
242	Organic	R	0	0	1
243	Organic	S	1	0	0
244	Organic	S	1	0	0
245	Organic	S	1	0	0

Sample ID	Management	KAN			
		S/I/R	S	I	R
246	Organic	S	1	0	0
247	Organic	S	1	0	0
248	Organic	R	0	0	1
249	Organic	S	1	0	0
250	Organic	S	1	0	0
251	Organic	R	0	0	1
252	Organic	S	1	0	0
253	Organic	I	0	1	I
254	Organic	S	1	0	0
255	Organic	R	0	0	1
256	Organic	I	0	1	I
257	Organic	S	1	0	0
258	Organic	S	1	0	0
259	Organic	R	0	0	1
260	Organic	S	1	0	0
261	Organic	S	1	0	0
262	Organic	S	1	0	0
263	Organic	R	0	0	1
264	Organic	S	1	0	0
265	Organic	S	1	0	0
266	Organic	S	1	0	0
267	Organic	S	1	0	0
268	Organic	S	1	0	0
269	Organic	S	1	0	0
270	Organic	S	1	0	0
271	Organic	S	1	0	0
272	Organic	S	1	0	0
273	Organic	S	1	0	0
275	Organic	S	1	0	0
276	Organic	S	1	0	0
277	Organic	S	1	0	0
278	Organic	S	1	0	0
279	Organic	S	1	0	0
280	Organic	S	1	0	0
281	Organic	S	1	0	0
282	Organic	S	1	0	0
283	Organic	S	1	0	0
284	Organic	S	1	0	0
285	Organic	S	1	0	0
286	Organic	S	1	0	0
287	Organic	S	1	0	0

Sample ID	Management	KAN			
		S/I/R	S	I	R
288	Organic	R	0	0	1
289	Organic	S	1	0	0
290	Organic	R	0	0	1
292	Organic	S	1	0	0
293	Organic	R	0	0	1
294	Organic	S	1	0	0
295	Organic	I	0	1	I
296	Organic	R	0	0	1
297	Organic	R	0	0	1
298	Organic	S	1	0	0
299	Organic	S	1	0	0
300	Organic	S	1	0	0
301	Organic	R	0	0	1
302	Organic	R	0	0	1
303	Organic	S	1	0	0
304	Organic	S	1	0	0
305	Organic	S	1	0	0
306	Organic	S	1	0	0
307	Organic	S	1	0	0
308	Organic	S	1	0	0
309	Organic	S	1	0	0
310	Organic	S	1	0	0
311	Organic	S	1	0	0
312	Organic	S	1	0	0
313	Organic	S	1	0	0
314	Organic	S	1	0	0
315	Organic	S	1	0	0
316	Organic	R	0	0	1
317	Organic	R	0	0	1
318	Organic	S	1	0	0
319	Organic	S	1	0	0
320	Organic	R	0	0	1
321	Organic	R	0	0	1
324	Organic	S	1	0	0
325	Organic	S	1	0	0
326	Organic	S	1	0	0
327	Organic	S	1	0	0
328	Organic	S	1	0	0
329	Organic	S	1	0	0
330	Organic	S	1	0	0
331	Organic	R	0	0	1

Sample ID	Management	KAN			
		S/I/R	S	I	R
332	Organic	R	0	0	1
333	Organic	R	0	0	1
336	Organic	R	0	0	1
337	Organic	R	0	0	1
338	Organic	R	0	0	1
339	Organic	R	0	0	1
341	Organic	I	0	1	I
342	Organic	R	0	0	1
343	Organic	R	0	0	1
344	Organic	S	1	0	0
345	Organic	R	0	0	1
346	Organic	S	1	0	0
348	Organic	R	0	0	1
349	Organic	R	0	0	1
350	Organic	S	1	0	0
351	Organic	S	1	0	0
353	Organic	R	0	0	1
354	Organic	R	0	0	1
355	Organic	R	0	0	1
356	Organic	R	0	0	1
357	Organic	R	0	0	1
358	Organic	R	0	0	1
359	Organic	R	0	0	1
360	Organic	R	0	0	1
361	Organic	R	0	0	1
362	Organic	R	0	0	1
363	Organic	R	0	0	1
364	Organic	R	0	0	1
365	Organic	R	0	0	1
366	Organic	R	0	0	1
367	Organic	R	0	0	1
368	Organic	R	0	0	1
369	Organic	R	0	0	1
370	Organic	R	0	0	1
371	Organic	R	0	0	1
372	Organic	S	1	0	0
373	Organic	R	0	0	1
374	Organic	R	0	0	1
375	Organic	R	0	0	1
376	Organic	R	0	0	1
378	Organic	R	0	0	1

Sample ID	Management	KAN			
		S/I/R	S	I	R
379	Organic	I	0	1	I
380	Organic	S	1	0	0
381	Organic	R	0	0	1
382	Organic	R	0	0	1
384	Organic	R	0	0	1
385	Organic	S	1	0	0
386	Organic	S	1	0	0
388	Organic	S	1	0	0
389	Organic	S	1	0	0
390	Organic	S	1	0	0
391	Organic	S	1	0	0
392	Organic	S	1	0	0
393	Organic	R	0	0	1
394	Organic	R	0	0	1
397	Organic	R	0	0	1
398	Organic	R	0	0	1
399	Organic	S	1	0	0
400	Organic	S	1	0	0
401	Inorganic	R	0	0	1
402	Inorganic	R	0	0	1
403	Inorganic	R	0	0	1
404	Inorganic	0	0	0	0
405	Inorganic	S	1	0	0
406	Inorganic	S	1	0	0
407	Inorganic	S	1	0	0
409	Inorganic	R	0	0	1
410	Inorganic	R	0	0	1
411	Inorganic	0	0	0	0
412	Inorganic	R	0	0	1
414	Inorganic	S	1	0	0
415	Inorganic	R	0	0	1
416	Inorganic	R	0	0	1
417	Inorganic	R	0	0	1
418	Inorganic	R	0	0	1
419	Inorganic	R	0	0	1
420	Inorganic	S	1	0	0
421	Inorganic	S	1	0	0
423	Inorganic	R	0	0	1
425	Inorganic	R	0	0	1
426	Inorganic	R	0	0	1
427	Inorganic	R	0	0	1

Sample ID	Management	KAN			
		S/I/R	S	I	R
430	Inorganic	R	0	0	1
431	Inorganic	R	0	0	1
433	Inorganic	R	0	0	1
434	Inorganic	R	0	0	1
435	Inorganic	R	0	0	1
436	Inorganic	R	0	0	1
437	Inorganic	R	0	0	1
438	Inorganic	R	0	0	1
439	Inorganic	R	0	0	1
440	Inorganic	R	0	0	1
441	Inorganic	R	0	0	1
442	Inorganic	R	0	0	1
443	Inorganic	R	0	0	1
444	Inorganic	R	0	0	1
445	Inorganic	R	0	0	1
446	Inorganic	R	0	0	1
447	Inorganic	R	0	0	1
448	Inorganic	R	0	0	1
449	Inorganic	R	0	0	1
450	Inorganic	R	0	0	1
451	Inorganic	R	0	0	1
452	Inorganic	R	0	0	1
453	Inorganic	R	0	0	1
454	Inorganic	R	0	0	1
455	Inorganic	R	0	0	1
456	Inorganic	R	0	0	1
457	Inorganic	S	1	0	0
458	Inorganic	R	0	0	1
459	Inorganic	R	0	0	1
460	Inorganic	R	0	0	1
462	Inorganic	R	0	0	1
463	Inorganic	S	1	0	0
464	Inorganic	I	0	1	I
465	Inorganic	R	0	0	1
466	Inorganic	R	0	0	1
467	Inorganic	R	0	0	1
468	Inorganic	R	0	0	1
469	Inorganic	R	0	0	1
470	Inorganic	R	0	0	1
471	Inorganic	R	0	0	1
472	Inorganic	R	0	0	1

Sample ID	Management	KAN			
		S/I/R	S	I	R
473	Inorganic	R	0	0	1
474	Inorganic	S	1	0	0
475	Inorganic	R	0	0	1
476	Inorganic	R	0	0	1
477	Inorganic	R	0	0	1
478	Inorganic	R	0	0	1
479	Inorganic	R	0	0	1
480	Inorganic	R	0	0	1
481	Inorganic	R	0	0	1
482	Inorganic	R	0	0	1
483	Inorganic	S	1	0	0
484	Inorganic	S	1	0	0
485	Inorganic	R	0	0	1
486	Inorganic	R	0	0	1
487	Inorganic	R	0	0	1
488	Inorganic	R	0	0	1
489	Inorganic	R	0	0	1
490	Inorganic	R	0	0	1
491	Inorganic	R	0	0	1
492	Inorganic	R	0	0	1
493	Inorganic	S	1	0	0
494	Inorganic	R	0	0	1
495	Inorganic	R	0	0	1
497	Inorganic	R	0	0	1
498	Inorganic	R	0	0	1
499	Inorganic	R	0	0	1
500	Inorganic	S	1	0	0
501	Inorganic	R	0	0	1
502	Inorganic	R	0	0	1
503	Inorganic	R	0	0	1
504	Inorganic	R	0	0	1
505	Inorganic	R	0	0	1
506	Inorganic	R	0	0	1
507	Inorganic	R	0	0	1
508	Inorganic	I	0	1	I
509	Inorganic	R	0	0	1
510	Inorganic	R	0	0	1
511	Inorganic	R	0	0	1
512	Inorganic	R	0	0	1
513	Inorganic	R	0	0	1
514	Inorganic	S	1	0	0

Sample ID	Management	KAN			
		S/I/R	S	I	R
515	Inorganic	R	0	0	1
516	Inorganic	S	1	0	0
517	Inorganic	R	0	0	1
518	Inorganic	R	0	0	1
519	Inorganic	R	0	0	1
520	Inorganic	S	1	0	0
521	Inorganic	R	0	0	1
522	Inorganic	S	1	0	0
523	Inorganic	R	0	0	1
525	Inorganic	R	0	0	1
526	Inorganic	S	1	0	0
527	Inorganic	S	1	0	0
528	Inorganic	S	1	0	0
529	Inorganic	S	1	0	0
530	Inorganic	S	1	0	0
531	Inorganic	S	1	0	0
532	Inorganic	S	1	0	0
533	Inorganic	S	1	0	0
534	Inorganic	S	1	0	0
535	Inorganic	R	0	0	1
536	Inorganic	S	1	0	0
537	Inorganic	S	1	0	0
538	Inorganic	S	1	0	0
539	Inorganic	S	1	0	0
540	Inorganic	S	1	0	0
541	Inorganic	S	1	0	0
542	Inorganic	S	1	0	0
543	Inorganic	S	1	0	0
544	Inorganic	S	1	0	0
545	Inorganic	S	1	0	0
546	Inorganic	S	1	0	0
547	Inorganic	S	1	0	0
548	Inorganic	S	1	0	0
549	Inorganic	S	1	0	0
550	Inorganic	S	1	0	0
551	Inorganic	S	1	0	0
552	Inorganic	S	1	0	0
553	Inorganic	S	1	0	0
554	Inorganic	S	1	0	0
556	Inorganic	S	1	0	0

Sample ID	Management	TYL			
		S/I/R	S	I	R
1	Inorganic	R	0	0	1
2	Inorganic	R	0	0	1
3	Inorganic	R	0	0	1
4	Inorganic	S	1	0	0
5	Inorganic	S	1	0	0
6	Inorganic	S	1	0	0
7	Inorganic	R	0	0	1
8	Inorganic	I	0	1	0
9	Inorganic	R	0	0	1
10	Inorganic	R	0	0	1
11	Inorganic	R	0	0	1
12	Inorganic	R	0	0	1
13	Inorganic	R	0	0	1
14	Inorganic	R	0	0	1
15	Inorganic	R	0	0	1
16	Inorganic	R	0	0	1
17	Inorganic	R	0	0	1
19	Inorganic	R	0	0	1
20	Inorganic	R	0	0	1
21	Inorganic	R	0	0	1
22	Inorganic	R	0	0	1
24	Inorganic	R	0	0	1
25	Inorganic	R	0	0	1
27	Inorganic	R	0	0	1
28	Inorganic	R	0	0	1
29	Inorganic	R	0	0	1
30	Inorganic	R	0	0	1
31	Inorganic	R	0	0	1
32	Inorganic	R	0	0	1
33	Inorganic	R	0	0	1
34	Inorganic	R	0	0	1
35	Inorganic	R	0	0	1
36	Inorganic	R	0	0	1
37	Inorganic	R	0	0	1
38	Inorganic	R	0	0	1
39	Inorganic	I	0	1	0
40	Inorganic	R	0	0	1
41	Inorganic	R	0	0	1
42	Inorganic	R	0	0	1
43	Inorganic	R	0	0	1
44	Inorganic	R	0	0	1

Sample ID	Management	TYL			
		S/I/R	S	I	R
46	Inorganic	R	0	0	1
47	Inorganic	R	0	0	1
48	Inorganic	R	0	0	1
49	Inorganic	R	0	0	1
50	Inorganic	R	0	0	1
51	Inorganic	R	0	0	1
52	Inorganic	R	0	0	1
53	Inorganic	R	0	0	1
54	Inorganic	R	0	0	1
54 dup	Inorganic	R	0	0	1
55	Inorganic	R	0	0	1
57	Inorganic	R	0	0	1
58	Inorganic	R	0	0	1
59	Inorganic	R	0	0	1
60	Inorganic	R	0	0	1
61	Inorganic	R	0	0	1
62	Inorganic	R	0	0	1
63	Inorganic	R	0	0	1
64	Inorganic	R	0	0	1
65	Inorganic	R	0	0	1
66	Inorganic	R	0	0	1
67	Inorganic	R	0	0	1
68	Inorganic	R	0	0	1
69	Inorganic	R	0	0	1
70	Inorganic	R	0	0	1
71	Inorganic	R	0	0	1
72	Inorganic	R	0	0	1
73	Inorganic	R	0	0	1
74	Inorganic	R	0	0	1
75	Inorganic	R	0	0	1
76	Inorganic	R	0	0	1
77	Inorganic	R	0	0	1
79	Inorganic	R	0	0	1
82	Inorganic	R	0	0	1
84	Inorganic	R	0	0	1
88	Inorganic	R	0	0	1
89	Inorganic	R	0	0	1
90	Inorganic	R	0	0	1
91	Inorganic	R	0	0	1
93	Inorganic	R	0	0	1
96	Inorganic	R	0	0	1

Sample ID	Management	TYL			
		S/I/R	S	I	R
101	Inorganic	R	0	0	1
102	Inorganic	R	0	0	1
103	Inorganic	R	0	0	1
104	Inorganic	R	0	0	1
105	Inorganic	R	0	0	1
106	Inorganic	R	0	0	1
107	Inorganic	R	0	0	1
108	Inorganic	R	0	0	1
109	Inorganic	R	0	0	1
110	Inorganic	R	0	0	1
111	Inorganic	R	0	0	1
112	Inorganic	R	0	0	1
113	Inorganic	R	0	0	1
114	Inorganic	R	0	0	1
115	Inorganic	R	0	0	1
116	Inorganic	R	0	0	1
117	Inorganic	R	0	0	1
118	Inorganic	R	0	0	1
119	Inorganic	R	0	0	1
120	Inorganic	R	0	0	1
121	Inorganic	R	0	0	1
122	Inorganic	R	0	0	1
123	Inorganic	R	0	0	1
124	Inorganic	R	0	0	1
126	Inorganic	R	0	0	1
130	Inorganic	R	0	0	1
131	Inorganic	R	0	0	1
133	Inorganic	R	0	0	1
134	Inorganic	R	0	0	1
136	Inorganic	R	0	0	1
138	Inorganic	R	0	0	1
139	Inorganic	R	0	0	1
140	Inorganic	R	0	0	1
141	Inorganic	R	0	0	1
142	Inorganic	R	0	0	1
143	Inorganic	R	0	0	1
144	Inorganic	R	0	0	1
147	Inorganic	R	0	0	1
148	Inorganic	R	0	0	1
149	Inorganic	R	0	0	1
151	Inorganic	R	0	0	1

Sample ID	Management	TYL			
		S/I/R	S	I	R
153	Inorganic	R	0	0	1
154	Inorganic	R	0	0	1
155	Inorganic	R	0	0	1
156	Inorganic	R	0	0	1
158	Inorganic	R	0	0	1
159	Inorganic	R	0	0	1
161	Inorganic	R	0	0	1
162	Inorganic	R	0	0	1
163	Inorganic	R	0	0	1
164	Inorganic	R	0	0	1
166	Inorganic	R	0	0	1
167	Inorganic	R	0	0	1
168	Inorganic	R	0	0	1
169	Inorganic	R	0	0	1
170	Inorganic	R	0	0	1
171	Inorganic	R	0	0	1
172	Inorganic	R	0	0	1
173	Inorganic	R	0	0	1
174	Inorganic	R	0	0	1
175	Inorganic	R	0	0	1
176	Inorganic	R	0	0	1
177	Inorganic	S	1	0	0
178	Inorganic	R	0	0	1
179	Inorganic	R	0	0	1
180	Inorganic	R	0	0	1
181	Inorganic	R	0	0	1
182	Inorganic	R	0	0	1
183	Inorganic	R	0	0	1
184	Inorganic	R	0	0	1
185	Inorganic	R	0	0	1
186	Inorganic	R	0	0	1
187	Inorganic	R	0	0	1
189	Inorganic	R	0	0	1
190	Inorganic	R	0	0	1
191	Inorganic	R	0	0	1
192	Inorganic	R	0	0	1
197	Inorganic	R	0	0	1
199	Inorganic	R	0	0	1
200	Inorganic	R	0	0	1
201	Organic	R	0	0	1
202	Organic	R	0	0	1

Sample ID	Management	TYL			
		S/I/R	S	I	R
203	Organic	R	0	0	1
204	Organic	R	0	0	1
205	Organic	R	0	0	1
206	Organic	R	0	0	1
207	Organic	R	0	0	1
208	Organic	R	0	0	1
209	Organic	R	0	0	1
210	Organic	R	0	0	1
211	Organic	R	0	0	1
212	Organic	R	0	0	1
213	Organic	R	0	0	1
214	Organic	R	0	0	1
215	Organic	R	0	0	1
216	Organic	R	0	0	1
217	Organic	R	0	0	1
218	Organic	R	0	0	1
219	Organic	R	0	0	1
220	Organic	R	0	0	1
221	Organic	R	0	0	1
222	Organic	R	0	0	1
224	Organic	R	0	0	1
225	Organic	R	0	0	1
227	Organic	R	0	0	1
228	Organic	R	0	0	1
229	Organic	R	0	0	1
230	Organic	R	0	0	1
231	Organic	R	0	0	1
232	Organic	R	0	0	1
233	Organic	R	0	0	1
234	Organic	R	0	0	1
235	Organic	R	0	0	1
236	Organic	R	0	0	1
237	Organic	R	0	0	1
238	Organic	R	0	0	1
239	Organic	R	0	0	1
240	Organic	R	0	0	1
241	Organic	R	0	0	1
242	Organic	R	0	0	1
243	Organic	R	0	0	1
244	Organic	R	0	0	1
245	Organic	R	0	0	1

Sample ID	Management	TYL			
		S/I/R	S	I	R
246	Organic	R	0	0	1
247	Organic	R	0	0	1
248	Organic	R	0	0	1
249	Organic	R	0	0	1
250	Organic	R	0	0	1
251	Organic	R	0	0	1
252	Organic	R	0	0	1
253	Organic	R	0	0	1
254	Organic	R	0	0	1
255	Organic	R	0	0	1
256	Organic	R	0	0	1
257	Organic	R	0	0	1
258	Organic	R	0	0	1
259	Organic	R	0	0	1
260	Organic	R	0	0	1
261	Organic	R	0	0	1
262	Organic	R	0	0	1
263	Organic	R	0	0	1
264	Organic	R	0	0	1
265	Organic	R	0	0	1
266	Organic	R	0	0	1
267	Organic	R	0	0	1
268	Organic	R	0	0	1
269	Organic	R	0	0	1
270	Organic	R	0	0	1
271	Organic	R	0	0	1
272	Organic	R	0	0	1
273	Organic	S	1	0	0
275	Organic	S	1	0	0
276	Organic	R	0	0	1
277	Organic	R	0	0	1
278	Organic	R	0	0	1
279	Organic	R	0	0	1
280	Organic	R	0	0	1
281	Organic	R	0	0	1
282	Organic	R	0	0	1
283	Organic	R	0	0	1
284	Organic	R	0	0	1
285	Organic	S	1	0	0
286	Organic	S	1	0	0
287	Organic	S	1	0	0

Sample ID	Management	TYL			
		S/I/R	S	I	R
288	Organic	S	1	0	0
289	Organic	S	1	0	0
290	Organic	S	1	0	0
292	Organic	R	0	0	1
293	Organic	R	0	0	1
294	Organic	R	0	0	1
295	Organic	R	0	0	1
296	Organic	R	0	0	1
297	Organic	R	0	0	1
298	Organic	R	0	0	1
299	Organic	R	0	0	1
300	Organic	R	0	0	1
301	Organic	S	1	0	0
302	Organic	R	0	0	1
303	Organic	R	0	0	1
304	Organic	R	0	0	1
305	Organic	R	0	0	1
306	Organic	R	0	0	1
307	Organic	R	0	0	1
308	Organic	R	0	0	1
309	Organic	R	0	0	1
310	Organic	R	0	0	1
311	Organic	R	0	0	1
312	Organic	R	0	0	1
313	Organic	R	0	0	1
314	Organic	R	0	0	1
315	Organic	R	0	0	1
316	Organic	R	0	0	1
317	Organic	R	0	0	1
318	Organic	R	0	0	1
319	Organic	R	0	0	1
320	Organic	R	0	0	1
321	Organic	R	0	0	1
324	Organic	R	0	0	1
325	Organic	S	1	0	0
326	Organic	R	0	0	1
327	Organic	R	0	0	1
328	Organic	R	0	0	1
329	Organic	R	0	0	1
330	Organic	S	1	0	0
331	Organic	S	1	0	0

Sample ID	Management	TYL			
		S/I/R	S	I	R
332	Organic	R	0	0	1
333	Organic	S	1	0	0
336	Organic	R	0	0	1
337	Organic	R	0	0	1
338	Organic	S	1	0	0
339	Organic	R	0	0	1
341	Organic	S	1	0	0
342	Organic	R	0	0	1
343	Organic	R	0	0	1
344	Organic	S	1	0	0
345	Organic	R	0	0	1
346	Organic	R	0	0	1
348	Organic	R	0	0	1
349	Organic	R	0	0	1
350	Organic	R	0	0	1
351	Organic	R	0	0	1
353	Organic	R	0	0	1
354	Organic	R	0	0	1
355	Organic	R	0	0	1
356	Organic	R	0	0	1
357	Organic	R	0	0	1
358	Organic	R	0	0	1
359	Organic	R	0	0	1
360	Organic	R	0	0	1
361	Organic	R	0	0	1
362	Organic	R	0	0	1
363	Organic	R	0	0	1
364	Organic	R	0	0	1
365	Organic	R	0	0	1
366	Organic	R	0	0	1
367	Organic	R	0	0	1
368	Organic	R	0	0	1
369	Organic	R	0	0	1
370	Organic	R	0	0	1
371	Organic	R	0	0	1
372	Organic	R	0	0	1
373	Organic	R	0	0	1
374	Organic	R	0	0	1
375	Organic	R	0	0	1
376	Organic	R	0	0	1
378	Organic	R	0	0	1

Sample ID	Management	TYL			
		S/I/R	S	I	R
379	Organic	R	0	0	1
380	Organic	R	0	0	1
381	Organic	R	0	0	1
382	Organic	R	0	0	1
384	Organic	R	0	0	1
385	Organic	R	0	0	1
386	Organic	R	0	0	1
388	Organic	S	1	0	0
389	Organic	S	1	0	0
390	Organic	R	0	0	1
391	Organic	S	1	0	0
392	Organic	S	1	0	0
393	Organic	R	0	0	1
394	Organic	R	0	0	1
397	Organic	R	0	0	1
398	Organic	R	0	0	1
399	Organic	S	1	0	0
400	Organic	S	1	0	0
401	Inorganic	R	0	0	1
402	Inorganic	R	0	0	1
403	Inorganic	R	0	0	1
404	Inorganic	R	0	0	1
405	Inorganic	S	1	0	0
406	Inorganic	S	1	0	0
407	Inorganic	R	0	0	1
409	Inorganic	R	0	0	1
410	Inorganic	R	0	0	1
411	Inorganic	R	0	0	1
412	Inorganic	R	0	0	1
414	Inorganic	R	0	0	1
415	Inorganic	S	1	0	0
416	Inorganic	R	0	0	1
417	Inorganic	R	0	0	1
418	Inorganic	R	0	0	1
419	Inorganic	R	0	0	1
420	Inorganic	R	0	0	1
421	Inorganic	S	1	0	0
423	Inorganic	R	0	0	1
425	Inorganic	R	0	0	1
426	Inorganic	R	0	0	1
427	Inorganic	R	0	0	1

Sample ID	Management	TYL			
		S/I/R	S	I	R
430	Inorganic	R	0	0	1
431	Inorganic	R	0	0	1
433	Inorganic	R	0	0	1
434	Inorganic	R	0	0	1
435	Inorganic	R	0	0	1
436	Inorganic	R	0	0	1
437	Inorganic	R	0	0	1
438	Inorganic	R	0	0	1
439	Inorganic	R	0	0	1
440	Inorganic	R	0	0	1
441	Inorganic	R	0	0	1
442	Inorganic	R	0	0	1
443	Inorganic	R	0	0	1
444	Inorganic	R	0	0	1
445	Inorganic	R	0	0	1
446	Inorganic	R	0	0	1
447	Inorganic	I	0	1	0
448	Inorganic	S	1	0	0
449	Inorganic	R	0	0	1
450	Inorganic	R	0	0	1
451	Inorganic	R	0	0	1
452	Inorganic	R	0	0	1
453	Inorganic	R	0	0	1
454	Inorganic	R	0	0	1
455	Inorganic	R	0	0	1
456	Inorganic	R	0	0	1
457	Inorganic	S	1	0	0
458	Inorganic	I	0	1	0
459	Inorganic	R	0	0	1
460	Inorganic	R	0	0	1
462	Inorganic	R	0	0	1
463	Inorganic	R	0	0	1
464	Inorganic	S	1	0	0
465	Inorganic	R	0	0	1
466	Inorganic	R	0	0	1
467	Inorganic	R	0	0	1
468	Inorganic	R	0	0	1
469	Inorganic	R	0	0	1
470	Inorganic	R	0	0	1
471	Inorganic	R	0	0	1
472	Inorganic	R	0	0	1

Sample ID	Management	TYL			
		S/I/R	S	I	R
473	Inorganic	R	0	0	1
474	Inorganic	R	0	0	1
475	Inorganic	R	0	0	1
476	Inorganic	R	0	0	1
477	Inorganic	R	0	0	1
478	Inorganic	R	0	0	1
479	Inorganic	R	0	0	1
480	Inorganic	R	0	0	1
481	Inorganic	R	0	0	1
482	Inorganic	R	0	0	1
483	Inorganic	R	0	0	1
484	Inorganic	R	0	0	1
485	Inorganic	R	0	0	1
486	Inorganic	R	0	0	1
487	Inorganic	R	0	0	1
488	Inorganic	R	0	0	1
489	Inorganic	R	0	0	1
490	Inorganic	R	0	0	1
491	Inorganic	R	0	0	1
492	Inorganic	R	0	0	1
493	Inorganic	R	0	0	1
494	Inorganic	R	0	0	1
495	Inorganic	R	0	0	1
497	Inorganic	R	0	0	1
498	Inorganic	R	0	0	1
499	Inorganic	R	0	0	1
500	Inorganic	R	0	0	1
501	Inorganic	R	0	0	1
502	Inorganic	R	0	0	1
503	Inorganic	R	0	0	1
504	Inorganic	R	0	0	1
505	Inorganic	R	0	0	1
506	Inorganic	R	0	0	1
507	Inorganic	R	0	0	1
508	Inorganic	S	1	0	0
509	Inorganic	R	0	0	1
510	Inorganic	R	0	0	1
511	Inorganic	R	0	0	1
512	Inorganic	R	0	0	1
513	Inorganic	R	0	0	1
514	Inorganic	R	0	0	1

Sample ID	Management	TYL			
		S/I/R	S	I	R
515	Inorganic	R	0	0	1
516	Inorganic	R	0	0	1
517	Inorganic	S	1	0	0
518	Inorganic	R	0	0	1
519	Inorganic	R	0	0	1
520	Inorganic	R	0	0	1
521	Inorganic	R	0	0	1
522	Inorganic	R	0	0	1
523	Inorganic	R	0	0	1
525	Inorganic	R	0	0	1
526	Inorganic	R	0	0	1
527	Inorganic	R	0	0	1
528	Inorganic	R	0	0	1
529	Inorganic	R	0	0	1
530	Inorganic	S	1	0	0
531	Inorganic	R	0	0	1
532	Inorganic	R	0	0	1
533	Inorganic	R	0	0	1
534	Inorganic	R	0	0	1
535	Inorganic	S	1	0	0
536	Inorganic	R	0	0	1
537	Inorganic	R	0	0	1
538	Inorganic	R	0	0	1
539	Inorganic	R	0	0	1
540	Inorganic	R	0	0	1
541	Inorganic	R	0	0	1
542	Inorganic	R	0	0	1
543	Inorganic	R	0	0	1
544	Inorganic	R	0	0	1
545	Inorganic	R	0	0	1
546	Inorganic	R	0	0	1
547	Inorganic	R	0	0	1
548	Inorganic	R	0	0	1
549	Inorganic	R	0	0	1
550	Inorganic	R	0	0	1
551	Inorganic	R	0	0	1
552	Inorganic	R	0	0	1
553	Inorganic	R	0	0	1
554	Inorganic	R	0	0	1
556	Inorganic	R	0	0	1

Sample ID	Management	ERY			
		S/I/R	S	I	R
1	Inorganic	R	0	0	1
2	Inorganic	R	0	0	1
3	Inorganic	R	0	0	1
4	Inorganic	R	0	0	1
5	Inorganic	R	0	0	1
6	Inorganic	R	0	0	1
7	Inorganic	R	0	0	1
8	Inorganic	R	0	0	1
9	Inorganic	R	0	0	1
10	Inorganic	R	0	0	1
11	Inorganic	R	0	0	1
12	Inorganic	R	0	0	1
13	Inorganic	R	0	0	1
14	Inorganic	R	0	0	1
15	Inorganic	R	0	0	1
16	Inorganic	R	0	0	1
17	Inorganic	R	0	0	1
19	Inorganic	R	0	0	1
20	Inorganic	R	0	0	1
21	Inorganic	R	0	0	1
22	Inorganic	R	0	0	1
24	Inorganic	R	0	0	1
25	Inorganic	R	0	0	1
27	Inorganic	R	0	0	1
28	Inorganic	R	0	0	1
29	Inorganic	R	0	0	1
30	Inorganic	R	0	0	1
31	Inorganic	R	0	0	1
32	Inorganic	R	0	0	1
33	Inorganic	R	0	0	1
34	Inorganic	R	0	0	1
35	Inorganic	R	0	0	1
36	Inorganic	R	0	0	1
37	Inorganic	R	0	0	1
38	Inorganic	R	0	0	1
39	Inorganic	S	1	0	0
40	Inorganic	R	0	0	1
41	Inorganic	R	0	0	1
42	Inorganic	R	0	0	1
43	Inorganic	R	0	0	1
44	Inorganic	R	0	0	1

Sample ID	Management	ERY			
		S/I/R	S	I	R
46	Inorganic	R	0	0	1
47	Inorganic	I	0	1	0
48	Inorganic	R	0	0	1
49	Inorganic	R	0	0	1
50	Inorganic	R	0	0	1
51	Inorganic	R	0	0	1
52	Inorganic	R	0	0	1
53	Inorganic	S	1	0	0
54	Inorganic	R	0	0	1
54 dup	Inorganic	R	0	0	1
55	Inorganic	R	0	0	1
57	Inorganic	R	0	0	1
58	Inorganic	R	0	0	1
59	Inorganic	R	0	0	1
60	Inorganic	R	0	0	1
61	Inorganic	R	0	0	1
62	Inorganic	R	0	0	1
63	Inorganic	R	0	0	1
64	Inorganic	R	0	0	1
65	Inorganic	R	0	0	1
66	Inorganic	R	0	0	1
67	Inorganic	R	0	0	1
68	Inorganic	R	0	0	1
69	Inorganic	R	0	0	1
70	Inorganic	R	0	0	1
71	Inorganic	R	0	0	1
72	Inorganic	R	0	0	1
73	Inorganic	R	0	0	1
74	Inorganic	R	0	0	1
75	Inorganic	R	0	0	1
76	Inorganic	R	0	0	1
77	Inorganic	R	0	0	1
79	Inorganic	R	0	0	1
82	Inorganic	R	0	0	1
84	Inorganic	R	0	0	1
88	Inorganic	R	0	0	1
89	Inorganic	R	0	0	1
90	Inorganic	R	0	0	1
91	Inorganic	S	1	0	0
93	Inorganic	S	1	0	0
96	Inorganic	R	0	0	1

Sample ID	Management	ERY			
		S/I/R	S	I	R
101	Inorganic	R	0	0	1
102	Inorganic	R	0	0	1
103	Inorganic	R	0	0	1
104	Inorganic	R	0	0	1
105	Inorganic	R	0	0	1
106	Inorganic	R	0	0	1
107	Inorganic	R	0	0	1
108	Inorganic	R	0	0	1
109	Inorganic	R	0	0	1
110	Inorganic	R	0	0	1
111	Inorganic	R	0	0	1
112	Inorganic	R	0	0	1
113	Inorganic	R	0	0	1
114	Inorganic	R	0	0	1
115	Inorganic	R	0	0	1
116	Inorganic	R	0	0	1
117	Inorganic	R	0	0	1
118	Inorganic	R	0	0	1
119	Inorganic	R	0	0	1
120	Inorganic	R	0	0	1
121	Inorganic	R	0	0	1
122	Inorganic	R	0	0	1
123	Inorganic	R	0	0	1
124	Inorganic	R	0	0	1
126	Inorganic	R	0	0	1
130	Inorganic	R	0	0	1
131	Inorganic	R	0	0	1
133	Inorganic	R	0	0	1
134	Inorganic	R	0	0	1
136	Inorganic	R	0	0	1
138	Inorganic	R	0	0	1
139	Inorganic	R	0	0	1
140	Inorganic	R	0	0	1
141	Inorganic	R	0	0	1
142	Inorganic	R	0	0	1
143	Inorganic	R	0	0	1
144	Inorganic	R	0	0	1
147	Inorganic	R	0	0	1
148	Inorganic	R	0	0	1
149	Inorganic	R	0	0	1
151	Inorganic	R	0	0	1

Sample ID	Management	ERY			
		S/I/R	S	I	R
153	Inorganic	R	0	0	1
154	Inorganic	R	0	0	1
155	Inorganic	R	0	0	1
156	Inorganic	R	0	0	1
158	Inorganic	R	0	0	1
159	Inorganic	R	0	0	1
161	Inorganic	R	0	0	1
162	Inorganic	R	0	0	1
163	Inorganic	R	0	0	1
164	Inorganic	R	0	0	1
166	Inorganic	R	0	0	1
167	Inorganic	R	0	0	1
168	Inorganic	R	0	0	1
169	Inorganic	R	0	0	1
170	Inorganic	R	0	0	1
171	Inorganic	R	0	0	1
172	Inorganic	R	0	0	1
173	Inorganic	R	0	0	1
174	Inorganic	S	1	0	0
175	Inorganic	S	1	0	0
176	Inorganic	R	0	0	1
177	Inorganic	S	1	0	0
178	Inorganic	R	0	0	1
179	Inorganic	R	0	0	1
180	Inorganic	R	0	0	1
181	Inorganic	R	0	0	1
182	Inorganic	R	0	0	1
183	Inorganic	R	0	0	1
184	Inorganic	R	0	0	1
185	Inorganic	R	0	0	1
186	Inorganic	R	0	0	1
187	Inorganic	R	0	0	1
189	Inorganic	R	0	0	1
190	Inorganic	R	0	0	1
191	Inorganic	R	0	0	1
192	Inorganic	R	0	0	1
197	Inorganic	R	0	0	1
199	Inorganic	R	0	0	1
200	Inorganic	R	0	0	1
201	Organic	R	0	0	1
202	Organic	R	0	0	1

Sample ID	Management	ERY			
		S/I/R	S	I	R
203	Organic	R	0	0	1
204	Organic	R	0	0	1
205	Organic	R	0	0	1
206	Organic	R	0	0	1
207	Organic	R	0	0	1
208	Organic	R	0	0	1
209	Organic	R	0	0	1
210	Organic	R	0	0	1
211	Organic	R	0	0	1
212	Organic	R	0	0	1
213	Organic	R	0	0	1
214	Organic	R	0	0	1
215	Organic	R	0	0	1
216	Organic	R	0	0	1
217	Organic	R	0	0	1
218	Organic	R	0	0	1
219	Organic	R	0	0	1
220	Organic	R	0	0	1
221	Organic	R	0	0	1
222	Organic	R	0	0	1
224	Organic	R	0	0	1
225	Organic	R	0	0	1
227	Organic	R	0	0	1
228	Organic	R	0	0	1
229	Organic	R	0	0	1
230	Organic	R	0	0	1
231	Organic	S	1	0	0
232	Organic	S	1	0	0
233	Organic	S	1	0	0
234	Organic	S	1	0	0
235	Organic	S	1	0	0
236	Organic	S	1	0	0
237	Organic	S	1	0	0
238	Organic	S	1	0	0
239	Organic	S	1	0	0
240	Organic	S	1	0	0
241	Organic	S	1	0	0
242	Organic	S	1	0	0
243	Organic	S	1	0	0
244	Organic	S	1	0	0
245	Organic	S	1	0	0

Sample ID	Management	ERY			
		S/I/R	S	I	R
246	Organic	S	1	0	0
247	Organic	S	1	0	0
248	Organic	S	1	0	0
249	Organic	S	1	0	0
250	Organic	S	1	0	0
251	Organic	S	1	0	0
252	Organic	S	1	0	0
253	Organic	S	1	0	0
254	Organic	S	1	0	0
255	Organic	S	1	0	0
256	Organic	S	1	0	0
257	Organic	S	1	0	0
258	Organic	S	1	0	0
259	Organic	S	1	0	0
260	Organic	S	1	0	0
261	Organic	S	1	0	0
262	Organic	S	1	0	0
263	Organic	S	1	0	0
264	Organic	S	1	0	0
265	Organic	S	1	0	0
266	Organic	R	0	0	1
267	Organic	R	0	0	1
268	Organic	R	0	0	1
269	Organic	R	0	0	1
270	Organic	R	0	0	1
271	Organic	R	0	0	1
272	Organic	R	0	0	1
273	Organic	S	1	0	0
275	Organic	S	1	0	0
276	Organic	R	0	0	1
277	Organic	R	0	0	1
278	Organic	R	0	0	1
279	Organic	R	0	0	1
280	Organic	R	0	0	1
281	Organic	R	0	0	1
282	Organic	R	0	0	1
283	Organic	R	0	0	1
284	Organic	R	0	0	1
285	Organic	R	0	0	1
286	Organic	R	0	0	1
287	Organic	R	0	0	1

Sample ID	Management	ERY			
		S/I/R	S	I	R
288	Organic	R	0	0	1
289	Organic	R	0	0	1
290	Organic	R	0	0	1
292	Organic	R	0	0	1
293	Organic	R	0	0	1
294	Organic	R	0	0	1
295	Organic	R	0	0	1
296	Organic	R	0	0	1
297	Organic	R	0	0	1
298	Organic	R	0	0	1
299	Organic	R	0	0	1
300	Organic	R	0	0	1
301	Organic	R	0	0	1
302	Organic	R	0	0	1
303	Organic	R	0	0	1
304	Organic	R	0	0	1
305	Organic	R	0	0	1
306	Organic	R	0	0	1
307	Organic	R	0	0	1
308	Organic	R	0	0	1
309	Organic	R	0	0	1
310	Organic	R	0	0	1
311	Organic	R	0	0	1
312	Organic	R	0	0	1
313	Organic	R	0	0	1
314	Organic	R	0	0	1
315	Organic	R	0	0	1
316	Organic	R	0	0	1
317	Organic	R	0	0	1
318	Organic	R	0	0	1
319	Organic	R	0	0	1
320	Organic	R	0	0	1
321	Organic	R	0	0	1
324	Organic	R	0	0	1
325	Organic	S	1	0	0
326	Organic	R	0	0	1
327	Organic	R	0	0	1
328	Organic	R	0	0	1
329	Organic	R	0	0	1
330	Organic	S	1	0	0
331	Organic	R	0	0	1

Sample ID	Management	ERY			
		S/I/R	S	I	R
332	Organic	R	0	0	1
333	Organic	R	0	0	1
336	Organic	R	0	0	1
337	Organic	R	0	0	1
338	Organic	S	1	0	0
339	Organic	R	0	0	1
341	Organic	R	0	0	1
342	Organic	R	0	0	1
343	Organic	R	0	0	1
344	Organic	S	1	0	0
345	Organic	R	0	0	1
346	Organic	R	0	0	1
348	Organic	R	0	0	1
349	Organic	R	0	0	1
350	Organic	R	0	0	1
351	Organic	R	0	0	1
353	Organic	R	0	0	1
354	Organic	R	0	0	1
355	Organic	R	0	0	1
356	Organic	R	0	0	1
357	Organic	R	0	0	1
358	Organic	R	0	0	1
359	Organic	R	0	0	1
360	Organic	R	0	0	1
361	Organic	R	0	0	1
362	Organic	R	0	0	1
363	Organic	R	0	0	1
364	Organic	R	0	0	1
365	Organic	R	0	0	1
366	Organic	R	0	0	1
367	Organic	R	0	0	1
368	Organic	R	0	0	1
369	Organic	R	0	0	1
370	Organic	R	0	0	1
371	Organic	R	0	0	1
372	Organic	R	0	0	1
373	Organic	R	0	0	1
374	Organic	R	0	0	1
375	Organic	R	0	0	1
376	Organic	R	0	0	1
378	Organic	R	0	0	1

Sample ID	Management	ERY			
		S/I/R	S	I	R
379	Organic	R	0	0	1
380	Organic	R	0	0	1
381	Organic	R	0	0	1
382	Organic	R	0	0	1
384	Organic	R	0	0	1
385	Organic	R	0	0	1
386	Organic	S	1	0	0
388	Organic	R	0	0	1
389	Organic	R	0	0	1
390	Organic	R	0	0	1
391	Organic	S	1	0	0
392	Organic	S	1	0	0
393	Organic	R	0	0	1
394	Organic	R	0	0	1
397	Organic	R	0	0	1
398	Organic	R	0	0	1
399	Organic	R	0	0	1
400	Organic	R	0	0	1
401	Inorganic	R	0	0	1
402	Inorganic	R	0	0	1
403	Inorganic	R	0	0	1
404	Inorganic	R	0	0	1
405	Inorganic	R	0	0	1
406	Inorganic	R	0	0	1
407	Inorganic	R	0	0	1
409	Inorganic	I	0	1	0
410	Inorganic	I	0	1	0
411	Inorganic	R	0	0	1
412	Inorganic	R	0	0	1
414	Inorganic	I	0	1	0
415	Inorganic	R	0	0	1
416	Inorganic	R	0	0	1
417	Inorganic	R	0	0	1
418	Inorganic	R	0	0	1
419	Inorganic	R	0	0	1
420	Inorganic	S	1	0	0
421	Inorganic	S	1	0	0
423	Inorganic	R	0	0	1
425	Inorganic	R	0	0	1
426	Inorganic	I	0	1	0
427	Inorganic	R	0	0	1

Sample ID	Management	ERY			
		S/I/R	S	I	R
430	Inorganic	R	0	0	1
431	Inorganic	R	0	0	1
433	Inorganic	R	0	0	1
434	Inorganic	R	0	0	1
435	Inorganic	R	0	0	1
436	Inorganic	R	0	0	1
437	Inorganic	R	0	0	1
438	Inorganic	R	0	0	1
439	Inorganic	R	0	0	1
440	Inorganic	R	0	0	1
441	Inorganic	S	1	0	0
442	Inorganic	R	0	0	1
443	Inorganic	R	0	0	1
444	Inorganic	R	0	0	1
445	Inorganic	I	0	1	0
446	Inorganic	I	0	1	0
447	Inorganic	R	0	0	1
448	Inorganic	I	0	1	0
449	Inorganic	S	1	0	0
450	Inorganic	R	0	0	1
451	Inorganic	R	0	0	1
452	Inorganic	R	0	0	1
453	Inorganic	R	0	0	1
454	Inorganic	R	0	0	1
455	Inorganic	R	0	0	1
456	Inorganic	S	1	0	0
457	Inorganic	R	0	0	1
458	Inorganic	R	0	0	1
459	Inorganic	R	0	0	1
460	Inorganic	R	0	0	1
462	Inorganic	I	0	1	0
463	Inorganic	R	0	0	1
464	Inorganic	R	0	0	1
465	Inorganic	R	0	0	1
466	Inorganic	R	0	0	1
467	Inorganic	R	0	0	1
468	Inorganic	R	0	0	1
469	Inorganic	R	0	0	1
470	Inorganic	R	0	0	1
471	Inorganic	R	0	0	1
472	Inorganic	R	0	0	1

Sample ID	Management	ERY			
		S/I/R	S	I	R
473	Inorganic	R	0	0	1
474	Inorganic	R	0	0	1
475	Inorganic	R	0	0	1
476	Inorganic	R	0	0	1
477	Inorganic	R	0	0	1
478	Inorganic	R	0	0	1
479	Inorganic	R	0	0	1
480	Inorganic	R	0	0	1
481	Inorganic	R	0	0	1
482	Inorganic	R	0	0	1
483	Inorganic	R	0	0	1
484	Inorganic	R	0	0	1
485	Inorganic	R	0	0	1
486	Inorganic	R	0	0	1
487	Inorganic	R	0	0	1
488	Inorganic	R	0	0	1
489	Inorganic	R	0	0	1
490	Inorganic	R	0	0	1
491	Inorganic	R	0	0	1
492	Inorganic	R	0	0	1
493	Inorganic	R	0	0	1
494	Inorganic	R	0	0	1
495	Inorganic	R	0	0	1
497	Inorganic	R	0	0	1
498	Inorganic	R	0	0	1
499	Inorganic	R	0	0	1
500	Inorganic	R	0	0	1
501	Inorganic	R	0	0	1
502	Inorganic	R	0	0	1
503	Inorganic	R	0	0	1
504	Inorganic	R	0	0	1
505	Inorganic	R	0	0	1
506	Inorganic	R	0	0	1
507	Inorganic	R	0	0	1
508	Inorganic	S	1	0	0
509	Inorganic	R	0	0	1
510	Inorganic	R	0	0	1
511	Inorganic	R	0	0	1
512	Inorganic	R	0	0	1
513	Inorganic	R	0	0	1
514	Inorganic	R	0	0	1

Sample ID	Management	ERY			
		S/I/R	S	I	R
515	Inorganic	R	0	0	1
516	Inorganic	R	0	0	1
517	Inorganic	S	1	0	0
518	Inorganic	R	0	0	1
519	Inorganic	R	0	0	1
520	Inorganic	R	0	0	1
521	Inorganic	R	0	0	1
522	Inorganic	S	1	0	0
523	Inorganic	R	0	0	1
525	Inorganic	S	1	0	0
526	Inorganic	R	0	0	1
527	Inorganic	R	0	0	1
528	Inorganic	R	0	0	1
529	Inorganic	R	0	0	1
530	Inorganic	R	0	0	1
531	Inorganic	R	0	0	1
532	Inorganic	R	0	0	1
533	Inorganic	R	0	0	1
534	Inorganic	R	0	0	1
535	Inorganic	R	0	0	1
536	Inorganic	R	0	0	1
537	Inorganic	R	0	0	1
538	Inorganic	R	0	0	1
539	Inorganic	R	0	0	1
540	Inorganic	R	0	0	1
541	Inorganic	R	0	0	1
542	Inorganic	R	0	0	1
543	Inorganic	R	0	0	1
544	Inorganic	R	0	0	1
545	Inorganic	R	0	0	1
546	Inorganic	R	0	0	1
547	Inorganic	R	0	0	1
548	Inorganic	R	0	0	1
549	Inorganic	R	0	0	1
550	Inorganic	R	0	0	1
551	Inorganic	R	0	0	1
552	Inorganic	R	0	0	1
553	Inorganic	R	0	0	1
554	Inorganic	R	0	0	1
556	Inorganic	R	0	0	1

Sample ID	Management	AMX			
		S/I/R	S	I	R
1	Inorganic	S	1	0	0
2	Inorganic	S	1	0	0
3	Inorganic	R	0	0	1
4	Inorganic	S	1	0	0
5	Inorganic	S	1	0	0
6	Inorganic	R	0	0	1
7	Inorganic	R	0	0	1
8	Inorganic	S	1	0	0
9	Inorganic	R	0	0	1
10	Inorganic	I	0	1	0
11	Inorganic	S	1	0	0
12	Inorganic	S	1	0	0
13	Inorganic	S	1	0	0
14	Inorganic	S	1	0	0
15	Inorganic	R	0	0	1
16	Inorganic	S	1	0	0
17	Inorganic	S	1	0	0
19	Inorganic	S	1	0	0
20	Inorganic	R	0	0	1
21	Inorganic	R	0	0	1
22	Inorganic	R	0	0	1
24	Inorganic	S	1	0	0
25	Inorganic	S	1	0	0
27	Inorganic	S	1	0	0
28	Inorganic	R	0	0	1
29	Inorganic	S	1	0	0
30	Inorganic	S	1	0	0
31	Inorganic	S	1	0	0
32	Inorganic	R	0	0	1
33	Inorganic	R	0	0	1
34	Inorganic	S	1	0	0
35	Inorganic	S	1	0	0
36	Inorganic	S	1	0	0
37	Inorganic	S	1	0	0
38	Inorganic	S	1	0	0
39	Inorganic	S	1	0	0
40	Inorganic	S	1	0	0
41	Inorganic	R	0	0	1
42	Inorganic	R	0	0	1
43	Inorganic	S	1	0	0
44	Inorganic	S	1	0	0

Sample ID	Management	AMX			
		S/I/R	S	I	R
46	Inorganic	S	1	0	0
47	Inorganic	S	1	0	0
48	Inorganic	S	1	0	0
49	Inorganic	S	1	0	0
50	Inorganic	S	1	0	0
51	Inorganic	S	1	0	0
52	Inorganic	S	1	0	0
53	Inorganic	S	1	0	0
54	Inorganic	R	0	0	1
54 dup	Inorganic	R	0	0	1
55	Inorganic	S	1	0	0
57	Inorganic	R	0	0	1
58	Inorganic	R	0	0	1
59	Inorganic	S	1	0	0
60	Inorganic	S	1	0	0
61	Inorganic	R	0	0	1
62	Inorganic	S	1	0	0
63	Inorganic	S	1	0	0
64	Inorganic	S	1	0	0
65	Inorganic	R	0	0	1
66	Inorganic	S	1	0	0
67	Inorganic	R	0	0	1
68	Inorganic	S	1	0	0
69	Inorganic	S	1	0	0
70	Inorganic	S	1	0	0
71	Inorganic	R	0	0	1
72	Inorganic	S	1	0	0
73	Inorganic	S	1	0	0
74	Inorganic	R	0	0	1
75	Inorganic	R	0	0	1
76	Inorganic	S	1	0	0
77	Inorganic	S	1	0	0
79	Inorganic	S	1	0	0
82	Inorganic	S	1	0	0
84	Inorganic	S	1	0	0
88	Inorganic	S	1	0	0
89	Inorganic	S	1	0	0
90	Inorganic	S	1	0	0
91	Inorganic	S	1	0	0
93	Inorganic	S	1	0	0
96	Inorganic	S	1	0	0

Sample ID	Management	AMX			
		S/I/R	S	I	R
101	Inorganic	R	0	0	1
102	Inorganic	R	0	0	1
103	Inorganic	R	0	0	1
104	Inorganic	S	1	0	0
105	Inorganic	R	0	0	1
106	Inorganic	R	0	0	1
107	Inorganic	R	0	0	1
108	Inorganic	R	0	0	1
109	Inorganic	R	0	0	1
110	Inorganic	R	0	0	1
111	Inorganic	R	0	0	1
112	Inorganic	R	0	0	1
113	Inorganic	R	0	0	1
114	Inorganic	R	0	0	1
115	Inorganic	R	0	0	1
116	Inorganic	R	0	0	1
117	Inorganic	R	0	0	1
118	Inorganic	R	0	0	1
119	Inorganic	R	0	0	1
120	Inorganic	R	0	0	1
121	Inorganic	R	0	0	1
122	Inorganic	S	1	0	0
123	Inorganic	S	1	0	0
124	Inorganic	R	0	0	1
126	Inorganic	R	0	0	1
130	Inorganic	R	0	0	1
131	Inorganic	R	0	0	1
133	Inorganic	R	0	0	1
134	Inorganic	R	0	0	1
136	Inorganic	I	0	1	0
138	Inorganic	R	0	0	1
139	Inorganic	R	0	0	1
140	Inorganic	S	1	0	0
141	Inorganic	I	0	1	0
142	Inorganic	R	0	0	1
143	Inorganic	R	0	0	1
144	Inorganic	S	1	0	0
147	Inorganic	R	0	0	1
148	Inorganic	S	1	0	0
149	Inorganic	R	0	0	1
151	Inorganic	R	0	0	1

Sample ID	Management	AMX			
		S/I/R	S	I	R
153	Inorganic	R	0	0	1
154	Inorganic	R	0	0	1
155	Inorganic	R	0	0	1
156	Inorganic	S	1	0	0
158	Inorganic	R	0	0	1
159	Inorganic	R	0	0	1
161	Inorganic	R	0	0	1
162	Inorganic	R	0	0	1
163	Inorganic	R	0	0	1
164	Inorganic	S	1	0	0
166	Inorganic	S	1	0	0
167	Inorganic	S	1	0	0
168	Inorganic	S	1	0	0
169	Inorganic	R	0	0	1
170	Inorganic	S	1	0	0
171	Inorganic	R	0	0	1
172	Inorganic	S	1	0	0
173	Inorganic	S	1	0	0
174	Inorganic	S	1	0	0
175	Inorganic	R	0	0	1
176	Inorganic	S	1	0	0
177	Inorganic	S	1	0	0
178	Inorganic	R	0	0	1
179	Inorganic	R	0	0	1
180	Inorganic	R	0	0	1
181	Inorganic	R	0	0	1
182	Inorganic	R	0	0	1
183	Inorganic	S	1	0	0
184	Inorganic	R	0	0	1
185	Inorganic	S	1	0	0
186	Inorganic	S	1	0	0
187	Inorganic	S	1	0	0
189	Inorganic	S	1	0	0
190	Inorganic	S	1	0	0
191	Inorganic	S	1	0	0
192	Inorganic	S	1	0	0
197	Inorganic	S	1	0	0
199	Inorganic	S	1	0	0
200	Inorganic	S	1	0	0
201	Organic	S	1	0	0
202	Organic	S	1	0	0

Sample ID	Management	AMX			
		S/I/R	S	I	R
203	Organic	S	1	0	0
204	Organic	S	1	0	0
205	Organic	S	1	0	0
206	Organic	S	1	0	0
207	Organic	S	1	0	0
208	Organic	S	1	0	0
209	Organic	S	1	0	0
210	Organic	S	1	0	0
211	Organic	S	1	0	0
212	Organic	S	1	0	0
213	Organic	S	1	0	0
214	Organic	S	1	0	0
215	Organic	R	0	0	1
216	Organic	S	1	0	0
217	Organic	S	1	0	0
218	Organic	S	1	0	0
219	Organic	S	1	0	0
220	Organic	S	1	0	0
221	Organic	S	1	0	0
222	Organic	S	1	0	0
224	Organic	S	1	0	0
225	Organic	R	0	0	1
227	Organic	S	1	0	0
228	Organic	S	1	0	0
229	Organic	S	1	0	0
230	Organic	S	1	0	0
231	Organic	S	1	0	0
232	Organic	R	0	0	1
233	Organic	S	1	0	0
234	Organic	I	0	1	0
235	Organic	S	1	0	0
236	Organic	S	1	0	0
237	Organic	I	0	1	0
238	Organic	S	1	0	0
239	Organic	S	1	0	0
240	Organic	S	1	0	0
241	Organic	R	0	0	1
242	Organic	S	1	0	0
243	Organic	S	1	0	0
244	Organic	S	1	0	0
245	Organic	R	0	0	1

Sample ID	Management	AMX			
		S/I/R	S	I	R
246	Organic	S	1	0	0
247	Organic	R	0	0	1
248	Organic	S	1	0	0
249	Organic	S	1	0	0
250	Organic	R	0	0	1
251	Organic	S	1	0	0
252	Organic	S	1	0	0
253	Organic	S	1	0	0
254	Organic	S	1	0	0
255	Organic	I	0	1	0
256	Organic	S	1	0	0
257	Organic	R	0	0	1
258	Organic	S	1	0	0
259	Organic	S	1	0	0
260	Organic	S	1	0	0
261	Organic	R	0	0	1
262	Organic	S	1	0	0
263	Organic	I	0	1	0
264	Organic	S	1	0	0
265	Organic	S	1	0	0
266	Organic	S	1	0	0
267	Organic	S	1	0	0
268	Organic	S	1	0	0
269	Organic	S	1	0	0
270	Organic	S	1	0	0
271	Organic	S	1	0	0
272	Organic	S	1	0	0
273	Organic	S	1	0	0
275	Organic	S	1	0	0
276	Organic	S	1	0	0
277	Organic	S	1	0	0
278	Organic	S	1	0	0
279	Organic	S	1	0	0
280	Organic	I	0	1	0
281	Organic	R	0	0	1
282	Organic	S	1	0	0
283	Organic	S	1	0	0
284	Organic	S	1	0	0
285	Organic	S	1	0	0
286	Organic	S	1	0	0
287	Organic	S	1	0	0

Sample ID	Management	AMX			
		S/I/R	S	I	R
288	Organic	S	1	0	0
289	Organic	S	1	0	0
290	Organic	S	1	0	0
292	Organic	S	1	0	0
293	Organic	R	0	0	1
294	Organic	S	1	0	0
295	Organic	S	1	0	0
296	Organic	S	1	0	0
297	Organic	S	1	0	0
298	Organic	R	0	0	1
299	Organic	S	1	0	0
300	Organic	S	1	0	0
301	Organic	R	0	0	1
302	Organic	S	1	0	0
303	Organic	S	1	0	0
304	Organic	S	1	0	0
305	Organic	S	1	0	0
306	Organic	S	1	0	0
307	Organic	S	1	0	0
308	Organic	S	1	0	0
309	Organic	S	1	0	0
310	Organic	S	1	0	0
311	Organic	S	1	0	0
312	Organic	S	1	0	0
313	Organic	S	1	0	0
314	Organic	S	1	0	0
315	Organic	S	1	0	0
316	Organic	S	1	0	0
317	Organic	S	1	0	0
318	Organic	S	1	0	0
319	Organic	S	1	0	0
320	Organic	S	1	0	0
321	Organic	S	1	0	0
324	Organic	R	0	0	1
325	Organic	S	1	0	0
326	Organic	S	1	0	0
327	Organic	S	1	0	0
328	Organic	S	1	0	0
329	Organic	S	1	0	0
330	Organic	S	1	0	0
331	Organic	R	0	0	1

Sample ID	Management	AMX			
		S/I/R	S	I	R
332	Organic	R	0	0	1
333	Organic	R	0	0	1
336	Organic	S	1	0	0
337	Organic	S	1	0	0
338	Organic	S	1	0	0
339	Organic	S	1	0	0
341	Organic	S	1	0	0
342	Organic	S	1	0	0
343	Organic	S	1	0	0
344	Organic	R	0	0	1
345	Organic	S	1	0	0
346	Organic	R	0	0	1
348	Organic	R	0	0	1
349	Organic	S	1	0	0
350	Organic	S	1	0	0
351	Organic	S	1	0	0
353	Organic	S	1	0	0
354	Organic	S	1	0	0
355	Organic	S	1	0	0
356	Organic	S	1	0	0
357	Organic	S	1	0	0
358	Organic	S	1	0	0
359	Organic	S	1	0	0
360	Organic	S	1	0	0
361	Organic	S	1	0	0
362	Organic	S	1	0	0
363	Organic	S	1	0	0
364	Organic	S	1	0	0
365	Organic	S	1	0	0
366	Organic	S	1	0	0
367	Organic	S	1	0	0
368	Organic	S	1	0	0
369	Organic	S	1	0	0
370	Organic	S	1	0	0
371	Organic	S	1	0	0
372	Organic	S	1	0	0
373	Organic	R	0	0	1
374	Organic	R	0	0	1
375	Organic	R	0	0	1
376	Organic	S	1	0	0
378	Organic	R	0	0	1

Sample ID	Management	AMX			
		S/I/R	S	I	R
379	Organic	R	0	0	1
380	Organic	S	1	0	0
381	Organic	S	1	0	0
382	Organic	S	1	0	0
384	Organic	S	1	0	0
385	Organic	S	1	0	0
386	Organic	R	0	0	1
388	Organic	R	0	0	1
389	Organic	R	0	0	1
390	Organic	R	0	0	1
391	Organic	S	1	0	0
392	Organic	R	0	0	1
393	Organic	S	1	0	0
394	Organic	S	1	0	0
397	Organic	S	1	0	0
398	Organic	S	1	0	0
399	Organic	S	1	0	0
400	Organic	S	1	0	0
401	Inorganic	S	1	0	0
402	Inorganic	S	1	0	0
403	Inorganic	R	0	0	1
404	Inorganic	S	1	0	0
405	Inorganic	S	1	0	0
406	Inorganic	S	1	0	0
407	Inorganic	R	0	0	1
409	Inorganic	R	0	0	1
410	Inorganic	R	0	0	1
411	Inorganic	S	1	0	0
412	Inorganic	S	1	0	0
414	Inorganic	R	0	0	1
415	Inorganic	S	1	0	0
416	Inorganic	I	0	1	0
417	Inorganic	S	1	0	0
418	Inorganic	S	1	0	0
419	Inorganic	S	1	0	0
420	Inorganic	S	1	0	0
421	Inorganic	S	1	0	0
423	Inorganic	S	1	0	0
425	Inorganic	S	1	0	0
426	Inorganic	S	1	0	0
427	Inorganic	S	1	0	0

Sample ID	Management	AMX			
		S/I/R	S	I	R
430	Inorganic	S	1	0	0
431	Inorganic	S	1	0	0
433	Inorganic	R	0	0	1
434	Inorganic	S	1	0	0
435	Inorganic	R	0	0	1
436	Inorganic	R	0	0	1
437	Inorganic	S	1	0	0
438	Inorganic	S	1	0	0
439	Inorganic	R	0	0	1
440	Inorganic	S	1	0	0
441	Inorganic	R	0	0	1
442	Inorganic	R	0	0	1
443	Inorganic	S	1	0	0
444	Inorganic	I	0	1	0
445	Inorganic	S	1	0	0
446	Inorganic	S	1	0	0
447	Inorganic	R	0	0	1
448	Inorganic	S	1	0	0
449	Inorganic	S	1	0	0
450	Inorganic	S	1	0	0
451	Inorganic	S	1	0	0
452	Inorganic	S	1	0	0
453	Inorganic	R	0	0	1
454	Inorganic	R	0	0	1
455	Inorganic	S	1	0	0
456	Inorganic	S	1	0	0
457	Inorganic	S	1	0	0
458	Inorganic	I	0	1	0
459	Inorganic	R	0	0	1
460	Inorganic	R	0	0	1
462	Inorganic	S	1	0	0
463	Inorganic	S	1	0	0
464	Inorganic	S	1	0	0
465	Inorganic	R	0	0	1
466	Inorganic	R	0	0	1
467	Inorganic	S	1	0	0
468	Inorganic	S	1	0	0
469	Inorganic	S	1	0	0
470	Inorganic	S	1	0	0
471	Inorganic	R	0	0	1
472	Inorganic	R	0	0	1

Sample ID	Management	AMX			
		S/I/R	S	I	R
473	Inorganic	R	0	0	1
474	Inorganic	S	1	0	0
475	Inorganic	S	1	0	0
476	Inorganic	S	1	0	0
477	Inorganic	R	0	0	1
478	Inorganic	R	0	0	1
479	Inorganic	R	0	0	1
480	Inorganic	R	0	0	1
481	Inorganic	R	0	0	1
482	Inorganic	S	1	0	0
483	Inorganic	R	0	0	1
484	Inorganic	R	0	0	1
485	Inorganic	R	0	0	1
486	Inorganic	R	0	0	1
487	Inorganic	R	0	0	1
488	Inorganic	S	1	0	0
489	Inorganic	R	0	0	1
490	Inorganic	R	0	0	1
491	Inorganic	S	1	0	0
492	Inorganic	R	0	0	1
493	Inorganic	S	1	0	0
494	Inorganic	S	1	0	0
495	Inorganic	S	1	0	0
497	Inorganic	R	0	0	1
498	Inorganic	R	0	0	1
499	Inorganic	R	0	0	1
500	Inorganic	S	1	0	0
501	Inorganic	S	1	0	0
502	Inorganic	S	1	0	0
503	Inorganic	S	1	0	0
504	Inorganic	S	1	0	0
505	Inorganic	R	0	0	1
506	Inorganic	S	1	0	0
507	Inorganic	S	1	0	0
508	Inorganic	S	1	0	0
509	Inorganic	R	0	0	1
510	Inorganic	S	1	0	0
511	Inorganic	S	1	0	0
512	Inorganic	S	1	0	0
513	Inorganic	S	1	0	0
514	Inorganic	S	1	0	0

Sample ID	Management	AMX			
		S/I/R	S	I	R
515	Inorganic	S	1	0	0
516	Inorganic	S	1	0	0
517	Inorganic	S	1	0	0
518	Inorganic	S	1	0	0
519	Inorganic	R	0	0	1
520	Inorganic	S	1	0	0
521	Inorganic	S	1	0	0
522	Inorganic	S	1	0	0
523	Inorganic	R	0	0	1
525	Inorganic	R	0	0	1
526	Inorganic	S	1	0	0
527	Inorganic	R	0	0	1
528	Inorganic	S	1	0	0
529	Inorganic	R	0	0	1
530	Inorganic	R	0	0	1
531	Inorganic	S	1	0	0
532	Inorganic	R	0	0	1
533	Inorganic	S	1	0	0
534	Inorganic	S	1	0	0
535	Inorganic	R	0	0	1
536	Inorganic	S	1	0	0
537	Inorganic	S	1	0	0
538	Inorganic	S	1	0	0
539	Inorganic	S	1	0	0
540	Inorganic	R	0	0	1
541	Inorganic	S	1	0	0
542	Inorganic	S	1	0	0
543	Inorganic	S	1	0	0
544	Inorganic	S	1	0	0
545	Inorganic	S	1	0	0
546	Inorganic	S	1	0	0
547	Inorganic	S	1	0	0
548	Inorganic	S	1	0	0
549	Inorganic	S	1	0	0
550	Inorganic	S	1	0	0
551	Inorganic	S	1	0	0
552	Inorganic	R	0	0	1
553	Inorganic	S	1	0	0
554	Inorganic	S	1	0	0
556	Inorganic	R	0	0	1

Sample ID	Management	CTC			
		S/I/R	S	I	R
1	Inorganic	R	0	0	1
2	Inorganic	R	0	0	1
3	Inorganic	R	0	0	1
4	Inorganic	R	0	0	1
5	Inorganic	R	0	0	1
6	Inorganic	R	0	0	1
7	Inorganic	R	0	0	1
8	Inorganic	S	1	0	0
9	Inorganic	R	0	0	1
10	Inorganic	R	0	0	1
11	Inorganic	R	0	0	1
12	Inorganic	R	0	0	1
13	Inorganic	R	0	0	1
14	Inorganic	R	0	0	1
15	Inorganic	R	0	0	1
16	Inorganic	R	0	0	1
17	Inorganic	R	0	0	1
19	Inorganic	R	0	0	1
20	Inorganic	R	0	0	1
21	Inorganic	R	0	0	1
22	Inorganic	R	0	0	1
24	Inorganic	R	0	0	1
25	Inorganic	R	0	0	1
27	Inorganic	R	0	0	1
28	Inorganic	R	0	0	1
29	Inorganic	R	0	0	1
30	Inorganic	R	0	0	1
31	Inorganic	R	0	0	1
32	Inorganic	R	0	0	1
33	Inorganic	R	0	0	1
34	Inorganic	R	0	0	1
35	Inorganic	R	0	0	1
36	Inorganic	R	0	0	1
37	Inorganic	R	0	0	1
38	Inorganic	R	0	0	1
39	Inorganic	S	1	0	0
40	Inorganic	S	1	0	0
41	Inorganic	R	0	0	1
42	Inorganic	R	0	0	1
43	Inorganic	S	1	0	0
44	Inorganic	R	0	0	1

Sample ID	Management	CTC			
		S/I/R	S	I	R
46	Inorganic	S	1	0	0
47	Inorganic	S	1	0	0
48	Inorganic	R	0	0	1
49	Inorganic	S	1	0	0
50	Inorganic	R	0	0	1
51	Inorganic	R	0	0	1
52	Inorganic	R	0	0	1
53	Inorganic	R	0	0	1
54	Inorganic	R	0	0	1
54 dup	Inorganic	R	0	0	1
55	Inorganic	R	0	0	1
57	Inorganic	R	0	0	1
58	Inorganic	R	0	0	1
59	Inorganic	R	0	0	1
60	Inorganic	R	0	0	1
61	Inorganic	R	0	0	1
62	Inorganic	S	1	0	0
63	Inorganic	R	0	0	1
64	Inorganic	I	0	1	0
65	Inorganic	R	0	0	1
66	Inorganic	R	0	0	1
67	Inorganic	I	0	1	0
68	Inorganic	R	0	0	1
69	Inorganic	R	0	0	1
70	Inorganic	R	0	0	1
71	Inorganic	R	0	0	1
72	Inorganic	S	1	0	0
73	Inorganic	R	0	0	1
74	Inorganic	S	1	0	0
75	Inorganic	R	0	0	1
76	Inorganic	R	0	0	1
77	Inorganic	R	0	0	1
79	Inorganic	R	0	0	1
82	Inorganic	S	1	0	0
84	Inorganic	R	0	0	1
88	Inorganic	R	0	0	1
89	Inorganic	R	0	0	1
90	Inorganic	R	0	0	1
91	Inorganic	S	1	0	0
93	Inorganic	S	1	0	0
96	Inorganic	R	0	0	1

Sample ID	Management	CTC			
		S/I/R	S	I	R
101	Inorganic	R	0	0	1
102	Inorganic	R	0	0	1
103	Inorganic	R	0	0	1
104	Inorganic	S	1	0	0
105	Inorganic	R	0	0	1
106	Inorganic	R	0	0	1
107	Inorganic	R	0	0	1
108	Inorganic	R	0	0	1
109	Inorganic	R	0	0	1
110	Inorganic	R	0	0	1
111	Inorganic	R	0	0	1
112	Inorganic	R	0	0	1
113	Inorganic	R	0	0	1
114	Inorganic	S	1	0	0
115	Inorganic	R	0	0	1
116	Inorganic	R	0	0	1
117	Inorganic	S	1	0	0
118	Inorganic	R	0	0	1
119	Inorganic	R	0	0	1
120	Inorganic	R	0	0	1
121	Inorganic	R	0	0	1
122	Inorganic	R	0	0	1
123	Inorganic	R	0	0	1
124	Inorganic	R	0	0	1
126	Inorganic	R	0	0	1
130	Inorganic	R	0	0	1
131	Inorganic	R	0	0	1
133	Inorganic	R	0	0	1
134	Inorganic	R	0	0	1
136	Inorganic	R	0	0	1
138	Inorganic	R	0	0	1
139	Inorganic	R	0	0	1
140	Inorganic	R	0	0	1
141	Inorganic	R	0	0	1
142	Inorganic	R	0	0	1
143	Inorganic	R	0	0	1
144	Inorganic	R	0	0	1
147	Inorganic	R	0	0	1
148	Inorganic	R	0	0	1
149	Inorganic	R	0	0	1
151	Inorganic	R	0	0	1

Sample ID	Management	CTC			
		S/I/R	S	I	R
153	Inorganic	R	0	0	1
154	Inorganic	R	0	0	1
155	Inorganic	R	0	0	1
156	Inorganic	R	0	0	1
158	Inorganic	R	0	0	1
159	Inorganic	R	0	0	1
161	Inorganic	R	0	0	1
162	Inorganic	R	0	0	1
163	Inorganic	R	0	0	1
164	Inorganic	R	0	0	1
166	Inorganic	R	0	0	1
167	Inorganic	R	0	0	1
168	Inorganic	R	0	0	1
169	Inorganic	R	0	0	1
170	Inorganic	R	0	0	1
171	Inorganic	R	0	0	1
172	Inorganic	R	0	0	1
173	Inorganic	R	0	0	1
174	Inorganic	I	0	1	0
175	Inorganic	I	0	1	0
176	Inorganic	R	0	0	1
177	Inorganic	S	1	0	0
178	Inorganic	R	0	0	1
179	Inorganic	R	0	0	1
180	Inorganic	R	0	0	1
181	Inorganic	R	0	0	1
182	Inorganic	R	0	0	1
183	Inorganic	R	0	0	1
184	Inorganic	R	0	0	1
185	Inorganic	R	0	0	1
186	Inorganic	R	0	0	1
187	Inorganic	S	1	0	0
189	Inorganic	R	0	0	1
190	Inorganic	R	0	0	1
191	Inorganic	S	1	0	0
192	Inorganic	R	0	0	1
197	Inorganic	R	0	0	1
199	Inorganic	R	0	0	1
200	Inorganic	R	0	0	1
201	Organic	R	0	0	1
202	Organic	R	0	0	1

Sample ID	Management	CTC			
		S/I/R	S	I	R
203	Organic	S	1	0	0
204	Organic	R	0	0	1
205	Organic	R	0	0	1
206	Organic	S	1	0	0
207	Organic	R	0	0	1
208	Organic	R	0	0	1
209	Organic	S	1	0	0
210	Organic	R	0	0	1
211	Organic	S	1	0	0
212	Organic	R	0	0	1
213	Organic	S	1	0	0
214	Organic	R	0	0	1
215	Organic	R	0	0	1
216	Organic	R	0	0	1
217	Organic	R	0	0	1
218	Organic	R	0	0	1
219	Organic	R	0	0	1
220	Organic	R	0	0	1
221	Organic	R	0	0	1
222	Organic	R	0	0	1
224	Organic	I	0	1	0
225	Organic	R	0	0	1
227	Organic	R	0	0	1
228	Organic	S	1	0	0
229	Organic	S	1	0	0
230	Organic	I	0	1	0
231	Organic	R	0	0	1
232	Organic	R	0	0	1
233	Organic	R	0	0	1
234	Organic	I	0	1	0
235	Organic	R	0	0	1
236	Organic	R	0	0	1
237	Organic	R	0	0	1
238	Organic	R	0	0	1
239	Organic	R	0	0	1
240	Organic	R	0	0	1
241	Organic	R	0	0	1
242	Organic	R	0	0	1
243	Organic	R	0	0	1
244	Organic	R	0	0	1
245	Organic	R	0	0	1

Sample ID	Management	CTC			
		S/I/R	S	I	R
246	Organic	S	1	0	0
247	Organic	S	1	0	0
248	Organic	S	1	0	0
249	Organic	R	0	0	1
250	Organic	R	0	0	1
251	Organic	R	0	0	1
252	Organic	R	0	0	1
253	Organic	R	0	0	1
254	Organic	S	1	0	0
255	Organic	R	0	0	1
256	Organic	R	0	0	1
257	Organic	R	0	0	1
258	Organic	R	0	0	1
259	Organic	R	0	0	1
260	Organic	R	0	0	1
261	Organic	R	0	0	1
262	Organic	R	0	0	1
263	Organic	R	0	0	1
264	Organic	R	0	0	1
265	Organic	R	0	0	1
266	Organic	S	1	0	0
267	Organic	S	1	0	0
268	Organic	S	1	0	0
269	Organic	S	1	0	0
270	Organic	R	0	0	1
271	Organic	S	1	0	0
272	Organic	R	0	0	1
273	Organic	S	1	0	0
275	Organic	S	1	0	0
276	Organic	S	1	0	0
277	Organic	S	1	0	0
278	Organic	S	1	0	0
279	Organic	R	0	0	1
280	Organic	R	0	0	1
281	Organic	S	1	0	0
282	Organic	S	1	0	0
283	Organic	R	0	0	1
284	Organic	R	0	0	1
285	Organic	R	0	0	1
286	Organic	R	0	0	1
287	Organic	R	0	0	1

Sample ID	Management	CTC			
		S/I/R	S	I	R
288	Organic	R	0	0	1
289	Organic	R	0	0	1
290	Organic	S	1	0	0
292	Organic	S	1	0	0
293	Organic	R	0	0	1
294	Organic	R	0	0	1
295	Organic	I	0	1	0
296	Organic	R	0	0	1
297	Organic	R	0	0	1
298	Organic	R	0	0	1
299	Organic	R	0	0	1
300	Organic	R	0	0	1
301	Organic	S	1	0	0
302	Organic	I	0	1	0
303	Organic	I	0	1	0
304	Organic	R	0	0	1
305	Organic	R	0	0	1
306	Organic	I	0	1	0
307	Organic	R	0	0	1
308	Organic	R	0	0	1
309	Organic	S	1	0	0
310	Organic	R	0	0	1
311	Organic	R	0	0	1
312	Organic	S	1	0	0
313	Organic	S	1	0	0
314	Organic	S	1	0	0
315	Organic	S	1	0	0
316	Organic	S	1	0	0
317	Organic	I	0	1	0
318	Organic	-	-	-	-
319	Organic	S	1	0	0
320	Organic	S	1	0	0
321	Organic	S	1	0	0
324	Organic	S	1	0	0
325	Organic	S	1	0	0
326	Organic	S	1	0	0
327	Organic	S	1	0	0
328	Organic	R	0	0	1
329	Organic	R	0	0	1
330	Organic	S	1	0	0
331	Organic	S	1	0	0

Sample ID	Management	CTC			
		S/I/R	S	I	R
332	Organic	S	1	0	0
333	Organic	S	1	0	0
336	Organic	R	0	0	1
337	Organic	R	0	0	1
338	Organic	S	1	0	0
339	Organic	S	1	0	0
341	Organic	S	1	0	0
342	Organic	R	0	0	1
343	Organic	R	0	0	1
344	Organic	S	1	0	0
345	Organic	S	1	0	0
346	Organic	S	1	0	0
348	Organic	R	0	0	1
349	Organic	S	1	0	0
350	Organic	S	1	0	0
351	Organic	S	1	0	0
353	Organic	R	0	0	1
354	Organic	R	0	0	1
355	Organic	R	0	0	1
356	Organic	R	0	0	1
357	Organic	R	0	0	1
358	Organic	R	0	0	1
359	Organic	R	0	0	1
360	Organic	R	0	0	1
361	Organic	R	0	0	1
362	Organic	R	0	0	1
363	Organic	R	0	0	1
364	Organic	R	0	0	1
365	Organic	R	0	0	1
366	Organic	R	0	0	1
367	Organic	R	0	0	1
368	Organic	R	0	0	1
369	Organic	R	0	0	1
370	Organic	R	0	0	1
371	Organic	R	0	0	1
372	Organic	S	1	0	0
373	Organic	R	0	0	1
374	Organic	R	0	0	1
375	Organic	R	0	0	1
376	Organic	R	0	0	1
378	Organic	S	1	0	0

Sample ID	Management	CTC			
		S/I/R	S	I	R
379	Organic	R	0	0	1
380	Organic	S	1	0	0
381	Organic	S	1	0	0
382	Organic	S	1	0	0
384	Organic	S	1	0	0
385	Organic	S	1	0	0
386	Organic	S	1	0	0
388	Organic	S	1	0	0
389	Organic	S	1	0	0
390	Organic	R	0	0	1
391	Organic	S	1	0	0
392	Organic	S	1	0	0
393	Organic	S	1	0	0
394	Organic	S	1	0	0
397	Organic	S	1	0	0
398	Organic	S	1	0	0
399	Organic	S	1	0	0
400	Organic	S	1	0	0
401	Inorganic	S	1	0	0
402	Inorganic	S	1	0	0
403	Inorganic	R	0	0	1
404	Inorganic	S	1	0	0
405	Inorganic	S	1	0	0
406	Inorganic	S	1	0	0
407	Inorganic	S	1	0	0
409	Inorganic	R	0	0	1
410	Inorganic	R	0	0	1
411	Inorganic	S	1	0	0
412	Inorganic	S	1	0	0
414	Inorganic	S	1	0	0
415	Inorganic	S	1	0	0
416	Inorganic	I	0	1	0
417	Inorganic	S	1	0	0
418	Inorganic	S	1	0	0
419	Inorganic	S	1	0	0
420	Inorganic	S	1	0	0
421	Inorganic	S	1	0	0
423	Inorganic	R	0	0	1
425	Inorganic	R	0	0	1
426	Inorganic	S	1	0	0
427	Inorganic	R	0	0	1

Sample ID	Management	CTC			
		S/I/R	S	I	R
430	Inorganic	R	0	0	1
431	Inorganic	R	0	0	1
433	Inorganic	R	0	0	1
434	Inorganic	R	0	0	1
435	Inorganic	R	0	0	1
436	Inorganic	S	1	0	0
437	Inorganic	S	1	0	0
438	Inorganic	R	0	0	1
439	Inorganic	R	0	0	1
440	Inorganic	R	0	0	1
441	Inorganic	R	0	0	1
442	Inorganic	R	0	0	1
443	Inorganic	R	0	0	1
444	Inorganic	S	1	0	0
445	Inorganic	R	0	0	1
446	Inorganic	R	0	0	1
447	Inorganic	R	0	0	1
448	Inorganic	R	0	0	1
449	Inorganic	R	0	0	1
450	Inorganic	S	1	0	0
451	Inorganic	I	0	1	0
452	Inorganic	R	0	0	1
453	Inorganic	R	0	0	1
454	Inorganic	R	0	0	1
455	Inorganic	S	1	0	0
456	Inorganic	S	1	0	0
457	Inorganic	S	1	0	0
458	Inorganic	S	1	0	0
459	Inorganic	R	0	0	1
460	Inorganic	R	0	0	1
462	Inorganic	S	1	0	0
463	Inorganic	S	1	0	0
464	Inorganic	S	1	0	0
465	Inorganic	R	0	0	1
466	Inorganic	R	0	0	1
467	Inorganic	S	1	0	0
468	Inorganic	S	1	0	0
469	Inorganic	R	0	0	1
470	Inorganic	R	0	0	1
471	Inorganic	R	0	0	1
472	Inorganic	R	0	0	1

Sample ID	Management	CTC			
		S/I/R	S	I	R
473	Inorganic	R	0	0	1
474	Inorganic	R	0	0	1
475	Inorganic	R	0	0	1
476	Inorganic	R	0	0	1
477	Inorganic	R	0	0	1
478	Inorganic	R	0	0	1
479	Inorganic	R	0	0	1
480	Inorganic	R	0	0	1
481	Inorganic	R	0	0	1
482	Inorganic	R	0	0	1
483	Inorganic	R	0	0	1
484	Inorganic	R	0	0	1
485	Inorganic	R	0	0	1
486	Inorganic	R	0	0	1
487	Inorganic	R	0	0	1
488	Inorganic	R	0	0	1
489	Inorganic	R	0	0	1
490	Inorganic	R	0	0	1
491	Inorganic	R	0	0	1
492	Inorganic	R	0	0	1
493	Inorganic	R	0	0	1
494	Inorganic	R	0	0	1
495	Inorganic	R	0	0	1
497	Inorganic	R	0	0	1
498	Inorganic	I	0	1	0
499	Inorganic	R	0	0	1
500	Inorganic	R	0	0	1
501	Inorganic	R	0	0	1
502	Inorganic	R	0	0	1
503	Inorganic	R	0	0	1
504	Inorganic	R	0	0	1
505	Inorganic	R	0	0	1
506	Inorganic	R	0	0	1
507	Inorganic	R	0	0	1
508	Inorganic	S	1	0	0
509	Inorganic	R	0	0	1
510	Inorganic	R	0	0	1
511	Inorganic	R	0	0	1
512	Inorganic	R	0	0	1
513	Inorganic	R	0	0	1
514	Inorganic	R	0	0	1

Sample ID	Management	CTC			
		S/I/R	S	I	R
515	Inorganic	R	0	0	1
516	Inorganic	R	0	0	1
517	Inorganic	S	1	0	0
518	Inorganic	R	0	0	1
519	Inorganic	R	0	0	1
520	Inorganic	R	0	0	1
521	Inorganic	R	0	0	1
522	Inorganic	R	0	0	1
523	Inorganic	S	1	0	0
525	Inorganic	S	1	0	0
526	Inorganic	R	0	0	1
527	Inorganic	R	0	0	1
528	Inorganic	R	0	0	1
529	Inorganic	R	0	0	1
530	Inorganic	S	1	0	0
531	Inorganic	R	0	0	1
532	Inorganic	R	0	0	1
533	Inorganic	R	0	0	1
534	Inorganic	R	0	0	1
535	Inorganic	S	1	0	0
536	Inorganic	R	0	0	1
537	Inorganic	R	0	0	1
538	Inorganic	R	0	0	1
539	Inorganic	R	0	0	1
540	Inorganic	R	0	0	1
541	Inorganic	R	0	0	1
542	Inorganic	R	0	0	1
543	Inorganic	R	0	0	1
544	Inorganic	R	0	0	1
545	Inorganic	R	0	0	1
546	Inorganic	R	0	0	1
547	Inorganic	R	0	0	1
548	Inorganic	R	0	0	1
549	Inorganic	R	0	0	1
550	Inorganic	R	0	0	1
551	Inorganic	R	0	0	1
552	Inorganic	R	0	0	1
553	Inorganic	R	0	0	1
554	Inorganic	R	0	0	1
556	Inorganic	S	1	0	0

Sample ID	Management	NEO			
		S/I/R	S	I	R
1	Inorganic	S	1	0	0
2	Inorganic	S	1	0	0
3	Inorganic	I	0	1	0
4	Inorganic	S	1	0	0
5	Inorganic	S	1	0	0
6	Inorganic	S	1	0	0
7	Inorganic	S	1	0	0
8	Inorganic	S	1	0	0
9	Inorganic	S	1	0	0
10	Inorganic	S	1	0	0
11	Inorganic	S	1	0	0
12	Inorganic	S	1	0	0
13	Inorganic	S	1	0	0
14	Inorganic	S	1	0	0
15	Inorganic	S	1	0	0
16	Inorganic	S	1	0	0
17	Inorganic	S	1	0	0
19	Inorganic	S	1	0	0
20	Inorganic	S	1	0	0
21	Inorganic	S	1	0	0
22	Inorganic	S	1	0	0
24	Inorganic	S	1	0	0
25	Inorganic	S	1	0	0
27	Inorganic	S	1	0	0
28	Inorganic	S	1	0	0
29	Inorganic	S	1	0	0
30	Inorganic	S	1	0	0
31	Inorganic	S	1	0	0
32	Inorganic	S	1	0	0
33	Inorganic	S	1	0	0
34	Inorganic	S	1	0	0
35	Inorganic	S	1	0	0
36	Inorganic	S	1	0	0
37	Inorganic	I	0	1	0
38	Inorganic	I	0	1	0
39	Inorganic	S	1	0	0
40	Inorganic	S	1	0	0
41	Inorganic	S	1	0	0
42	Inorganic	S	1	0	0
43	Inorganic	S	1	0	0
44	Inorganic	S	1	0	0

Sample ID	Management	NEO			
		S/I/R	S	I	R
46	Inorganic	S	1	0	0
47	Inorganic	S	1	0	0
48	Inorganic	S	1	0	0
49	Inorganic	S	1	0	0
50	Inorganic	S	1	0	0
51	Inorganic	S	1	0	0
52	Inorganic	S	1	0	0
53	Inorganic	S	1	0	0
54	Inorganic	S	1	0	0
54 dup	Inorganic	S	1	0	0
55	Inorganic	I	0	1	0
57	Inorganic	S	1	0	0
58	Inorganic	I	0	1	0
59	Inorganic	S	1	0	0
60	Inorganic	S	1	0	0
61	Inorganic	S	1	0	0
62	Inorganic	S	1	0	0
63	Inorganic	S	1	0	0
64	Inorganic	S	1	0	0
65	Inorganic	S	1	0	0
66	Inorganic	S	1	0	0
67	Inorganic	S	1	0	0
68	Inorganic	S	1	0	0
69	Inorganic	S	1	0	0
70	Inorganic	S	1	0	0
71	Inorganic	S	1	0	0
72	Inorganic	S	1	0	0
73	Inorganic	S	1	0	0
74	Inorganic	S	1	0	0
75	Inorganic	S	1	0	0
76	Inorganic	S	1	0	0
77	Inorganic	S	1	0	0
79	Inorganic	S	1	0	0
82	Inorganic	S	1	0	0
84	Inorganic	S	1	0	0
88	Inorganic	S	1	0	0
89	Inorganic	S	1	0	0
90	Inorganic	S	1	0	0
91	Inorganic	S	1	0	0
93	Inorganic	S	1	0	0
96	Inorganic	S	1	0	0

Sample ID	Management	NEO			
		S/I/R	S	I	R
101	Inorganic	I	0	1	0
102	Inorganic	R	0	0	1
103	Inorganic	R	0	0	1
104	Inorganic	S	1	0	0
105	Inorganic	I	0	1	0
106	Inorganic	S	1	0	0
107	Inorganic	I	0	1	0
108	Inorganic	R	0	0	1
109	Inorganic	R	0	0	1
110	Inorganic	I	0	1	0
111	Inorganic	I	0	1	0
112	Inorganic	I	0	1	0
113	Inorganic	I	0	1	0
114	Inorganic	I	0	1	0
115	Inorganic	R	0	0	1
116	Inorganic	R	0	0	1
117	Inorganic	R	0	0	1
118	Inorganic	I	0	1	0
119	Inorganic	I	0	1	0
120	Inorganic	I	0	1	0
121	Inorganic	S	1	0	0
122	Inorganic	R	0	0	1
123	Inorganic	R	0	0	1
124	Inorganic	R	0	0	1
126	Inorganic	R	0	0	1
130	Inorganic	S	1	0	0
131	Inorganic	R	0	0	1
133	Inorganic	R	0	0	1
134	Inorganic	R	0	0	1
136	Inorganic	R	0	0	1
138	Inorganic	R	0	0	1
139	Inorganic	R	0	0	1
140	Inorganic	R	0	0	1
141	Inorganic	R	0	0	1
142	Inorganic	R	0	0	1
143	Inorganic	R	0	0	1
144	Inorganic	R	0	0	1
147	Inorganic	R	0	0	1
148	Inorganic	R	0	0	1
149	Inorganic	R	0	0	1
151	Inorganic	S	1	0	0

Sample ID	Management	NEO			
		S/I/R	S	I	R
153	Inorganic	R	0	0	1
154	Inorganic	I	0	1	0
155	Inorganic	I	0	1	0
156	Inorganic	R	0	0	1
158	Inorganic	S	1	0	0
159	Inorganic	I	0	1	0
161	Inorganic	I	0	1	0
162	Inorganic	I	0	1	0
163	Inorganic	R	0	0	1
164	Inorganic	S	1	0	0
166	Inorganic	S	1	0	0
167	Inorganic	S	1	0	0
168	Inorganic	S	1	0	0
169	Inorganic	S	1	0	0
170	Inorganic	S	1	0	0
171	Inorganic	S	1	0	0
172	Inorganic	I	0	1	0
173	Inorganic	S	1	0	0
174	Inorganic	S	1	0	0
175	Inorganic	S	1	0	0
176	Inorganic	R	0	0	1
177	Inorganic	S	1	0	0
178	Inorganic	I	0	1	0
179	Inorganic	I	0	1	0
180	Inorganic	I	0	1	0
181	Inorganic	I	0	1	0
182	Inorganic	R	0	0	1
183	Inorganic	S	1	0	0
184	Inorganic	I	0	1	0
185	Inorganic	I	0	1	0
186	Inorganic	S	1	0	0
187	Inorganic	S	1	0	0
189	Inorganic	S	1	0	0
190	Inorganic	R	0	0	1
191	Inorganic	S	1	0	0
192	Inorganic	S	1	0	0
197	Inorganic	S	1	0	0
199	Inorganic	S	1	0	0
200	Inorganic	R	0	0	1
201	Organic	S	1	0	0
202	Organic	S	1	0	0

Sample ID	Management	NEO			
		S/I/R	S	I	R
203	Organic	S	1	0	0
204	Organic	S	1	0	0
205	Organic	S	1	0	0
206	Organic	S	1	0	0
207	Organic	S	1	0	0
208	Organic	S	1	0	0
209	Organic	S	1	0	0
210	Organic	S	1	0	0
211	Organic	S	1	0	0
212	Organic	S	1	0	0
213	Organic	S	1	0	0
214	Organic	S	1	0	0
215	Organic	S	1	0	0
216	Organic	S	1	0	0
217	Organic	S	1	0	0
218	Organic	S	1	0	0
219	Organic	S	1	0	0
220	Organic	S	1	0	0
221	Organic	S	1	0	0
222	Organic	S	1	0	0
224	Organic	S	1	0	0
225	Organic	R	0	0	1
227	Organic	R	0	0	1
228	Organic	S	1	0	0
229	Organic	S	1	0	0
230	Organic	R	0	0	1
231	Organic	S	1	0	0
232	Organic	I	0	1	0
233	Organic	S	1	0	0
234	Organic	S	1	0	0
235	Organic	S	1	0	0
236	Organic	S	1	0	0
237	Organic	S	1	0	0
238	Organic	S	1	0	0
239	Organic	S	1	0	0
240	Organic	S	1	0	0
241	Organic	I	0	1	0
242	Organic	S	1	0	0
243	Organic	S	1	0	0
244	Organic	S	1	0	0
245	Organic	R	0	0	1

Sample ID	Management	NEO			
		S/I/R	S	I	R
246	Organic	S	1	0	0
247	Organic	S	1	0	0
248	Organic	R	0	0	1
249	Organic	R	0	0	1
250	Organic	I	0	1	0
251	Organic	S	1	0	0
252	Organic	S	1	0	0
253	Organic	S	1	0	0
254	Organic	S	1	0	0
255	Organic	R	0	0	1
256	Organic	S	1	0	0
257	Organic	S	1	0	0
258	Organic	S	1	0	0
259	Organic	S	1	0	0
260	Organic	S	1	0	0
261	Organic	S	1	0	0
262	Organic	S	1	0	0
263	Organic	S	1	0	0
264	Organic	S	1	0	0
265	Organic	S	1	0	0
266	Organic	S	1	0	0
267	Organic	S	1	0	0
268	Organic	S	1	0	0
269	Organic	S	1	0	0
270	Organic	S	1	0	0
271	Organic	S	1	0	0
272	Organic	S	1	0	0
273	Organic	S	1	0	0
275	Organic	S	1	0	0
276	Organic	S	1	0	0
277	Organic	S	1	0	0
278	Organic	S	1	0	0
279	Organic	S	1	0	0
280	Organic	S	1	0	0
281	Organic	I	0	1	0
282	Organic	S	1	0	0
283	Organic	S	1	0	0
284	Organic	S	1	0	0
285	Organic	S	1	0	0
286	Organic	S	1	0	0
287	Organic	S	1	0	0

Sample ID	Management	NEO			
		S/I/R	S	I	R
288	Organic	S	1	0	0
289	Organic	S	1	0	0
290	Organic	S	1	0	0
292	Organic	S	1	0	0
293	Organic	R	0	0	1
294	Organic	I	0	1	0
295	Organic	S	1	0	0
296	Organic	S	1	0	0
297	Organic	S	1	0	0
298	Organic	S	1	0	0
299	Organic	I	0	1	0
300	Organic	S	1	0	0
301	Organic	S	1	0	0
302	Organic	S	1	0	0
303	Organic	S	1	0	0
304	Organic	S	1	0	0
305	Organic	S	1	0	0
306	Organic	S	1	0	0
307	Organic	S	1	0	0
308	Organic	S	1	0	0
309	Organic	S	1	0	0
310	Organic	S	1	0	0
311	Organic	S	1	0	0
312	Organic	S	1	0	0
313	Organic	S	1	0	0
314	Organic	S	1	0	0
315	Organic	S	1	0	0
316	Organic	R	0	0	1
317	Organic	S	1	0	0
318	Organic	S	1	0	0
319	Organic	S	1	0	0
320	Organic	S	1	0	0
321	Organic	S	1	0	0
324	Organic	S	1	0	0
325	Organic	S	1	0	0
326	Organic	S	1	0	0
327	Organic	S	1	0	0
328	Organic	S	1	0	0
329	Organic	S	1	0	0
330	Organic	S	1	0	0
331	Organic	S	1	0	0

Sample ID	Management	NEO			
		S/I/R	S	I	R
332	Organic	S	1	0	0
333	Organic	S	1	0	0
336	Organic	R	0	0	1
337	Organic	R	0	0	1
338	Organic	S	1	0	0
339	Organic	S	1	0	0
341	Organic	S	1	0	0
342	Organic	R	0	0	1
343	Organic	R	0	0	1
344	Organic	S	1	0	0
345	Organic	S	1	0	0
346	Organic	S	1	0	0
348	Organic	R	0	0	1
349	Organic	S	1	0	0
350	Organic	S	1	0	0
351	Organic	I	0	1	0
353	Organic	I	0	1	0
354	Organic	R	0	0	1
355	Organic	I	0	1	0
356	Organic	R	0	0	1
357	Organic	R	0	0	1
358	Organic	I	0	1	0
359	Organic	I	0	1	0
360	Organic	R	0	0	1
361	Organic	R	0	0	1
362	Organic	R	0	0	1
363	Organic	R	0	0	1
364	Organic	R	0	0	1
365	Organic	R	0	0	1
366	Organic	R	0	0	1
367	Organic	R	0	0	1
368	Organic	R	0	0	1
369	Organic	R	0	0	1
370	Organic	R	0	0	1
371	Organic	R	0	0	1
372	Organic	S	1	0	0
373	Organic	R	0	0	1
374	Organic	R	0	0	1
375	Organic	R	0	0	1
376	Organic	R	0	0	1
378	Organic	S	1	0	0

Sample ID	Management	NEO			
		S/I/R	S	I	R
379	Organic	R	0	0	1
380	Organic	S	1	0	0
381	Organic	R	0	0	1
382	Organic	R	0	0	1
384	Organic	R	0	0	1
385	Organic	S	1	0	0
386	Organic	S	1	0	0
388	Organic	S	1	0	0
389	Organic	S	1	0	0
390	Organic	S	1	0	0
391	Organic	S	1	0	0
392	Organic	S	1	0	0
393	Organic	R	0	0	1
394	Organic	R	0	0	1
397	Organic	R	0	0	1
398	Organic	R	0	0	1
399	Organic	S	1	0	0
400	Organic	S	1	0	0
401	Inorganic	R	0	0	1
402	Inorganic	R	0	0	1
403	Inorganic	R	0	0	1
404	Inorganic	S	1	0	0
405	Inorganic	S	1	0	0
406	Inorganic	S	1	0	0
407	Inorganic	S	1	0	0
409	Inorganic	S	1	0	0
410	Inorganic	R	0	0	1
411	Inorganic	R	0	0	1
412	Inorganic	S	1	0	0
414	Inorganic	S	1	0	0
415	Inorganic	S	1	0	0
416	Inorganic	S	1	0	0
417	Inorganic	S	1	0	0
418	Inorganic	S	1	0	0
419	Inorganic	S	1	0	0
420	Inorganic	S	1	0	0
421	Inorganic	S	1	0	0
423	Inorganic	R	0	0	1
425	Inorganic	R	0	0	1
426	Inorganic	R	0	0	1
427	Inorganic	R	0	0	1

Sample ID	Management	NEO			
		S/I/R	S	I	R
430	Inorganic	R	0	0	1
431	Inorganic	R	0	0	1
433	Inorganic	R	0	0	1
434	Inorganic	R	0	0	1
435	Inorganic	R	0	0	1
436	Inorganic	R	0	0	1
437	Inorganic	R	0	0	1
438	Inorganic	R	0	0	1
439	Inorganic	R	0	0	1
440	Inorganic	R	0	0	1
441	Inorganic	I	0	1	0
442	Inorganic	R	0	0	1
443	Inorganic	R	0	0	1
444	Inorganic	R	0	0	1
445	Inorganic	R	0	0	1
446	Inorganic	R	0	0	1
447	Inorganic	S	1	0	0
448	Inorganic	S	1	0	0
449	Inorganic	R	0	0	1
450	Inorganic	R	0	0	1
451	Inorganic	R	0	0	1
452	Inorganic	R	0	0	1
453	Inorganic	R	0	0	1
454	Inorganic	R	0	0	1
455	Inorganic	S	1	0	0
456	Inorganic	S	1	0	0
457	Inorganic	S	1	0	0
458	Inorganic	S	1	0	0
459	Inorganic	R	0	0	1
460	Inorganic	R	0	0	1
462	Inorganic	S	1	0	0
463	Inorganic	S	1	0	0
464	Inorganic	S	1	0	0
465	Inorganic	R	0	0	1
466	Inorganic	R	0	0	1
467	Inorganic	R	0	0	1
468	Inorganic	S	1	0	0
469	Inorganic	R	0	0	1
470	Inorganic	R	0	0	1
471	Inorganic	R	0	0	1
472	Inorganic	R	0	0	1

Sample ID	Management	NEO			
		S/I/R	S	I	R
473	Inorganic	R	0	0	1
474	Inorganic	S	1	0	0
475	Inorganic	R	0	0	1
476	Inorganic	R	0	0	1
477	Inorganic	S	1	0	0
478	Inorganic	S	1	0	0
479	Inorganic	R	0	0	1
480	Inorganic	R	0	0	1
481	Inorganic	R	0	0	1
482	Inorganic	R	0	0	1
483	Inorganic	S	1	0	0
484	Inorganic	S	1	0	0
485	Inorganic	R	0	0	1
486	Inorganic	R	0	0	1
487	Inorganic	R	0	0	1
488	Inorganic	R	0	0	1
489	Inorganic	I	0	1	0
490	Inorganic	I	0	1	0
491	Inorganic	R	0	0	1
492	Inorganic	R	0	0	1
493	Inorganic	R	0	0	1
494	Inorganic	S	1	0	0
495	Inorganic	I	0	1	0
497	Inorganic	I	0	1	0
498	Inorganic	R	0	0	1
499	Inorganic	R	0	0	1
500	Inorganic	S	1	0	0
501	Inorganic	S	1	0	0
502	Inorganic	S	1	0	0
503	Inorganic	S	1	0	0
504	Inorganic	R	0	0	1
505	Inorganic	R	0	0	1
506	Inorganic	R	0	0	1
507	Inorganic	R	0	0	1
508	Inorganic	S	1	0	0
509	Inorganic	S	1	0	0
510	Inorganic	R	0	0	1
511	Inorganic	R	0	0	1
512	Inorganic	R	0	0	1
513	Inorganic	R	0	0	1
514	Inorganic	S	1	0	0

Sample ID	Management	NEO			
		S/I/R	S	I	R
515	Inorganic	S	1	0	0
516	Inorganic	S	1	0	0
517	Inorganic	S	1	0	0
518	Inorganic	R	0	0	1
519	Inorganic	R	0	0	1
520	Inorganic	S	1	0	0
521	Inorganic	S	1	0	0
522	Inorganic	S	1	0	0
523	Inorganic	S	1	0	0
525	Inorganic	S	1	0	0
526	Inorganic	S	1	0	0
527	Inorganic	S	1	0	0
528	Inorganic	S	1	0	0
529	Inorganic	S	1	0	0
530	Inorganic	R	0	0	1
531	Inorganic	S	1	0	0
532	Inorganic	S	1	0	0
533	Inorganic	S	1	0	0
534	Inorganic	S	1	0	0
535	Inorganic	S	1	0	0
536	Inorganic	S	1	0	0
537	Inorganic	S	1	0	0
538	Inorganic	S	1	0	0
539	Inorganic	I	0	1	0
540	Inorganic	I	0	1	0
541	Inorganic	S	1	0	0
542	Inorganic	S	1	0	0
543	Inorganic	S	1	0	0
544	Inorganic	S	1	0	0
545	Inorganic	S	1	0	0
546	Inorganic	S	1	0	0
547	Inorganic	S	1	0	0
548	Inorganic	S	1	0	0
549	Inorganic	S	1	0	0
550	Inorganic	S	1	0	0
551	Inorganic	S	1	0	0
552	Inorganic	S	1	0	0
553	Inorganic	S	1	0	0
554	Inorganic	S	1	0	0
556	Inorganic	S	1	0	0

Sample ID	Management	NAL			
		S/I/R	S	I	R
1	Inorganic	S	1	0	0
2	Inorganic	S	1	0	0
3	Inorganic	S	1	0	0
4	Inorganic	S	1	0	0
5	Inorganic	S	1	0	0
6	Inorganic	S	1	0	0
7	Inorganic	S	1	0	0
8	Inorganic	S	1	0	0
9	Inorganic	S	1	0	0
10	Inorganic	S	1	0	0
11	Inorganic	S	1	0	0
12	Inorganic	S	1	0	0
13	Inorganic	.	.	.	.
14	Inorganic	.	.	.	.
15	Inorganic	.	.	.	.
16	Inorganic	.	.	.	.
17	Inorganic	.	.	.	.
19	Inorganic	S	1	0	0
20	Inorganic	S	1	0	0
21	Inorganic	S	1	0	0
22	Inorganic	S	1	0	0
24	Inorganic	S	1	0	0
25	Inorganic	S	1	0	0
27	Inorganic	S	1	0	0
28	Inorganic	S	1	0	0
29	Inorganic	S	1	0	0
30	Inorganic	S	1	0	0
31	Inorganic	S	1	0	0
32	Inorganic	S	1	0	0
33	Inorganic	S	1	0	0
34	Inorganic	S	1	0	0
35	Inorganic	S	1	0	0
36	Inorganic	S	1	0	0
37	Inorganic	S	1	0	0
38	Inorganic	S	1	0	0
39	Inorganic	S	1	0	0
40	Inorganic	S	1	0	0
41	Inorganic	S	1	0	0
42	Inorganic	S	1	0	0
43	Inorganic	S	1	0	0
44	Inorganic	S	1	0	0

Sample ID	Management	NAL			
		S/I/R	S	I	R
46	Inorganic	S	1	0	0
47	Inorganic	S	1	0	0
48	Inorganic	S	1	0	0
49	Inorganic	S	1	0	0
50	Inorganic	S	1	0	0
51	Inorganic	S	1	0	0
52	Inorganic	S	1	0	0
53	Inorganic	S	1	0	0
54	Inorganic	S	1	0	0
54 dup	Inorganic	S	1	0	0
55	Inorganic	I	0	1	0
57	Inorganic	S	1	0	0
58	Inorganic	S	1	0	0
59	Inorganic	I	0	1	0
60	Inorganic	S	1	0	0
61	Inorganic	S	1	0	0
62	Inorganic	S	1	0	0
63	Inorganic	S	1	0	0
64	Inorganic	S	1	0	0
65	Inorganic	S	1	0	0
66	Inorganic	S	1	0	0
67	Inorganic	S	1	0	0
68	Inorganic	S	1	0	0
69	Inorganic	S	1	0	0
70	Inorganic	S	1	0	0
71	Inorganic	S	1	0	0
72	Inorganic	S	1	0	0
73	Inorganic	S	1	0	0
74	Inorganic	S	1	0	0
75	Inorganic	S	1	0	0
76	Inorganic	S	1	0	0
77	Inorganic	S	1	0	0
79	Inorganic	S	1	0	0
82	Inorganic	S	1	0	0
84	Inorganic	S	1	0	0
88	Inorganic	S	1	0	0
89	Inorganic	S	1	0	0
90	Inorganic	S	1	0	0
91	Inorganic	R	0	0	1
93	Inorganic	S	1	0	0
96	Inorganic	S	1	0	0

Sample ID	Management	NAL			
		S/I/R	S	I	R
101	Inorganic	I	0	1	0
102	Inorganic	R	0	0	1
103	Inorganic	R	0	0	1
104	Inorganic	I	0	1	0
105	Inorganic	R	0	0	1
106	Inorganic	R	0	0	1
107	Inorganic	R	0	0	1
108	Inorganic	I	0	1	0
109	Inorganic	R	0	0	1
110	Inorganic	I	0	1	0
111	Inorganic	R	0	0	1
112	Inorganic	R	0	0	1
113	Inorganic	I	0	1	0
114	Inorganic	R	0	0	1
115	Inorganic	I	0	1	0
116	Inorganic	R	0	0	1
117	Inorganic	I	0	1	0
118	Inorganic	S	1	0	0
119	Inorganic	S	1	0	0
120	Inorganic	R	0	0	1
121	Inorganic	S	1	0	0
122	Inorganic	S	1	0	0
123	Inorganic	S	1	0	0
124	Inorganic	S	1	0	0
126	Inorganic	S	1	0	0
130	Inorganic	S	1	0	0
131	Inorganic	S	1	0	0
133	Inorganic	S	1	0	0
134	Inorganic	S	1	0	0
136	Inorganic	S	1	0	0
138	Inorganic	S	1	0	0
139	Inorganic	S	1	0	0
140	Inorganic	S	1	0	0
141	Inorganic	S	1	0	0
142	Inorganic	S	1	0	0
143	Inorganic	S	1	0	0
144	Inorganic	S	1	0	0
147	Inorganic	S	1	0	0
148	Inorganic	S	1	0	0
149	Inorganic	S	1	0	0
151	Inorganic	S	1	0	0

Sample ID	Management	NAL			
		S/I/R	S	I	R
153	Inorganic	S	1	0	0
154	Inorganic	S	1	0	0
155	Inorganic	S	1	0	0
156	Inorganic	S	1	0	0
158	Inorganic	S	1	0	0
159	Inorganic	S	1	0	0
161	Inorganic	S	1	0	0
162	Inorganic	S	1	0	0
163	Inorganic	S	1	0	0
164	Inorganic	S	1	0	0
166	Inorganic	S	1	0	0
167	Inorganic	S	1	0	0
168	Inorganic	S	1	0	0
169	Inorganic	S	1	0	0
170	Inorganic	S	1	0	0
171	Inorganic	S	1	0	0
172	Inorganic	S	1	0	0
173	Inorganic	S	1	0	0
174	Inorganic	S	1	0	0
175	Inorganic	S	1	0	0
176	Inorganic	S	1	0	0
177	Inorganic	S	1	0	0
178	Inorganic	S	1	0	0
179	Inorganic	S	1	0	0
180	Inorganic	S	1	0	0
181	Inorganic	S	1	0	0
182	Inorganic	S	1	0	0
183	Inorganic	S	1	0	0
184	Inorganic	R	0	0	1
185	Inorganic	S	1	0	0
186	Inorganic	I	0	1	0
187	Inorganic	S	1	0	0
189	Inorganic	I	0	1	0
190	Inorganic	S	1	0	0
191	Inorganic	R	0	0	1
192	Inorganic	S	1	0	0
197	Inorganic	S	1	0	0
199	Inorganic	S	1	0	0
200	Inorganic	S	1	0	0
201	Organic	S	1	0	0
202	Organic	S	1	0	0

Sample ID	Management	NAL			
		S/I/R	S	I	R
203	Organic	S	1	0	0
204	Organic	S	1	0	0
205	Organic	S	1	0	0
206	Organic	S	1	0	0
207	Organic	S	1	0	0
208	Organic	S	1	0	0
209	Organic	S	1	0	0
210	Organic	S	1	0	0
211	Organic	R	0	0	1
212	Organic	I	0	1	0
213	Organic	S	1	0	0
214	Organic	S	1	0	0
215	Organic	S	1	0	0
216	Organic	S	1	0	0
217	Organic	S	1	0	0
218	Organic	S	1	0	0
219	Organic	S	1	0	0
220	Organic	S	1	0	0
221	Organic	S	1	0	0
222	Organic	S	1	0	0
224	Organic	S	1	0	0
225	Organic	R	0	0	1
227	Organic	S	1	0	0
228	Organic	R	0	0	1
229	Organic	S	1	0	0
230	Organic	S	1	0	0
231	Organic	S	1	0	0
232	Organic	I	0	1	0
233	Organic	S	1	0	0
234	Organic	S	1	0	0
235	Organic	S	1	0	0
236	Organic	S	1	0	0
237	Organic	R	0	0	1
238	Organic	S	1	0	0
239	Organic	S	1	0	0
240	Organic	S	1	0	0
241	Organic	S	1	0	0
242	Organic	R	0	0	1
243	Organic	S	1	0	0
244	Organic	S	1	0	0
245	Organic	S	1	0	0

Sample ID	Management	NAL			
		S/I/R	S	I	R
246	Organic	S	1	0	0
247	Organic	S	1	0	0
248	Organic	R	0	0	1
249	Organic	I	0	1	0
250	Organic	S	1	0	0
251	Organic	S	1	0	0
252	Organic	S	1	0	0
253	Organic	I	0	1	0
254	Organic	S	1	0	0
255	Organic	R	0	0	1
256	Organic	S	1	0	0
257	Organic	S	1	0	0
258	Organic	S	1	0	0
259	Organic	S	1	0	0
260	Organic	S	1	0	0
261	Organic	I	0	1	0
262	Organic	S	1	0	0
263	Organic	S	1	0	0
264	Organic	S	1	0	0
265	Organic	S	1	0	0
266	Organic	S	1	0	0
267	Organic	S	1	0	0
268	Organic	R	0	0	1
269	Organic	R	0	0	1
270	Organic	R	0	0	1
271	Organic	S	1	0	0
272	Organic	S	1	0	0
273	Organic	S	1	0	0
275	Organic	S	1	0	0
276	Organic	S	1	0	0
277	Organic	S	1	0	0
278	Organic	S	1	0	0
279	Organic	S	1	0	0
280	Organic	S	1	0	0
281	Organic	S	1	0	0
282	Organic	S	1	0	0
283	Organic	R	0	0	1
284	Organic	R	0	0	1
285	Organic	S	1	0	0
286	Organic	S	1	0	0
287	Organic	S	1	0	0

Sample ID	Management	NAL			
		S/I/R	S	I	R
288	Organic	R	0	0	1
289	Organic	S	1	0	0
290	Organic	R	0	0	1
292	Organic	S	1	0	0
293	Organic	S	1	0	0
294	Organic	S	1	0	0
295	Organic	S	1	0	0
296	Organic	S	1	0	0
297	Organic	S	1	0	0
298	Organic	S	1	0	0
299	Organic	S	1	0	0
300	Organic	S	1	0	0
301	Organic	R	0	0	1
302	Organic	S	1	0	0
303	Organic	S	1	0	0
304	Organic	S	1	0	0
305	Organic	S	1	0	0
306	Organic	S	1	0	0
307	Organic	S	1	0	0
308	Organic	S	1	0	0
309	Organic	S	1	0	0
310	Organic	S	1	0	0
311	Organic	S	1	0	0
312	Organic	I	0	1	0
313	Organic	I	0	1	0
314	Organic	S	1	0	0
315	Organic	S	1	0	0
316	Organic	S	1	0	0
317	Organic	S	1	0	0
318	Organic	I	0	1	0
319	Organic	I	0	1	0
320	Organic	S	1	0	0
321	Organic	S	1	0	0
324	Organic	R	0	0	1
325	Organic	S	1	0	0
326	Organic	R	0	0	1
327	Organic	R	0	0	1
328	Organic	R	0	0	1
329	Organic	R	0	0	1
330	Organic	S	1	0	0
331	Organic	R	0	0	1

Sample ID	Management	NAL			
		S/I/R	S	I	R
332	Organic	R	0	0	1
333	Organic	R	0	0	1
336	Organic	R	0	0	1
337	Organic	R	0	0	1
338	Organic	I	0	1	0
339	Organic	R	0	0	1
341	Organic	R	0	0	1
342	Organic	R	0	0	1
343	Organic	R	0	0	1
344	Organic	S	1	0	0
345	Organic	R	0	0	1
346	Organic	R	0	0	1
348	Organic	S	1	0	0
349	Organic	I	0	1	0
350	Organic	R	0	0	1
351	Organic	S	1	0	0
353	Organic	R	0	0	1
354	Organic	S	1	0	0
355	Organic	R	0	0	1
356	Organic	S	1	0	0
357	Organic	S	1	0	0
358	Organic	R	0	0	1
359	Organic	R	0	0	1
360	Organic	S	1	0	0
361	Organic	S	1	0	0
362	Organic	R	0	0	1
363	Organic	R	0	0	1
364	Organic	R	0	0	1
365	Organic	R	0	0	1
366	Organic	S	1	0	0
367	Organic	S	1	0	0
368	Organic	R	0	0	1
369	Organic	R	0	0	1
370	Organic	R	0	0	1
371	Organic	S	1	0	0
372	Organic	S	1	0	0
373	Organic	S	1	0	0
374	Organic	S	1	0	0
375	Organic	R	0	0	1
376	Organic	R	0	0	1
378	Organic	I	0	1	0

Sample ID	Management	NAL			
		S/I/R	S	I	R
379	Organic	S	1	0	0
380	Organic	S	1	0	0
381	Organic	R	0	0	1
382	Organic	R	0	0	1
384	Organic	S	1	0	0
385	Organic	S	1	0	0
386	Organic	S	1	0	0
388	Organic	R	0	0	1
389	Organic	R	0	0	1
390	Organic	R	0	0	1
391	Organic	S	1	0	0
392	Organic	R	0	0	1
393	Organic	S	1	0	0
394	Organic	I	0	1	0
397	Organic	I	0	1	0
398	Organic	S	1	0	0
399	Organic	I	0	1	0
400	Organic	I	0	1	0
401	Inorganic	S	1	0	0
402	Inorganic	I	0	1	0
403	Inorganic	I	0	1	0
404	Inorganic	S	1	0	0
405	Inorganic	I	0	1	0
406	Inorganic	I	0	1	0
407	Inorganic	R	0	0	1
409	Inorganic	S	1	0	0
410	Inorganic	I	0	1	0
411	Inorganic	S	1	0	0
412	Inorganic	R	0	0	1
414	Inorganic	S	1	0	0
415	Inorganic	S	1	0	0
416	Inorganic	I	0	1	0
417	Inorganic	S	1	0	0
418	Inorganic	R	0	0	1
419	Inorganic	R	0	0	1
420	Inorganic	S	1	0	0
421	Inorganic	I	0	1	0
423	Inorganic	I	0	1	0
425	Inorganic	I	0	1	0
426	Inorganic	R	0	0	1
427	Inorganic	S	1	0	0

Sample ID	Management	NAL			
		S/I/R	S	I	R
430	Inorganic	I	0	1	0
431	Inorganic	I	0	1	0
433	Inorganic	S	1	0	0
434	Inorganic	S	1	0	0
435	Inorganic	R	0	0	1
436	Inorganic	I	0	1	0
437	Inorganic	S	1	0	0
438	Inorganic	S	1	0	0
439	Inorganic	S	1	0	0
440	Inorganic	S	1	0	0
441	Inorganic	S	1	0	0
442	Inorganic	S	1	0	0
443	Inorganic	S	1	0	0
444	Inorganic	S	1	0	0
445	Inorganic	S	1	0	0
446	Inorganic	S	1	0	0
447	Inorganic	I	0	1	0
448	Inorganic	I	0	1	0
449	Inorganic	S	1	0	0
450	Inorganic	S	1	0	0
451	Inorganic	S	1	0	0
452	Inorganic	S	1	0	0
453	Inorganic	S	1	0	0
454	Inorganic	S	1	0	0
455	Inorganic	I	0	1	0
456	Inorganic	S	1	0	0
457	Inorganic	I	0	1	0
458	Inorganic	I	0	1	0
459	Inorganic	S	1	0	0
460	Inorganic	S	1	0	0
462	Inorganic	S	1	0	0
463	Inorganic	I	0	1	0
464	Inorganic	I	0	1	0
465	Inorganic	S	1	0	0
466	Inorganic	S	1	0	0
467	Inorganic	I	0	1	0
468	Inorganic	S	1	0	0
469	Inorganic	I	0	1	0
470	Inorganic	I	0	1	0
471	Inorganic	S	1	0	0
472	Inorganic	S	1	0	0

Sample ID	Management	NAL			
		S/I/R	S	I	R
473	Inorganic	S	1	0	0
474	Inorganic	S	1	0	0
475	Inorganic	I	0	1	0
476	Inorganic	I	0	1	0
477	Inorganic	I	0	1	0
478	Inorganic	I	0	1	0
479	Inorganic	S	1	0	0
480	Inorganic	S	1	0	0
481	Inorganic	I	0	1	0
482	Inorganic	I	0	1	0
483	Inorganic	I	0	1	0
484	Inorganic	I	0	1	0
485	Inorganic	S	1	0	0
486	Inorganic	S	1	0	0
487	Inorganic	I	0	1	0
488	Inorganic	I	0	1	0
489	Inorganic	S	1	0	0
490	Inorganic	S	1	0	0
491	Inorganic	S	1	0	0
492	Inorganic	S	1	0	0
493	Inorganic	S	1	0	0
494	Inorganic	S	1	0	0
495	Inorganic	S	1	0	0
497	Inorganic	S	1	0	0
498	Inorganic	S	1	0	0
499	Inorganic	S	1	0	0
500	Inorganic	S	1	0	0
501	Inorganic	S	1	0	0
502	Inorganic	S	1	0	0
503	Inorganic	S	1	0	0
504	Inorganic	S	1	0	0
505	Inorganic	S	1	0	0
506	Inorganic	S	1	0	0
507	Inorganic	S	1	0	0
508	Inorganic	S	1	0	0
509	Inorganic	S	1	0	0
510	Inorganic	S	1	0	0
511	Inorganic	S	1	0	0
512	Inorganic	S	1	0	0
513	Inorganic	S	1	0	0
514	Inorganic	S	1	0	0

Sample ID	Management	NAL			
		S/I/R	S	I	R
515	Inorganic	S	1	0	0
516	Inorganic	S	1	0	0
517	Inorganic	I	0	1	0
518	Inorganic	S	1	0	0
519	Inorganic	S	1	0	0
520	Inorganic	S	1	0	0
521	Inorganic	S	1	0	0
522	Inorganic	S	1	0	0
523	Inorganic	R	0	0	1
525	Inorganic	S	1	0	0
526	Inorganic	S	1	0	0
527	Inorganic	S	1	0	0
528	Inorganic	S	1	0	0
529	Inorganic	S	1	0	0
530	Inorganic	R	0	0	1
531	Inorganic	I	0	1	0
532	Inorganic	S	1	0	0
533	Inorganic	S	1	0	0
534	Inorganic	S	1	0	0
535	Inorganic	R	0	0	1
536	Inorganic	S	1	0	0
537	Inorganic	.	.	.	.
538	Inorganic	S	1	0	0
539	Inorganic	S	1	0	0
540	Inorganic	S	1	0	0
541	Inorganic	S	1	0	0
542	Inorganic	S	1	0	0
543	Inorganic	S	1	0	0
544	Inorganic	S	1	0	0
545	Inorganic	S	1	0	0
546	Inorganic	S	1	0	0
547	Inorganic	S	1	0	0
548	Inorganic	S	1	0	0
549	Inorganic	S	1	0	0
550	Inorganic	S	1	0	0
551	Inorganic	S	1	0	0
552	Inorganic	S	1	0	0
553	Inorganic	S	1	0	0
554	Inorganic	S	1	0	0
556	Inorganic	S	1	0	0

Sample ID	Management	STP S/I/R	S	I	R
1	Inorganic	R	0	0	1
2	Inorganic	R	0	0	1
3	Inorganic	.	.	.	.
4	Inorganic	.	.	.	.
5	Inorganic	.	.	.	.
6	Inorganic	.	.	.	.
7	Inorganic	R	0	0	1
8	Inorganic	R	0	0	1
9	Inorganic	.	.	.	.
10	Inorganic	R	0	0	1
11	Inorganic	R	0	0	1
12	Inorganic	R	0	0	1
13	Inorganic	I	I	1	0
14	Inorganic	R	0	0	1
15	Inorganic	R	0	0	1
16	Inorganic	R	0	0	1
17	Inorganic	R	0	0	1
19	Inorganic	R	0	0	1
20	Inorganic	R	0	0	1
21	Inorganic	.	.	.	.
22	Inorganic	.	.	.	.
24	Inorganic	.	.	.	.
25	Inorganic	.	.	.	.
27	Inorganic	I	I	1	0
28	Inorganic	R	0	0	1
29	Inorganic	S	1	0	0
30	Inorganic	R	0	0	1
31	Inorganic	.	.	.	.
32	Inorganic	.	.	.	.
33	Inorganic	S	1	0	0
34	Inorganic	R	0	0	1
35	Inorganic	R	0	0	1
36	Inorganic	.	.	.	.
37	Inorganic	.	.	.	.
38	Inorganic	I	I	1	0
39	Inorganic	S	1	0	0
40	Inorganic	S	1	0	0
41	Inorganic	R	0	0	1
42	Inorganic	R	0	0	1
43	Inorganic	.	.	.	.
44	Inorganic	R	0	0	1

Sample ID	Management	STP S/I/R	S	I	R
46	Inorganic	S	1	0	0
47	Inorganic	S	1	0	0
48	Inorganic	S	1	0	0
49	Inorganic	S	1	0	0
50	Inorganic	R	0	0	1
51	Inorganic	R	0	0	1
52	Inorganic	R	0	0	1
53	Inorganic	R	0	0	1
54	Inorganic	R	0	0	1
54 dup	Inorganic	R	0	0	1
55	Inorganic	R	0	0	1
57	Inorganic	R	0	0	1
58	Inorganic	R	0	0	1
59	Inorganic	.	.	.	.
60	Inorganic	.	.	.	.
61	Inorganic	R	0	0	1
62	Inorganic	S	1	0	0
63	Inorganic	R	0	0	1
64	Inorganic	R	0	0	1
65	Inorganic	.	.	.	.
66	Inorganic	R	0	0	1
67	Inorganic	S	1	0	0
68	Inorganic	.	.	.	.
69	Inorganic	.	.	.	.
70	Inorganic	.	.	.	.
71	Inorganic	.	.	.	.
72	Inorganic	S	1	0	0
73	Inorganic	R	0	0	1
74	Inorganic	S	1	0	0
75	Inorganic	R	0	0	1
76	Inorganic	S	1	0	0
77	Inorganic	.	.	.	.
79	Inorganic	S	1	0	0
82	Inorganic	R	0	0	1
84	Inorganic	S	1	0	0
88	Inorganic	R	0	0	1
89	Inorganic	S	1	0	0
90	Inorganic	S	1	0	0
91	Inorganic	S	1	0	0
93	Inorganic	S	1	0	0
96	Inorganic	R	0	0	1

Sample ID	Management	STP			
		S/I/R	S	I	R
101	Inorganic	R	0	0	1
102	Inorganic	R	0	0	1
103	Inorganic	R	0	0	1
104	Inorganic	S	1	0	0
105	Inorganic	R	0	0	1
106	Inorganic	R	0	0	1
107	Inorganic	R	0	0	1
108	Inorganic	R	0	0	1
109	Inorganic	R	0	0	1
110	Inorganic	R	0	0	1
111	Inorganic	R	0	0	1
112	Inorganic	R	0	0	1
113	Inorganic	R	0	0	1
114	Inorganic	R	0	0	1
115	Inorganic	R	0	0	1
116	Inorganic	R	0	0	1
117	Inorganic	R	0	0	1
118	Inorganic	R	0	0	1
119	Inorganic	R	0	0	1
120	Inorganic	R	0	0	1
121	Inorganic	S	1	0	0
122	Inorganic	R	0	0	1
123	Inorganic	R	0	0	1
124	Inorganic	R	0	0	1
126	Inorganic	R	0	0	1
130	Inorganic	R	0	0	1
131	Inorganic	R	0	0	1
133	Inorganic	R	0	0	1
134	Inorganic	R	0	0	1
136	Inorganic	R	0	0	1
138	Inorganic	R	0	0	1
139	Inorganic	R	0	0	1
140	Inorganic	R	0	0	1
141	Inorganic	R	0	0	1
142	Inorganic	R	0	0	1
143	Inorganic	R	0	0	1
144	Inorganic	R	0	0	1
147	Inorganic	R	0	0	1
148	Inorganic	R	0	0	1
149	Inorganic	R	0	0	1
151	Inorganic	R	0	0	1

Sample ID	Management	STP			
		S/I/R	S	I	R
153	Inorganic	R	0	0	1
154	Inorganic	R	0	0	1
155	Inorganic	R	0	0	1
156	Inorganic	R	0	0	1
158	Inorganic	R	0	0	1
159	Inorganic	R	0	0	1
161	Inorganic	R	0	0	1
162	Inorganic	R	0	0	1
163	Inorganic	R	0	0	1
164	Inorganic	R	0	0	1
166	Inorganic	R	0	0	1
167	Inorganic	R	0	0	1
168	Inorganic	R	0	0	1
169	Inorganic	R	0	0	1
170	Inorganic	R	0	0	1
171	Inorganic	R	0	0	1
172	Inorganic	R	0	0	1
173	Inorganic	R	0	0	1
174	Inorganic	I	I	1	0
175	Inorganic	S	1	0	0
176	Inorganic	I	I	1	0
177	Inorganic	I	I	1	0
178	Inorganic	R	0	0	1
179	Inorganic	R	0	0	1
180	Inorganic	R	0	0	1
181	Inorganic	R	0	0	1
182	Inorganic	R	0	0	1
183	Inorganic	R	0	0	1
184	Inorganic	R	0	0	1
185	Inorganic	R	0	0	1
186	Inorganic	R	0	0	1
187	Inorganic	R	0	0	1
189	Inorganic	.	.	.	.
190	Inorganic	S	1	0	0
191	Inorganic	S	1	0	0
192	Inorganic	R	0	0	1
197	Inorganic	R	0	0	1
199	Inorganic	R	0	0	1
200	Inorganic	.	.	.	.
201	Organic	I	I	1	0
202	Organic	R	0	0	1

Sample ID	Management	STP S/I/R	S	I	R
203	Organic	S	1	0	0
204	Organic	R	0	0	1
205	Organic	R	0	0	1
206	Organic	I	I	1	0
207	Organic	R	0	0	1
208	Organic	R	0	0	1
209	Organic	I	I	1	0
210	Organic	S	1	0	0
211	Organic	I	I	1	0
212	Organic	R	0	0	1
213	Organic	R	0	0	1
214	Organic	I	I	1	0
215	Organic	I	I	1	0
216	Organic	I	I	1	0
217	Organic	I	I	1	0
218	Organic	S	1	0	0
219	Organic	S	1	0	0
220	Organic	.	.	.	.
221	Organic	S	1	0	0
222	Organic	S	1	0	0
224	Organic	S	1	0	0
225	Organic	I	I	1	0
227	Organic	R	0	0	1
228	Organic	S	1	0	0
229	Organic	S	1	0	0
230	Organic	R	0	0	1
231	Organic	I	I	1	0
232	Organic	R	0	0	1
233	Organic	I	I	1	0
234	Organic	I	I	1	0
235	Organic	I	I	1	0
236	Organic	I	I	1	0
237	Organic	I	I	1	0
238	Organic	I	I	1	0
239	Organic	I	I	1	0
240	Organic	I	I	1	0
241	Organic	R	0	0	1
242	Organic	I	I	1	0
243	Organic	I	I	1	0
244	Organic	S	1	0	0
245	Organic	R	0	0	1

Sample ID	Management	STP			
		S/I/R	S	I	R
246	Organic	R	0	0	1
247	Organic	I	I	1	0
248	Organic	R	0	0	1
249	Organic	R	0	0	1
250	Organic	R	0	0	1
251	Organic	I	I	1	0
252	Organic	I	I	1	0
253	Organic	R	0	0	1
254	Organic	R	0	0	1
255	Organic	R	0	0	1
256	Organic	I	I	1	0
257	Organic	I	I	1	0
258	Organic	I	I	1	0
259	Organic	R	0	0	1
260	Organic	R	0	0	1
261	Organic	R	0	0	1
262	Organic	R	0	0	1
263	Organic	R	0	0	1
264	Organic	I	I	1	0
265	Organic	I	I	1	0
266	Organic	S	1	0	0
267	Organic	S	1	0	0
268	Organic	I	I	1	0
269	Organic	I	I	1	0
270	Organic	R	0	0	1
271	Organic	I	I	1	0
272	Organic	I	I	1	0
273	Organic	S	1	0	0
275	Organic	I	I	1	0
276	Organic	I	I	1	0
277	Organic	I	I	1	0
278	Organic	I	I	1	0
279	Organic	I	I	1	0
280	Organic	I	I	1	0
281	Organic	R	0	0	1
282	Organic	S	1	0	0
283	Organic	S	1	0	0
284	Organic	I	I	1	0
285	Organic	I	I	1	0
286	Organic	R	0	0	1
287	Organic	R	0	0	1

Sample ID	Management	STP			
		S/I/R	S	I	R
288	Organic	R	0	0	1
289	Organic	R	0	0	1
290	Organic	I	I	1	0
292	Organic	I	I	1	0
293	Organic	R	0	0	1
294	Organic	R	0	0	1
295	Organic	I	I	1	0
296	Organic	R	0	0	1
297	Organic	I	I	1	0
298	Organic	R	0	0	1
299	Organic	I	I	1	0
300	Organic	R	0	0	1
301	Organic	.	.	.	.
302	Organic	R	0	0	1
303	Organic	R	0	0	1
304	Organic	R	0	0	1
305	Organic	R	0	0	1
306	Organic	I	I	1	0
307	Organic	I	I	1	0
308	Organic	R	0	0	1
309	Organic	R	0	0	1
310	Organic	R	0	0	1
311	Organic	R	0	0	1
312	Organic	S	1	0	0
313	Organic	S	1	0	0
314	Organic	I	I	1	0
315	Organic	S	1	0	0
316	Organic	S	1	0	0
317	Organic	S	1	0	0
318	Organic	S	1	0	0
319	Organic	S	1	0	0
320	Organic	S	1	0	0
321	Organic	S	1	0	0
324	Organic	.	.	.	.
325	Organic	S	1	0	0
326	Organic	S	1	0	0
327	Organic	S	1	0	0
328	Organic	S	1	0	0
329	Organic	S	1	0	0
330	Organic	S	1	0	0
331	Organic	S	1	0	0

Sample ID	Management	STP			
		S/I/R	S	I	R
332	Organic	.	.	.	.
333	Organic	.	.	.	.
336	Organic	R	0	0	1
337	Organic	R	0	0	1
338	Organic	.	.	.	.
339	Organic	I	I	1	0
341	Organic	.	.	.	.
342	Organic	R	0	0	1
343	Organic	R	0	0	1
344	Organic	.	.	.	.
345	Organic	I	I	1	0
346	Organic	.	.	.	.
348	Organic	R	0	0	1
349	Organic	.	.	.	.
350	Organic	R	0	0	1
351	Organic	R	0	0	1
353	Organic	R	0	0	1
354	Organic	R	0	0	1
355	Organic	R	0	0	1
356	Organic	R	0	0	1
357	Organic	R	0	0	1
358	Organic	R	0	0	1
359	Organic	R	0	0	1
360	Organic	R	0	0	1
361	Organic	R	0	0	1
362	Organic	R	0	0	1
363	Organic	R	0	0	1
364	Organic	R	0	0	1
365	Organic	R	0	0	1
366	Organic	R	0	0	1
367	Organic	R	0	0	1
368	Organic	R	0	0	1
369	Organic	R	0	0	1
370	Organic	R	0	0	1
371	Organic	R	0	0	1
372	Organic	I	I	1	0
373	Organic	R	0	0	1
374	Organic	R	0	0	1
375	Organic	R	0	0	1
376	Organic	R	0	0	1
378	Organic	.	.	.	.

Sample ID	Management	STP			
		S/I/R	S	I	R
379	Organic	R	0	0	1
380	Organic	R	0	0	1
381	Organic	R	0	0	1
382	Organic	R	0	0	1
384	Organic	I	I	1	0
385	Organic	I	I	1	0
386	Organic	S	1	0	0
388	Organic	.	.	.	.
389	Organic	.	.	.	.
390	Organic	.	.	.	.
391	Organic	I	I	0	0
392	Organic	.	.	.	.
393	Organic	S	1	0	0
394	Organic	S	1	0	0
397	Organic	R	0	0	1
398	Organic	R	0	0	1
399	Organic	S	1	0	0
400	Organic	S	1	0	0
401	Inorganic	S	1	0	0
402	Inorganic	S	1	0	0
403	Inorganic	R	0	0	1
404	Inorganic	R	0	0	1
405	Inorganic	S	1	0	0
406	Inorganic	S	1	0	0
407	Inorganic	.	.	.	.
409	Inorganic	R	0	0	1
410	Inorganic	R	0	0	1
411	Inorganic	I	I	1	0
412	Inorganic	I	I	1	0
414	Inorganic	.	.	.	.
415	Inorganic	I	I	1	0
416	Inorganic	I	I	1	0
417	Inorganic	S	1	0	0
418	Inorganic	I	I	1	0
419	Inorganic	R	0	0	1
420	Inorganic	R	0	0	1
421	Inorganic	.	.	.	.
423	Inorganic	S	1	0	0
425	Inorganic	R	0	0	1
426	Inorganic	R	0	0	1
427	Inorganic	R	0	0	1

Sample ID	Management	STP S/I/R	S	I	R
430	Inorganic	S	1	0	0
431	Inorganic	I	I	1	0
433	Inorganic	R	0	0	1
434	Inorganic	R	0	0	1
435	Inorganic	R	0	0	1
436	Inorganic	S	1	0	0
437	Inorganic	S	1	0	0
438	Inorganic	R	0	0	1
439	Inorganic	R	0	0	1
440	Inorganic	R	0	0	1
441	Inorganic	R	0	0	1
442	Inorganic	R	0	0	1
443	Inorganic	R	0	0	1
444	Inorganic	R	0	0	1
445	Inorganic	I	I	1	0
446	Inorganic	I	I	1	0
447	Inorganic	R	0	0	1
448	Inorganic	R	0	0	1
449	Inorganic	I	I	1	0
450	Inorganic	I	I	1	0
451	Inorganic	I	I	1	0
452	Inorganic	I	I	1	0
453	Inorganic	R	0	0	1
454	Inorganic	R	0	0	1
455	Inorganic	I	I	1	0
456	Inorganic	I	I	1	0
457	Inorganic	R	0	0	1
458	Inorganic	R	0	0	1
459	Inorganic	R	0	0	1
460	Inorganic	R	0	0	1
462	Inorganic	I	I	1	0
463	Inorganic	R	0	0	1
464	Inorganic	R	0	0	1
465	Inorganic	R	0	0	1
466	Inorganic	R	0	0	1
467	Inorganic	R	0	0	1
468	Inorganic	R	0	0	1
469	Inorganic	R	0	0	1
470	Inorganic	R	0	0	1
471	Inorganic	R	0	0	1
472	Inorganic	R	0	0	1

Sample ID	Management	STP			
		S/I/R	S	I	R
473	Inorganic	R	0	0	1
474	Inorganic	.	.	.	.
475	Inorganic	R	0	0	1
476	Inorganic	R	0	0	1
477	Inorganic	R	0	0	1
478	Inorganic	R	0	0	1
479	Inorganic	R	0	0	1
480	Inorganic	R	0	0	1
481	Inorganic	R	0	0	1
482	Inorganic	R	0	0	1
483	Inorganic	R	0	0	1
484	Inorganic	R	0	0	1
485	Inorganic	R	0	0	1
486	Inorganic	R	0	0	1
487	Inorganic	R	0	0	1
488	Inorganic	R	0	0	1
489	Inorganic	R	0	0	1
490	Inorganic	R	0	0	1
491	Inorganic	R	0	0	1
492	Inorganic	R	0	0	1
493	Inorganic	R	0	0	1
494	Inorganic	R	0	0	1
495	Inorganic	R	0	0	1
497	Inorganic	R	0	0	1
498	Inorganic	R	0	0	1
499	Inorganic	R	0	0	1
500	Inorganic	R	0	0	1
501	Inorganic	R	0	0	1
502	Inorganic	R	0	0	1
503	Inorganic	R	0	0	1
504	Inorganic	R	0	0	1
505	Inorganic	R	0	0	1
506	Inorganic	R	0	0	1
507	Inorganic	R	0	0	1
508	Inorganic	.	.	.	.
509	Inorganic	R	0	0	1
510	Inorganic	R	0	0	1
511	Inorganic	R	0	0	1
512	Inorganic	R	0	0	1
513	Inorganic	R	0	0	1
514	Inorganic	R	0	0	1

Sample ID	Management	STP			
		S/I/R	S	I	R
515	Inorganic	R	0	0	1
516	Inorganic	S	1	0	0
517	Inorganic	.	.	.	.
518	Inorganic	R	0	0	1
519	Inorganic	R	0	0	1
520	Inorganic	R	0	0	1
521	Inorganic	R	0	0	1
522	Inorganic	S	1	0	0
523	Inorganic	.	.	.	.
525	Inorganic	R	0	0	1
526	Inorganic	R	0	0	1
527	Inorganic	R	0	0	1
528	Inorganic	R	0	0	1
529	Inorganic	R	0	0	1
530	Inorganic	.	.	.	.
531	Inorganic	R	0	0	1
532	Inorganic	R	0	0	1
533	Inorganic	R	0	0	1
534	Inorganic	R	0	0	1
535	Inorganic	.	.	.	.
536	Inorganic	R	0	0	1
537	Inorganic	R	0	0	1
538	Inorganic	R	0	0	1
539	Inorganic	R	0	0	1
540	Inorganic	R	0	0	1
541	Inorganic	R	0	0	1
542	Inorganic	R	0	0	1
543	Inorganic	R	0	0	1
544	Inorganic	R	0	0	1
545	Inorganic	R	0	0	1
546	Inorganic	R	0	0	1
547	Inorganic	R	0	0	1
548	Inorganic	R	0	0	1
549	Inorganic	R	0	0	1
550	Inorganic	R	0	0	1
551	Inorganic	R	0	0	1
552	Inorganic	R	0	0	1
553	Inorganic	R	0	0	1
554	Inorganic	R	0	0	1
556	Inorganic	.	.	.	.

Sample ID	Management	CAM			
		S/I/R	S	I	R
1	Inorganic	S	1	0	0
2	Inorganic	S	1	0	0
3	Inorganic	S	1	0	0
4	Inorganic	I	0	1	0
5	Inorganic	I	0	1	0
6	Inorganic	S	1	0	0
7	Inorganic	S	1	0	0
8	Inorganic	S	1	0	0
9	Inorganic	S	1	0	0
10	Inorganic	S	1	0	0
11	Inorganic	S	1	0	0
12	Inorganic	S	1	0	0
13	Inorganic	S	1	0	0
14	Inorganic	S	1	0	0
15	Inorganic	S	1	0	0
16	Inorganic	S	1	0	0
17	Inorganic	S	1	0	0
19	Inorganic	R	0	0	1
20	Inorganic	S	1	0	0
21	Inorganic	R	0	0	1
22	Inorganic	S	1	0	0
24	Inorganic	R	0	0	1
25	Inorganic	S	1	0	0
27	Inorganic	S	1	0	0
28	Inorganic	S	1	0	0
29	Inorganic	S	1	0	0
30	Inorganic	S	1	0	0
31	Inorganic	S	1	0	0
32	Inorganic	S	1	0	0
33	Inorganic	S	1	0	0
34	Inorganic	S	1	0	0
35	Inorganic	S	1	0	0
36	Inorganic	S	1	0	0
37	Inorganic	S	1	0	0
38	Inorganic	S	1	0	0
39	Inorganic	S	1	0	0
40	Inorganic	S	1	0	0
41	Inorganic	S	1	0	0
42	Inorganic	S	1	0	0
43	Inorganic	S	1	0	0
44	Inorganic	I	0	1	0

Sample ID	Management	CAM			
		S/I/R	S	I	R
46	Inorganic	S	1	0	0
47	Inorganic	S	1	0	0
48	Inorganic	S	1	0	0
49	Inorganic	S	1	0	0
50	Inorganic	S	1	0	0
51	Inorganic	S	1	0	0
52	Inorganic	S	1	0	0
53	Inorganic	S	1	0	0
54	Inorganic	I	0	1	0
54 dup	Inorganic	I	0	1	0
55	Inorganic	S	1	0	0
57	Inorganic	S	1	0	0
58	Inorganic	I	0	1	0
59	Inorganic	R	0	0	1
60	Inorganic	S	1	0	0
61	Inorganic	R	0	0	1
62	Inorganic	S	1	0	0
63	Inorganic	S	1	0	0
64	Inorganic	S	1	0	0
65	Inorganic	I	0	1	0
66	Inorganic	S	1	0	0
67	Inorganic	S	1	0	0
68	Inorganic	S	1	0	0
69	Inorganic	R	0	0	1
70	Inorganic	R	0	0	1
71	Inorganic	S	1	0	0
72	Inorganic	S	1	0	0
73	Inorganic	S	1	0	0
74	Inorganic	S	1	0	0
75	Inorganic	S	1	0	0
76	Inorganic	S	1	0	0
77	Inorganic	R	0	0	1
79	Inorganic	S	1	0	0
82	Inorganic	S	1	0	0
84	Inorganic	S	1	0	0
88	Inorganic	S	1	0	0
89	Inorganic	S	1	0	0
90	Inorganic	S	1	0	0
91	Inorganic	S	1	0	0
93	Inorganic	S	1	0	0
96	Inorganic	S	1	0	0

Sample ID	Management	CAM			
		S/I/R	S	I	R
101	Inorganic	R	0	0	1
102	Inorganic	R	0	0	1
103	Inorganic	R	0	0	1
104	Inorganic	S	1	0	0
105	Inorganic	R	0	0	1
106	Inorganic	R	0	0	1
107	Inorganic	R	0	0	1
108	Inorganic	R	0	0	1
109	Inorganic	R	0	0	1
110	Inorganic	R	0	0	1
111	Inorganic	R	0	0	1
112	Inorganic	R	0	0	1
113	Inorganic	R	0	0	1
114	Inorganic	R	0	0	1
115	Inorganic	R	0	0	1
116	Inorganic	R	0	0	1
117	Inorganic	R	0	0	1
118	Inorganic	R	0	0	1
119	Inorganic	R	0	0	1
120	Inorganic	R	0	0	1
121	Inorganic	R	0	0	1
122	Inorganic	S	1	0	0
123	Inorganic	S	1	0	0
124	Inorganic	R	0	0	1
126	Inorganic	R	0	0	1
130	Inorganic	R	0	0	1
131	Inorganic	S	1	0	0
133	Inorganic	S	1	0	0
134	Inorganic	R	0	0	1
136	Inorganic	R	0	0	1
138	Inorganic	R	0	0	1
139	Inorganic	R	0	0	1
140	Inorganic	S	1	0	0
141	Inorganic	R	0	0	1
142	Inorganic	R	0	0	1
143	Inorganic	R	0	0	1
144	Inorganic	R	0	0	1
147	Inorganic	I	0	1	0
148	Inorganic	I	0	1	0
149	Inorganic	R	0	0	1
151	Inorganic	S	1	0	0

Sample ID	Management	CAM			
		S/I/R	S	I	R
153	Inorganic	I	0	1	0
154	Inorganic	S	1	0	0
155	Inorganic	S	1	0	0
156	Inorganic	S	1	0	0
158	Inorganic	S	1	0	0
159	Inorganic	S	1	0	0
161	Inorganic	I	0	1	0
162	Inorganic	I	0	1	0
163	Inorganic	S	1	0	0
164	Inorganic	S	1	0	0
166	Inorganic	S	1	0	0
167	Inorganic	S	1	0	0
168	Inorganic	S	1	0	0
169	Inorganic	S	1	0	0
170	Inorganic	S	1	0	0
171	Inorganic	S	1	0	0
172	Inorganic	I	0	1	0
173	Inorganic	S	1	0	0
174	Inorganic	S	1	0	0
175	Inorganic	S	1	0	0
176	Inorganic	S	1	0	0
177	Inorganic	S	1	0	0
178	Inorganic	R	0	0	1
179	Inorganic	R	0	0	1
180	Inorganic	S	1	0	0
181	Inorganic	S	1	0	0
182	Inorganic	S	1	0	0
183	Inorganic	S	1	0	0
184	Inorganic	S	1	0	0
185	Inorganic	I	0	1	0
186	Inorganic	S	1	0	0
187	Inorganic	S	1	0	0
189	Inorganic	S	1	0	0
190	Inorganic	S	1	0	0
191	Inorganic	S	1	0	0
192	Inorganic	S	1	0	0
197	Inorganic	S	1	0	0
199	Inorganic	S	1	0	0
200	Inorganic	S	1	0	0
201	Organic	S	1	0	0
202	Organic	S	1	0	0

Sample ID	Management	CAM			
		S/I/R	S	I	R
203	Organic	S	1	0	0
204	Organic	S	1	0	0
205	Organic	S	1	0	0
206	Organic	S	1	0	0
207	Organic	S	1	0	0
208	Organic	S	1	0	0
209	Organic	S	1	0	0
210	Organic	S	1	0	0
211	Organic	S	1	0	0
212	Organic	S	1	0	0
213	Organic	S	1	0	0
214	Organic	S	1	0	0
215	Organic	S	1	0	0
216	Organic	S	1	0	0
217	Organic	S	1	0	0
218	Organic	S	1	0	0
219	Organic	S	1	0	0
220	Organic	S	1	0	0
221	Organic	S	1	0	0
222	Organic	S	1	0	0
224	Organic	S	1	0	0
225	Organic	S	1	0	0
227	Organic	R	0	0	1
228	Organic	S	1	0	0
229	Organic	S	1	0	0
230	Organic	R	0	0	1
231	Organic	S	1	0	0
232	Organic	R	0	0	1
233	Organic	S	1	0	0
234	Organic	S	1	0	0
235	Organic	S	1	0	0
236	Organic	S	1	0	0
237	Organic	S	1	0	0
238	Organic	S	1	0	0
239	Organic	S	1	0	0
240	Organic	R	0	0	1
241	Organic	S	1	0	0
242	Organic	R	0	0	1
243	Organic	S	1	0	0
244	Organic	I	0	1	0
245	Organic	R	0	0	1

Sample ID	Management	CAM			
		S/I/R	S	I	R
246	Organic	R	0	0	1
247	Organic	S	1	0	0
248	Organic	S	1	0	0
249	Organic	S	1	0	0
250	Organic	S	1	0	0
251	Organic	S	1	0	0
252	Organic	S	1	0	0
253	Organic	S	1	0	0
254	Organic	S	1	0	0
255	Organic	S	1	0	0
256	Organic	S	1	0	0
257	Organic	R	0	0	1
258	Organic	S	1	0	0
259	Organic	S	1	0	0
260	Organic	S	1	0	0
261	Organic	S	1	0	0
262	Organic	S	1	0	0
263	Organic	S	1	0	0
264	Organic	S	1	0	0
265	Organic	S	1	0	0
266	Organic	S	1	0	0
267	Organic	S	1	0	0
268	Organic	S	1	0	0
269	Organic	S	1	0	0
270	Organic	R	0	0	1
271	Organic	S	1	0	0
272	Organic	R	0	0	1
273	Organic	S	1	0	0
275	Organic	S	1	0	0
276	Organic	S	1	0	0
277	Organic	I	0	1	0
278	Organic	S	1	0	0
279	Organic	S	1	0	0
280	Organic	S	1	0	0
281	Organic	S	1	0	0
282	Organic	S	1	0	0
283	Organic	S	1	0	0
284	Organic	S	1	0	0
285	Organic	S	1	0	0
286	Organic	S	1	0	0
287	Organic	S	1	0	0

Sample ID	Management	CAM			
		S/I/R	S	I	R
288	Organic	S	1	0	0
289	Organic	R	0	0	1
290	Organic	S	1	0	0
292	Organic	S	1	0	0
293	Organic	R	0	0	1
294	Organic	S	1	0	0
295	Organic	S	1	0	0
296	Organic	S	1	0	0
297	Organic	S	1	0	0
298	Organic	R	0	0	1
299	Organic	S	1	0	0
300	Organic	S	1	0	0
301	Organic	S	1	0	0
302	Organic	S	1	0	0
303	Organic	S	1	0	0
304	Organic	S	1	0	0
305	Organic	S	1	0	0
306	Organic	S	1	0	0
307	Organic	S	1	0	0
308	Organic	S	1	0	0
309	Organic	S	1	0	0
310	Organic	S	1	0	0
311	Organic	S	1	0	0
312	Organic	S	1	0	0
313	Organic	S	1	0	0
314	Organic	R	0	0	1
315	Organic	I	0	1	0
316	Organic	S	1	0	0
317	Organic	S	1	0	0
318	Organic	S	1	0	0
319	Organic	S	1	0	0
320	Organic	S	1	0	0
321	Organic	S	1	0	0
324	Organic	R	0	0	1
325	Organic	S	1	0	0
326	Organic	S	1	0	0
327	Organic	S	1	0	0
328	Organic	S	1	0	0
329	Organic	S	1	0	0
330	Organic	S	1	0	0
331	Organic	S	1	0	0

Sample ID	Management	CAM			
		S/I/R	S	I	R
332	Organic	S	1	0	0
333	Organic	S	1	0	0
336	Organic	R	0	0	1
337	Organic	S	1	0	0
338	Organic	S	1	0	0
339	Organic	S	1	0	0
341	Organic	S	1	0	0
342	Organic	S	1	0	0
343	Organic	I	0	1	0
344	Organic	S	1	0	0
345	Organic	S	1	0	0
346	Organic	S	1	0	0
348	Organic	R	0	0	1
349	Organic	S	1	0	0
350	Organic	S	1	0	0
351	Organic	I	0	1	0
353	Organic	S	1	0	0
354	Organic	R	0	0	1
355	Organic	R	0	0	1
356	Organic	R	0	0	1
357	Organic	R	0	0	1
358	Organic	R	0	0	1
359	Organic	R	0	0	1
360	Organic	R	0	0	1
361	Organic	R	0	0	1
362	Organic	R	0	0	1
363	Organic	R	0	0	1
364	Organic	R	0	0	1
365	Organic	R	0	0	1
366	Organic	R	0	0	1
367	Organic	R	0	0	1
368	Organic	R	0	0	1
369	Organic	R	0	0	1
370	Organic	R	0	0	1
371	Organic	R	0	0	1
372	Organic	S	1	0	0
373	Organic	R	0	0	1
374	Organic	R	0	0	1
375	Organic	R	0	0	1
376	Organic	R	0	0	1
378	Organic	S	1	0	0

Sample ID	Management	CAM			
		S/I/R	S	I	R
379	Organic	R	0	0	1
380	Organic	S	1	0	0
381	Organic	S	1	0	0
382	Organic	S	1	0	0
384	Organic	S	1	0	0
385	Organic	S	1	0	0
386	Organic	I	0	1	0
388	Organic	1	1	0	0
389	Organic	S	1	0	0
390	Organic	S	1	0	0
391	Organic	S	1	0	0
392	Organic	S	1	0	0
393	Organic	S	1	0	0
394	Organic	S	1	0	0
397	Organic	S	1	0	0
398	Organic	I	0	1	0
399	Organic	S	1	0	0
400	Organic	S	1	0	0
401	Inorganic	S	1	0	0
402	Inorganic	S	1	0	0
403	Inorganic	S	1	0	0
404	Inorganic	R	0	0	1
405	Inorganic	S	1	0	0
406	Inorganic	S	1	0	0
407	Inorganic	R	0	0	1
409	Inorganic	S	1	0	0
410	Inorganic	S	1	0	0
411	Inorganic	S	1	0	0
412	Inorganic	S	1	0	0
414	Inorganic	S	1	0	0
415	Inorganic	S	1	0	0
416	Inorganic	S	1	0	0
417	Inorganic	S	1	0	0
418	Inorganic	S	1	0	0
419	Inorganic	S	1	0	0
420	Inorganic	S	1	0	0
421	Inorganic	S	1	0	0
423	Inorganic	S	1	0	0
425	Inorganic	S	1	0	0
426	Inorganic	S	1	0	0
427	Inorganic	S	1	0	0

Sample ID	Management	CAM			
		S/I/R	S	I	R
430	Inorganic	S	1	0	0
431	Inorganic	S	1	0	0
433	Inorganic	S	1	0	0
434	Inorganic	S	1	0	0
435	Inorganic	S	1	0	0
436	Inorganic	S	1	0	0
437	Inorganic	S	1	0	0
438	Inorganic	S	1	0	0
439	Inorganic	S	1	0	0
440	Inorganic	S	1	0	0
441	Inorganic	S	1	0	0
442	Inorganic	I	0	1	0
443	Inorganic	S	1	0	0
444	Inorganic	S	1	0	0
445	Inorganic	S	1	0	0
446	Inorganic	S	1	0	0
447	Inorganic	S	1	0	0
448	Inorganic	S	1	0	0
449	Inorganic	S	1	0	0
450	Inorganic	S	1	0	0
451	Inorganic	S	1	0	0
452	Inorganic	S	1	0	0
453	Inorganic	S	1	0	0
454	Inorganic	S	1	0	0
455	Inorganic	S	1	0	0
456	Inorganic	S	1	0	0
457	Inorganic	S	1	0	0
458	Inorganic	S	1	0	0
459	Inorganic	S	1	0	0
460	Inorganic	S	1	0	0
462	Inorganic	S	1	0	0
463	Inorganic	S	1	0	0
464	Inorganic	S	1	0	0
465	Inorganic	S	1	0	0
466	Inorganic	S	1	0	0
467	Inorganic	S	1	0	0
468	Inorganic	S	1	0	0
469	Inorganic	S	1	0	0
470	Inorganic	S	1	0	0
471	Inorganic	S	1	0	0
472	Inorganic	S	1	0	0

Sample ID	Management	CAM			
		S/I/R	S	I	R
473	Inorganic	R	0	0	1
474	Inorganic	S	1	0	0
475	Inorganic	S	1	0	0
476	Inorganic	S	1	0	0
477	Inorganic	S	1	0	0
478	Inorganic	S	1	0	0
479	Inorganic	R	0	0	1
480	Inorganic	R	0	0	1
481	Inorganic	I	0	1	0
482	Inorganic	S	1	0	0
483	Inorganic	S	1	0	0
484	Inorganic	S	1	0	0
485	Inorganic	R	0	0	1
486	Inorganic	R	0	0	1
487	Inorganic	I	0	1	0
488	Inorganic	S	1	0	0
489	Inorganic	S	1	0	0
490	Inorganic	S	1	0	0
491	Inorganic	R	0	0	1
492	Inorganic	R	0	0	1
493	Inorganic	S	1	0	0
494	Inorganic	S	1	0	0
495	Inorganic	R	0	0	1
497	Inorganic	S	1	0	0
498	Inorganic	R	0	0	1
499	Inorganic	S	1	0	0
500	Inorganic	I	0	1	0
501	Inorganic	S	1	0	0
502	Inorganic	S	1	0	0
503	Inorganic	S	1	0	0
504	Inorganic	S	1	0	0
505	Inorganic	S	1	0	0
506	Inorganic	S	1	0	0
507	Inorganic	S	1	0	0
508	Inorganic	S	1	0	0
509	Inorganic	S	1	0	0
510	Inorganic	S	1	0	0
511	Inorganic	S	1	0	0
512	Inorganic	S	1	0	0
513	Inorganic	S	1	0	0
514	Inorganic	S	1	0	0

Sample ID	Management	CAM			
		S/I/R	S	I	R
515	Inorganic	S	1	0	0
516	Inorganic	S	1	0	0
517	Inorganic	S	1	0	0
518	Inorganic	S	1	0	0
519	Inorganic	S	1	0	0
520	Inorganic	S	1	0	0
521	Inorganic	S	1	0	0
522	Inorganic	S	1	0	0
523	Inorganic	S	1	0	0
525	Inorganic	S	1	0	0
526	Inorganic	S	1	0	0
527	Inorganic	S	1	0	0
528	Inorganic	S	1	0	0
529	Inorganic	S	1	0	0
530	Inorganic	S	1	0	0
531	Inorganic	S	1	0	0
532	Inorganic	S	1	0	0
533	Inorganic	S	1	0	0
534	Inorganic	S	1	0	0
535	Inorganic	S	1	0	0
536	Inorganic	S	1	0	0
537	Inorganic	S	1	0	0
538	Inorganic	S	1	0	0
539	Inorganic	S	1	0	0
540	Inorganic	S	1	0	0
541	Inorganic	S	1	0	0
542	Inorganic	S	1	0	0
543	Inorganic	S	1	0	0
544	Inorganic	S	1	0	0
545	Inorganic	S	1	0	0
546	Inorganic	S	1	0	0
547	Inorganic	S	1	0	0
548	Inorganic	S	1	0	0
549	Inorganic	S	1	0	0
550	Inorganic	S	1	0	0
551	Inorganic	S	1	0	0
552	Inorganic	S	1	0	0
553	Inorganic	S	1	0	0
554	Inorganic	S	1	0	0
556	Inorganic	S	1	0	0