GW - 32

REPORTS

YEAR(S):

DYE TRACE STUDY

DYE TRACE STUDY 2006

GIANT REFINING

CINIZA REFINERY

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SUBMITTED BY: TRIHYDRO CORPORATION

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1.0 INTRODUCTION

Trihydro Corporation (Trihydro) was contracted by Giant Refining (Giant) to conduct a dye trace study to determine whether any cross-connections exist between the process sewer and stormwater sewer systems at the Giant Ciniza Refinery, located approximately 17 miles east of Gallup, New Mexico. Trihydro was also contracted by Giant to identify locations where non-stormwater flow could inadvertently enter what Giant intends to use in the future as a stormwater sewer/non-process water sewer. These tasks were completed by Trihydro during the last two weeks of April 2006. It is important to note that process sewer flows were unusually low during this time, as the Refinery was undergoing turnaround and construction activities. Therefore, in some cases, water from the Refinery's water supply wells was used to facilitate the dye trace study.

Recently, Giant made some changes at the Refinery to manage its wastewater flows. There are effectively two wastewater sewer systems at the Refinery, a stormwater/non-process wastewater sewer system to manage stormflows and smaller incidental non-process wastewaters and a process wastewater sewer system intended to handle process wastewater from the Refinery. The stormwater/non-process wastewater sewer system was installed in 1997. It consists of 78 drains located throughout the Refinery and routes stormwater/non-process wastewater to the old API separator (OAPIS). The OAPIS currently serves as a stormwater/non-process wastewater collection tank. The process wastewater system dates back to 1957 and routes process water from throughout the Refinery to the new API separator (NAPIS). Until October 2004, the stormwater/non-process wastewater sewer and process sewer systems drained to a single API separator. In October 2004, Giant routed the process sewer to the NAPIS while the stormwater/non-process wastewater sewer system remained routed to the OAPIS.

Because hydrocarbon was observed in the OAPIS during a visit by the New Mexico Environmental Department (NMED) in September 2005, it was mutually agreed by the NMED and Giant, in March 2006, to conduct a sewer dye trace study in order to identify any possible cross-connects between the process and storm sewer/non-process wastewater systems. The principal concern was that non-stormwater flow might be entering the storm sewer/non-process wastewater system through an underground, unknown cross connect. This report presents the findings and results of the study.

2.0 BACKGROUND

2.1 PROCESS AND STORM SEWER SYSTEM MAPPING

The main lines of the process sewer system were outlined using a series of unit-specific sewer schematics provided by Giant personnel. A schematic showing the main routes of the process sewer system and relative locations of process sewer junction boxes is included as Figure 1. The stormwater sewer system was also mapped using a series of stormwater sewer system schematics. The stormwater sewer system was superimposed onto a Ciniza Refinery Master Equipment Plot Plan and is included as Figure 2.

2.2 FLUORESCENT DYE

Bright Dyes were used in this dye trace study. Bright dyes are commonly used to detect leaks in sewage systems, trace water, and industrial effluents, and trace cross-connections between systems. The bright dye colors used in this study are certified NSF International to ANSI/NSF Standard 60 for drinking water.

Red, green/yellow, and orange colors of fluorescent dye were used in this dye trace study. According to the manufacturer, one pint of green/yellow dye color is strongly visible in 12,500 gallons of water and lightly visible in 125,000 gallons of water; one pint of red dye is strongly visible in 6,250 gallons of water and lightly visible in 62,500 gallons of water; and one pint of orange dye is strongly visible in 4,000 gallons of water and lightly visible in 40,000 gallons of water. Dye colors are also detectable at lower concentrations by ultra violet (UV) light.

During the Giant dye trace study, samples were examined both visually and with the aid of two hand held UV light sources. Samples that were collected were examined with a 365 nanometer UV light (the recommended wave length to detect concentrations of this dye type).

Trihydro and Giant personnel mutually decided to begin the dye trace study using the green/yellow dye color because it could be seen in the greatest amount of water. However, green/yellow, red, and orange dye colors were all used in the dye trace study.

2.3 SEWER SYSTEM HISTORY AND INSPECTION PROCEDURES

The Alkylation (Alky) sewer systems were repaired after a process unit fire in 2004. In 2005, two junction boxes, identified in Refinery records as A2 and A5, were removed from service (see Figure 1). Remaining junction boxes were also repaired to ensure that there were no leaks or cracks. In addition, new process sewer lines were installed between equipment drain hubs and the main process sewer line.

According to Refinery personnel, 20 percent of the process sewer is inspected each year in accordance with mandates from the Oil Conservation Division (OCD) of the NMED. The inspections are required to ensure that process water is not leaking into groundwater. The inspection consists of blocking in a portion of the process sewer, filling that portion with water, and then measuring and tracking the water level.

3.0 DYE TRACE STUDY

Prior to introducing dye, samples of the storm sewer and process sewer effluents were collected as reference samples and examined for coloration. The dye trace study was conducted by introducing dye into various locations along the process sewer and observing the storm sewer for traces of dye. If dye was detected in the storm sewer system, it would indicate that there was a cross-connect between the process sewer and storm sewer.

This section describes, in general, how the dye trace study was performed at various locations within the Refinery. A summary of daily activities, including a description of the samples collected, are detailed in Appendix A.

An initial walk through of the Refinery was conducted with the aid of Refinery personnel. The purpose of the walk through was to get a general idea of the locations and the condition of the storm sewer/non-process wastewater and process sewer system drains.

3.1 INITIAL DYE TRACE TEST OF ENTIRE SYSTEM

Based on observations made during the initial site walk, history of the sewer systems (e.g., the Alky sewer repairs), and the process sewer inspection requirements and procedures, it was decided to conduct an initial test for cross-connects by introducing dye into the process sewer system. To accomplish this, dye was introduced at locations that were the farthest points upstream in each branch of the process sewer. Subsequently, the stormwater sewer system manhole #17 (MH17) was then monitored for evidence of the dye. Stormwater sewer MH17 is the storm sewer end-of-line (EOL) test location for the purpose of this dye trace study. This location was chosen because it was the furthest location down stream in the storm sewer system and that stormwater could be tested before reaching the OAPIS. Figure 1 shows the locations where dye was introduced into the process sewer system.

The dye quantities for the initial test were selected under the assumption that there would be very little dilution because the Refinery was in turnaround during the on-site visit and sewer flow was minimal. Table 1 lists the date, time, location, amount, and color of dye introduced into the process sewer system for the initial dye trace test.

To ensure the dye was flowing through the process sewer system, the main process sewer junction boxes were examined and sampled. The junction box samples were positive for dye and confirmed the flow of dye through the system to the EOL. The NAPIS effluent was sampled to verify the dye had reached the process sewer EOL. However, it was not certain the dye had reached the process sewer EOL because it was unclear if these samples fluoresced under UV light. Because dye was confirmed to be flowing through the process sewer, a sample was collected from the storm sewer EOL location stormwater sewer MH17. Dye was not detected visually or with a UV light in the storm sewer EOL.

Because dye was not observed to have reached the process sewer EOL (NAPIS effluent), it was determined that the dilution ratio was significantly higher than originally assumed. Therefore, it was decided to reintroduce dye into the process sewer system using additional dye.

3.2 SECOND DYE TRACE TEST OF ENTIRE SYSTEM

The date, time, location, amount, and color of dye introduced into the process sewer system for the second test of the system are listed in Table 1. Junction boxes were sampled again to ensure the dye was flowing through the process sewer system. These samples were positive for dye indicating that dye was flowing through the system. The NAPIS effluent was observed to verify that dye had reached the process sewer EOL. A dark green plume was flowing from the NAPIS indicating that dye had reached the EOL.

Because it was certain that dye had reached the process sewer EOL, stormwater sewer MH17 was sampled and examined for dye. This sample did not visually appear to be green, but rather appeared to be orange. The stormwater sewer MH17 sample did not fluoresce green but had a green hue under UV light. Stormwater sewer MH17 was re-sampled a short time later. Theses samples did not have a green hue that was visually detected and did not have a green hue or fluoresce when the samples were examined with UV light. The OAPIS effluent and influent were sampled and examined for green dye. There was no indication of green dye visually or when the sample was examined with UV light.

Therefore, it was uncertain whether the green hue in the first stormwater sewer MH17 sample was actually due to green dye or an anomaly. Green was not detected down stream in the storm sewer system or in subsequent samples collected at stormwater sewer MH17. It is logical to assume and conclude that, if green dye was present in the stormwater system, it would have been detected downstream of stormwater sewer MH17 and in subsequent samples.

Regardless, it was decided that each unit would be examined in more detail. Because the Alky Unit underwent major renovations after a fire in 2004, it was suspected by the Refinery that a cross-connect may exist. Therefore, it was decided to begin dye trace testing at the Alky Unit.

3.3 ALKYLATION UNIT

Three dye trace tests were performed in the Alky Unit prior to conclusively eliminating the possibility of any cross-connections in this unit. The tests were performed more than once due to interference from green liquid in the storm sewer system. See Appendix A for details of each Alky dye trace test.

In order to conclusively eliminate a cross-connect in the Alky Unit, three bottles of red dye were used in the final test. Table 1 lists the date, time, location, amount, and color of dye introduced into the Alky process sewer system on April 27, 2006. Water hoses were used to aid in stormwater sewer system flow. Dye was verified to be flowing through the process sewer system and out of the Alky unit by observing flow through junction boxes.

Flow rates were determined to be adequate in the storm sewer system. Storm sewer MH13 and MH4 were sampled and examined for red dye. Green oil was observed in MH4 and was believed to be slurry from the FCCU (the adjacent unit). There should not have been interference in this test because red dye was used. Dye was not detected visually or when the samples were examined with UV light. It is believed that, combined with the amount of dye introduced to the system, if a cross-connect existed in the Alky Unit, red dye would be have been detected visually. Therefore, it is believed that there is not a cross-connect in the Alky unit.

3.4 TREATING UNIT

Orange dye was used to conduct a dye trace test in the Treating Unit. Table 1 lists the date, time, location, amount, and color of dye introduced into the system in the Treating Unit.

NAPIS samples were taken to verify that orange dye had reached the process sewer effluent. Orange dye was not detected visually. However, the NAPIS samples did fluoresce orange under UV light. Several stormwater sewer MH17 samples were collected and subsequently examined with UV light. Orange dye was not detected visually or when these samples were examined with UV light.

Because orange dye was not present in the stormwater sewer MH17 but was detected in NAPIS influent samples, it is believed that there is not a cross-connect between the process and storm sewers in the Treating Unit. It is also conclusive that there is a not a cross-connect between the process and stormwater sewer systems downstream of the units because the samples, that were clear of dye, were taken from EOL locations. Further, dye was introduced into the Treating Unit; the furthest unit down stream in the process sewer system.

3.5 ISOMERIZATION AND NAPHTHA HYDROTREATING UNITS

Red dye was used to test for cross-connects between the process sewer system and storm sewer system in the Isomerization Unit (Isom). Table 1 lists the date, time, location, amount, and color of dye introduced into the system for this unit.

The process and storm sewer EOL locations, NAPIS influent, and stormwater sewer MH17 were observed for the presence of red dye. Red dye was not detected in the NAPIS influent nor stormwater sewer MH17 samples. Because dye was not detected in the EOL samples, it needed to be verified that dye was flowing through and out of the Isom. This was achieved by testing the process sewer drain hubs down stream of where dye was introduced. Red dye was present in subsequent drain hubs (drain hubs were checked because there are no junction boxes in the Isom). However, red dye was not detected in the Isom manhole (see Figure 1), the first location outside of the Isom. Because red dye was not detected in the NAPIS influent, stormwater sewer MH17, or Isom manhole, but was detected in subsequent drain hubs within the unit, it was determined that the flow from the Isom was not adequate to move dye through the unit. Therefore, additional dye was placed into the process sewer and water was introduced with a water hose.

When the Isom manhole was originally observed, green dye was present and could be seen visually. The residual green dye in the process sewer system was determined to be either from the Isom or Naphtha Hydrotreating (NHT) units introduced during previous tests. In this case, the NHT and Isom units could be tested at the same time (because the Isom had red dye in the system and the NHT had green dye). Therefore a water hose was also inserted into the process sewer in the NHT Unit.

After water hoses were placed in the NHT and Isom units, the Isom manhole was observed continuously. Flow, from both the Isom and NHT units, with a heavy green dye concentration was observed in the Isom manhole. Because it was clear that green dye was flowing from the Isom and NHT units, it is believed the observed dye was residual dye from previous tests. After approximately 30 minutes, red dye from the Isom unit was observed in the Isom manhole. Therefore, it was confirmed that dye was flowing from the Isom and NHT units.

The NAPIS influent was sampled to verify that dye was reaching the process sewer EOL. When it was confirmed, the stormwater sewer MH17 was sampled. Dye was not observed visually or when the samples were examined with UV light. Because no red or green dyes were observed in the stormwater sewer MH17, but dye was detected in NAPIS influent sample, it is believed that there is not a cross-connect between the process and storm sewers in the Isom or NHT units.

3.6 FLUID CATALYTIC CRACKING UNIT (FCCU)

Red dye was used to test for cross-connects between the process sewer system and storm sewer system in the FCCU. Table 1 lists the date, time, location, amount, and color of dye introduced into the system for this unit. Dye was verified to be flowing through the process sewer system and out of the FCCU by observing the flow through junction boxes.

Because it was verified that dye was flowing through the system, stormwater sewer MH17 was sampled. Dye was not detected visually or when the stormwater sewer MH17 sample was examined with UV light. Because red dye was not observed in stormwater sewer MH17, but was observed in the process sewer effluent of the FCCU, it is believed that there is not a cross-connect between the process and storm sewers in the FCCU.

3.7 GAS CONCENTRATION (GAS CON) UNIT

Red dye was used to test for cross-connects between the process sewer system and storm sewer system in the Gas Con Unit. Table 1 lists the date, time, location, amount, and color of dye introduced into the system for this unit. Dye was verified to be flowing through the process sewer system and out of the Gas Con Unit by observing the flow through junction boxes.

Stormwater sewer MH17 was observed for approximately 30 minutes after dye was introduced into the Gas Con unit. Red dye was not observed visually or when samples were examined with UV light. Therefore, it is believed that there is not a cross-connect between the process and storm sewer systems in the Gas Con Unit.

3.8 CRUDE UNIT

Green dye was initially used to perform the dye trace test in the Crude Unit. However, it is believed that green liquid in the storm sewer system interfered with conclusively eliminating the possibility of a cross-connect in this unit. Therefore, a subsequent test using red dye was performed. The activities of the first test are summarized in Appendix A.

Due to the results of the first Crude Unit dye trace test, we believe that there was interference with the test sample by either green coolant, green gas oil, or green antifreeze because we were unable to create the same green hue observed in previous samples with control samples. A control sample was created using clean water and just enough dye such that green dye was still barely visible. This sample still fluoresced brightly when it was examined with the UV light. Then, the sample was diluted to a point where the green dye was not visible. The control sample still fluoresced when it was examined with UV light. It is also important to note that a bright green liquid was observed near process sewer drains in the Crude unit. However, this liquid did not produce any fluorescence when observed with ultra violet light. Thus, because we could not match the color and the green liquid observed on the ground did not fluoresce, we are confident that there was interference with the green dye from other green liquid sources.

The date, time, location, amount, and color of dye introduced into the Crude process sewer system for both dye trace tests are listed in Table 1. Dye was verified to be flowing through the process sewer system and out of the Crude Unit by observing the flow through junction boxes.

Stormwater sewer manhole #6 (MH6) was examined and sampled three times for red dye. Red dye was not detected visibly or when the samples were examined with UV light. Two samples had a green hue. However, due to previous conclusions about interference with green dye, it is not believed that the green hue was caused by dye. In addition, the samples did not fluoresce green. Therefore, it is believed that there is not a cross-connect between the storm and process sewers in the Crude Unit.

3.9 PLATFORMER UNIT

Red dye was used to test for a cross-connect in the Platformer Unit. Red dye was selected to avoid any interference from the green liquid previously encountered in the sewer. Table 1 lists the date, time, location, amount, and color of dye introduced into the Platformer process sewer system. Water was introduced into the system with a water hose to ensure dye was flowing through and out of the Platformer Unit.

There are two branches of storm sewer system in the Platformer Unit (See Figure 2) that both flow to stormwater sewer MH6. Stormwater MH6 was observed for red dye. Water hoses were used to aid the storm sewer flow in each branch. The flow in the storm sewer system was verified to be adequate and three samples were collected from stormwater sewer MH6. Dye was not detected visually or when the samples were examined with UV light. Therefore, it is believed that there are no cross-connects in the Platformer Unit.

4.0 DYE TRACE STUDY CONCLUSIONS

Fluorescent dyes were used to determine if there were cross-connects between the process and stormwater sewers at the Refinery. Dye was placed in process sewer locations as far upstream as possible in each unit (see Figure 1). The storm sewer was then observed for dye at certain downstream locations. The storm sewer was observed at the EOL location stormwater sewer MH17 and other manholes located outside of individual process units. Water in the storm sewer was also examined at other manhole locations in order to detect dye before it became too diluted. If no feasible location was available, stormwater sewer MH17 was observed and sampled.

During the course of the dye trace study it was determined that there was interference with the green-colored dye that was being used. It was determined that green-colored antifreeze/coolant or gas oil was sometimes present in the storm sewer system. When it was unclear if there was a cross-connect the portion of the storm and process sewers were re-examined with a different color of dye in order to determine conclusively whether any cross-connections existed or did not exist.

No cross-connects were detected, using dye, between the process sewer and storm sewer systems at the Refinery. Therefore, based on this dye trace study, non-stormwater flow to the OAPIS is not due to sub-surface piping cross-connect(s) within the Refinery.

5.0 STORM SEWER DRAIN IMPROVEMENT STUDY

Trihydro was also asked to help determine where increased safeguards could be implemented to assure that only stormwater and non-process wastewater enters the respective drain system. This was initiated by mapping the stormwater/non-process wastewater sewer locations onto a Master Equipment Plot Plan. The Refinery's stormwater/non-process wastewater sewer drains were originally mapped on several different schematics. Therefore, to ensure all stormwater/non-process wastewater sewer drains were identified and documented, stormwater/non-process wastewater sewer system drains were mapped onto a Master Equipment Plot Plan and verified in the field during the on-site visit. During the on-site visit, each stormwater/non-process wastewater sewer drain was identified within the Refinery and the state of the drain was documented. Table 2 lists each stormwater/non-process wastewater drain, the unit in which it is located, the condition of the drain, and the recommendations for improvement.

Some stormwater/non-process wastewater sewer drains, identified during the on-site visit, need to be eliminated or further segregated from non-stormwater water flow potential. This segregation will help to assure that non-stormwater flow does not enter the storm sewer system (which is intended to receive only stormwater and non-process wastewater). Some drains had fresh oil stains while others were clean.

6.0 RECOMMENDATIONS

6.1 PROCESS SEWER / STORM SEWER CROSS-CONNECTS AND IMPROVEMENTS RECOMMENDED

Because this study did not find cross-connects between the storm and process sewer systems, recommendations to rectify cross-connects are not needed. However there are some recommendations for the stormwater sewer drains. Each stormwater sewer drain (and some process sewer drains) was inspected during the on-site visit to conduct the dye trace study.

Based on observations, it is recommended that a cup or lip be installed on some storm sewer drains. Recommendations for storm sewer drains are listed in Table 2. A cup or lip will help prevent non-stormwater flow from entering an adjacent storm sewer drain. This will also aid in keeping spills from flowing into storm sewer drains that are located below grade of the process sewer drain. In all cases, proper draining procedures will need to be followed. Failure to implement proper procedures to prevent non-stormwater flow from entering the storm sewer can result in hydrocarbon and other non-storm water entering any downstream stormwater collection system.

It is recommended that proper draining procedures include, but not be limited to, routing non-stormwater flow or other fluids through a hose or other device to a proper process sewer drain and prevent the fluids from flowing to a storm sewer drain. Proper draining procedures also include routing non-stormwater flow to a process sewer drain at a rate such that the process sewer drain does not become overwhelmed, resulting in a spill that may flow to a storm sewer drain. Proper draining procedures should be followed when draining all types of equipment

6.2 STORM SEWER DRAIN SYSTEM IMPROVEMENTS

Because no sub-surface piping cross-connects were found as a result of the dye trace study, non-stormwater flow to the OAPIS can be eliminated, with the exception of some non-contact cooling water and heat exchanger back-flush water, with improved equipment draining procedures. The storm sewer drains were mapped onto the Ciniza Master Equipment Plot Plan (Figure 2) and field verified in order to identify locations where inadvertent non-stormwater flow may enter the stormwater sewer system. During the field verification of the storm sewer drains, drain conditions were noted and are included in Table 2. Table 2 lists the identification number that corresponds to Figure 2, the unit in which the storm drain is located, the condition of the storm drain, and the recommendations for each storm drain location.

Recommendations include permanently plugging some storm drains, periodic cleaning of storm drains, and rerouting non-stormwater flow. Some storm sewer drains listed in Table 2 are in unsuitable locations. In these cases, it is our recommendation that these storm sewer locations be permanently plugged.

Some stormwater sewer drains, identified during the on-site visit, need to be more effectively isolated from non-stormwater flow and contaminated runoff. These drains are listed in Table 2.

Drains with fresh oil stains will need to be cleaned to prevent hydrocarbon from entering the storm sewer during rain events. In all cases, however, proper draining procedures need to be followed.

TABLES

Table 1: Dye Trace Study Dye Drop Locations
Ciniza Refinery, Giant Refining, Gallup, New Mexico

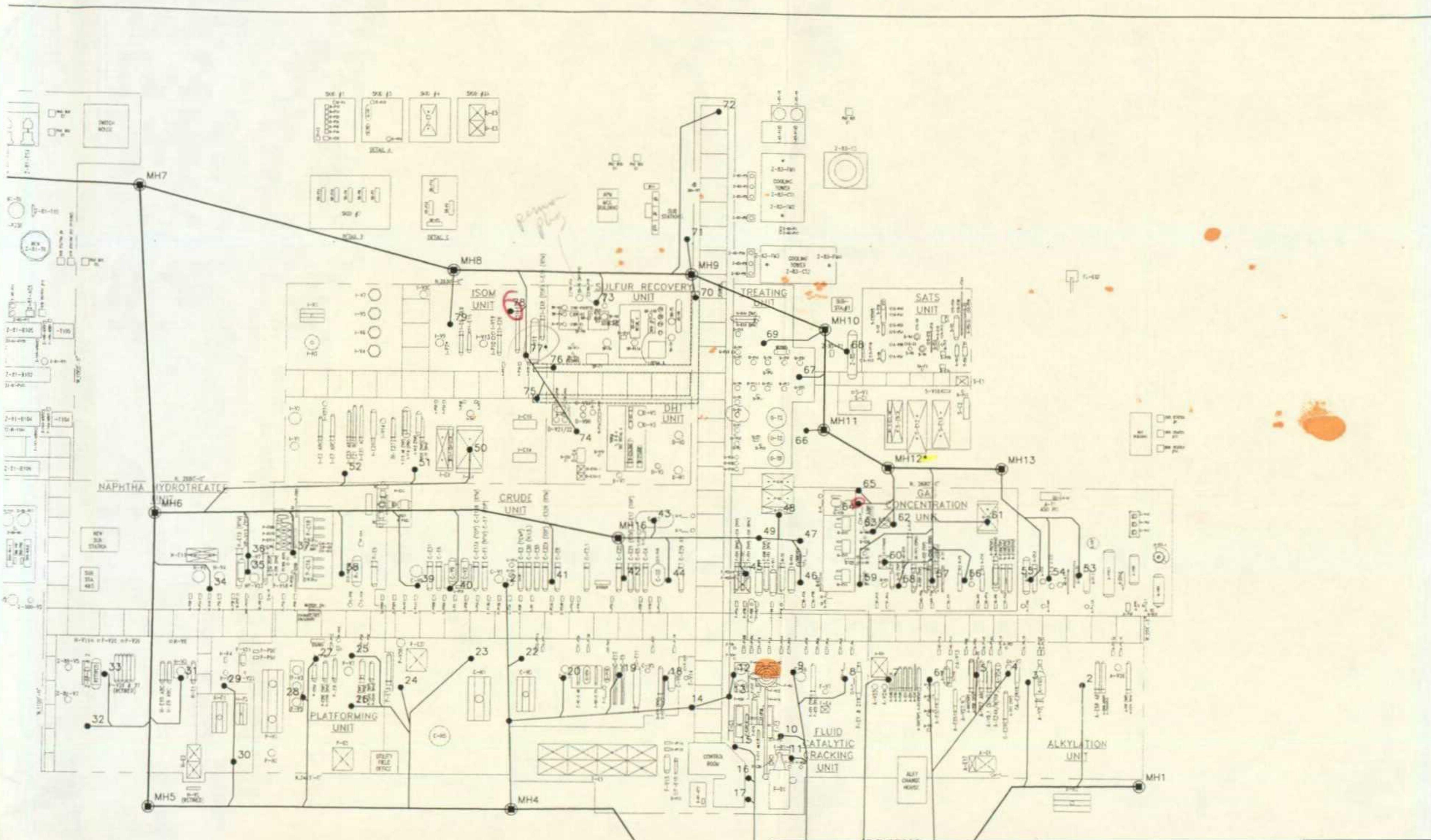
Unit	Time	Locations	Amount of dye	Dye Color	Duration of water flush
April 18, 2006					
Alkylation	1355	Sewer hub near AE44 that flows to process sewer junction box A1	3 ounces	Green	1-2 minutes with water hose
FCCU	1343	Sewer hub near F-P4 sewer bell (LCO Pump) that flows to sewer box F1	2 ounces	Green	1-2 minutes with water hose
NHT	1355	Sewer hub near H-V3 Reactor near sewer box P8.	2 ounces	Green	Constant flow from a process drain
Gas Con	1400	Sewer bell off of the G-P6 pump base that flows to sewer box G1	2 ounces	Green	1-2 minutes with water hose
Treaters	1410	Sewer bell just east of PSV-26 that flows to sewer box Q1	2 ounces	Green	Constant flow from a process drain
April 19, 2006					
Alkylation	0932	Sewer hub near AE44 that flows to sewer box A1	8 ounces	Green	1-2 minutes with water hose
FCCU	0933	Sewer hub near F-P4 sewer bell (LCO Pump) that flows to sewer box F1	8 ounces	Green	1-2 minutes with water hose
Gas Con	0938	Sewer bell off of the G-P6 pump base that flows to sewer box G1	8 ounces	Green	1-2 minutes with water hose
NHT	0944	Junction box near Reactor HV3 that flows to sewer junction box P6	8 ounces	Green	Flow was already present in box
Platformer	0947	Sewer hub near P5A Stabilizer Reflux Pump that flows to junction box P4	8 ounces	Green	1-2 minutes with water hose
Isom	0958	Sewer near profac bottoms (IV11) and isomerate sample station	8 ounces	Green	1-2 minutes with water hose
Treaters	1000	Sewer bell just east of PSV-26 that flows to sewer box Q1	6 ounces	Green	Constant flow from a process drain
April 20, 2006					
Alkylation	0826	A-V24 sewer drain hub that flows to process sewer junction box A1	8 ounces	Red	1-2 minutes with water hose
Alkylation	0827	Sewer hub near AE44 that flows to process sewer junction box A1	8 ounces	Red	1-2 minutes with water hose
Treating	1442	Drain near PSV-26 with effl. from Straight Run Water Wash column (via hose)	16 ounces	Orange	Cont. flow from SR Waster Wash
Treating	1525	Drain near PSV-26 with effl. from Straight Run Water Wash column (via hose)	48 ounces	Orange	Cont. flow from SR Waster Wash
April 21, 2006					
Isom	0757	Process sewer drain located near the Prefac Overhead Accumulator (IV6)	32 ounces	Red	Intermittent flow with water hose
FCC	1538	Process sewer drain hub located for F-P4 LCO Pump	16 ounces	Red	Constant flow from a process drain
April 24, 2006					
Alkylation	0843	Sewer hub near AE44 that flows to process sewer junction box A1	32 ounces	Green	Constant flow from water hose
April 25, 2006					
Alkylation	0811	Sewer hub near AE44 that flows to process sewer junction box A1	8 ounces	Green	Constant flow from water hose
Gas Con	1438	Process sewer drain hub near G-P6	16 ounces	Red	Constant flow from water hose

Table 1: Dye Trace Study Dye Drop Locations
Ciniza Refinery, Giant Refining, Gallup, New Mexico

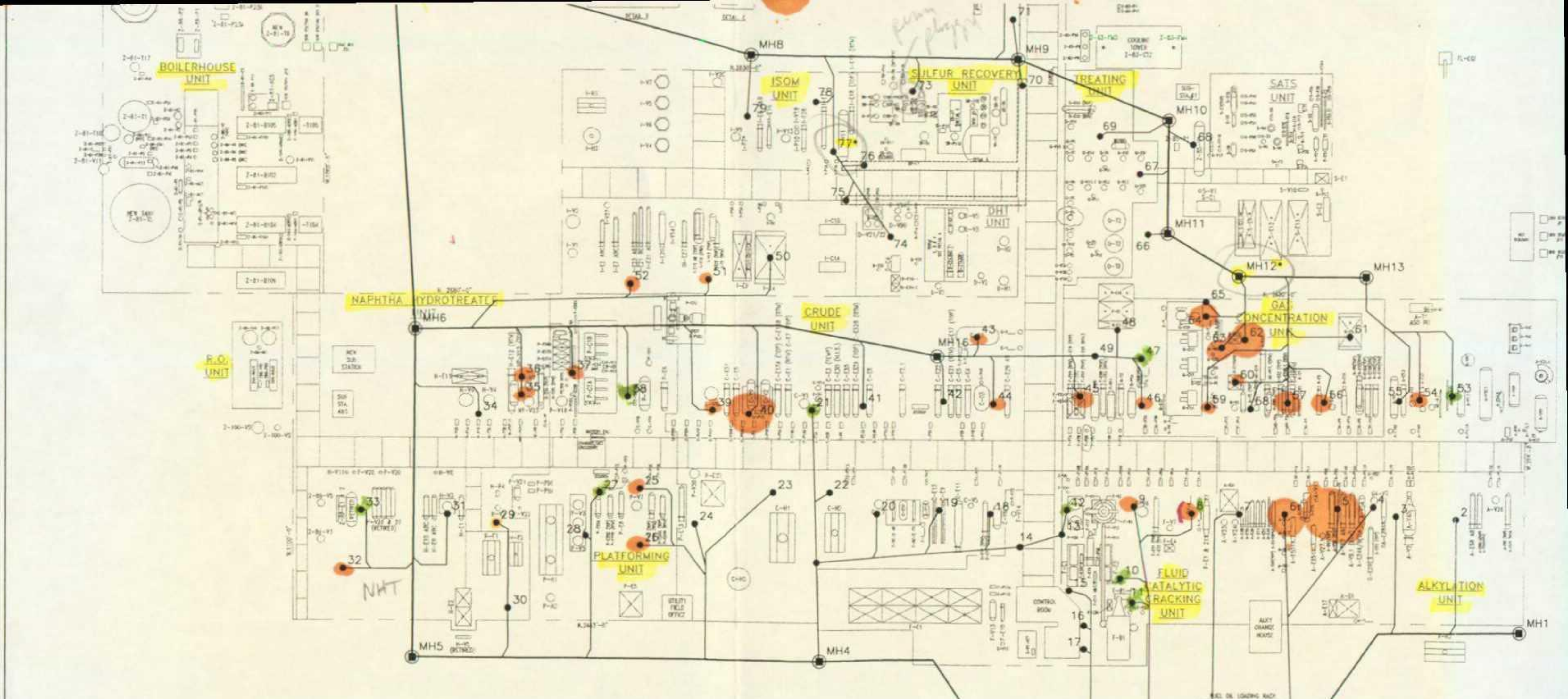
Unit	Time	Locations	Amount of dye	Dye Color	Duration of water flush
April 26, 2006					
Crude	1140	Process sewer pump drain hub for CP41B	16 ounces	Green	Constant flow from water hose
Crude	1532	Process sewer pump drain hub for CP41B	32 ounces	Red	Constant flow from water hose
April 27, 2006					
Alkylation	0858	Sewer hub near AE44 that flows to process sewer junction box A1	48 ounces	Red	Constant flow from water hose
Platformer	1452	Process sewer drain hub P-P2B located near the Reactor Charge Pump	32 ounces	Red	Constant flow from water hose

Table 2: Storm Sewer Drain Locations, Conditions, and Recommendations
Ciniza Refinery, Giant Refining, Gallup, New Mexico

Storm Sewer ID #	Process Unit	Description	Recommendation
1	NA	Storm sewer manhole	Repaint storm sewer grate green
2	Alky	Storm sewer drain is located adjacent to junction box; no oil residue present	Repaint storm sewer grate green; ensure proper draining procedures are followed
3	Alky	Storm sewer drain is located adjacent to junction box; observed steam condensate flow to storm sewer drain	Assure non-stormwater flow drains to process sewer; repaint storm sewer grate green; ensure proper draining procedures are followed
4	Alky	Storm sewer grate has old oil residue	Clean oil residue; repaint storm sewer grate green; ensure proper draining procedures are followed
5	Alky	Storm sewer grate has fresh oil residue; located near plugged process sewer drain	Unplug process sewer drain if possible; clean oil residue; repaint storm sewer grate green; ensure proper draining procedures are followed
6	Alky	Storm sewer grate has fresh oil residue; not located near process drain	Clean oil residue; repaint green; ensure proper draining procedures are followed
7	Alky	Storm sewer grate is clean; no oil residue	No corrective action is required
8	FCCU	Significant and recurrent risk of cross-contamination; storm sewer grate is located adjacent to process sewer drain; observed a lot of oil nearby	Permanently plug stormwater sewer drain
9	FCCU	Storm sewer has fresh oil residue	Clean oil residue; repaint storm sewer grate green; ensure proper draining procedures are followed
10	FCCU	Significant risk of cross-contamination; storm sewer grate is located adjacent to process drain	Install a lip on storm sewer drain; ensure proper draining procedures are followed
11	FCCU	Significant risk of cross-contamination; storm sewer drain is located near process sewer drain; non-contact cooling water is routed to storm sewer drain	Assure non-stormwater flow are connected to process sewer drain hub; unplug process sewer drain; ensure proper draining procedures are followed
12	FCCU	Significant and recurrent risk of cross-contamination; located directly under equipment; covered with oil residue; observed fresh oil residue	Permanently plug stormwater sewer drain
13	FCCU	Storm sewer grate is clean; no oil residue	No corrective action is required
14	FCCU	Storm sewer grate is clean; no oil residue	No corrective action is required
15	FCCU	Storm sewer grate is clean; no oil residue	No corrective action is required
16	FCCU	Storm sewer grate is clean; no oil residue	No corrective action is required
17	FCCU	Storm sewer grate is clean; no oil residue	No corrective action is required
18	Crude	Storm sewer grate is clean; no oil residue	No corrective action is required
19	Crude	Storm sewer grate is clean; no oil residue	No corrective action is required
20	Crude	Storm sewer grate is clean; no oil residue	No corrective action is required



MH1
MH4
MH5
MH6
MH7
MH8
MH9
MH10
MH11
MH12
MH13
MH16
ISOM UNIT
SULFUR RECOVERY UNIT
TREATING UNIT
SATS UNIT
DHT UNIT
CRUDE UNIT
NAPHTHA HYDROTREATER UNIT
GAS CONCENTRATION UNIT
PLATFORMING UNIT
FLUID CATALYTIC CRACKING UNIT
ALKYLATION UNIT



NOTE:

1. * INDICATES ITEM NOT FOUND IN FIELD SURVEY
2. SEWER MANHOLE, DRAIN, AND PIPING LOCATIONS ARE APPROXIMATE

NHT Naphtha Hydrotreat Unit

oil show
X contamy

EXPLANATION

- MH5 STORM SEWER MANHOLE AND DESIGNATION (15)
- 33 STORM SEWER DRAIN AND DESIGNATION (78)
- STORM SEWER PRIMARY PIPING RUN (14)
- STORM SEWER SECONDARY PIPING RUN (70)
- DRAIN GRATE SYSTEM

N

0 80'

A	6/2/06	ISSUE FOR CLIENT REVIEW	DJR	RA
Rev.	Date	Description	By	Chk'd
		REVISIONS		

Drawn By: DJR | Checked By: RA | Scale: 1" = 80' | Date: 6/16/06 | File: 072STORM

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STORMWA

GI

Table 2: Storm Sewer Drain Locations, Conditions, and Recommendations
Ciniza Refinery, Giant Refining, Gallup, New Mexico

Storm Sewer ID #	Process Unit	Description	Recommendation
21	Crude	Significant risk of cross-contamination; storm sewer located adjacent to process sewer drain; storm sewer drain below process sewer in grade	Repaint storm sewer green; ensure proper draining procedures are followed; install lip on storm sewer; assure non-stormwater flow drains to process sewer drain
22	Crude	Storm sewer grates is clean; no oil residue	Repaint storm sewer grate green
23	Crude	Storm sewer grates is clean; no oil residue	Repaint storm sewer grate green
24	Crude	Storm sewer grates is clean; no oil residue	Repaint storm sewer grate green
25	Platformer	Storm sewer drain has oil residue; observed steam condensate flow to storm sewer drain; process drain located adjacent to storm sewer drain; storm drain below process sewer in grade	Ensure condensate is routed to process drain; clean oil residue; repaint storm sewer drain green
26	Platformer	Storm sewer drain has old oil residue; observed steam condensate flow to storm sewer drain	Ensure condensate is routed to process drain; clean oil residue; repaint storm sewer drain green
27	Platformer	Significant risk of cross-contamination; storm sewer drain is below process sewer grade; process sewer drain adjacent to storm sewer drain	Install lip on storm sewer drain; assure process drains are connected to process sewer drain hub; ensure proper draining procedures are followed; unplug process sewer drain; repaint storm sewer drain green;
28	Platformer	Storm sewer grate is clean; storm sewer drain is located adjacent to process sewer drain	Ensure proper draining procedures are followed
29	NHT	Observed old oil residue nearby storm sewer grate	Clean oil residue; ensure proper draining procedures are followed
30	NHT	Location of new storm sewer drain; storm sewer grate is clean but old oil residue nearby	Clean oil residue; ensure proper draining procedures are followed
31	NHT	Storm sewer grate is clean; storm sewer located adjacent to process sewer drain; process sewer drain is plugged	Unplug process sewer drain if possible; ensure proper draining procedures are followed
32	NHT	Storm sewer drain located adjacent to junction box; storm sewer grate has old oil residue	Clean oil residue; repaint storm sewer grate green; ensure proper draining procedures are followed
33	NHT	Significant risk of cross-contamination; storm sewer is located adjacent to a process sewer drain with a lip	Install lip on storm sewer drain or permanently plug storm sewe drain; ensure proper draining procedures are followed
34	NHT	Storm sewer grate is rusty; no oil residue present; no process drain nearby	Repaint storm sewer green; ensure proper draining procedures are followed
35	NHT	Observed some oil residue near storm sewer drain; storm sewer drain located near process drain	Clean oil residue; ensure proper draining procedures are followed

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Ciniza Refinery, Giant Refining, Gallup, New Mexico

Storm Sewer ID #	Process Unit	Description	Recommendation
36	NHT	Observed some oil residue near storm sewer drain; storm sewer drain located near process drain	Clean oil residue; ensure proper draining procedures are followed
37	Platformer	Significant risk of cross-contamination; observed fresh oil residue on stormwater sewer grate; observed steam condensate flow to storm sewer drain	Assure non-stormwater drains to process sewer; install lip on storm sewer drain; clean oil residue; ensure proper draining procedures are followed
38	Platformer	Significant risk of cross-contamination; process drain located adjacent to stormwater drain; process sewer has lip; process sewer drain appears to be plugged	Unplug process sewer drain; install lip on storm sewer drain; ensure proper draining procedures are followed
39	Crude	Storm sewer grate has fresh oil residue; storm sewer drain is located nearby process sewer drain; process sewer drain appeared to be plugged	Unplug process sewer drain; clean oil residue; ensure proper draining procedures are followed
40	Crude	Storm sewer grate has fresh oil residue	Clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed
41	Crude	Storm sewer drain is clean; no oil residue	No corrective action is required
42	Crude	Storm sewer drain is clean; no oil residue	Repaint storm sewer grate green
43	Crude	Storm sewer grate has oil residue; storm sewer drain is located adjacent to process sewer drain with a lip; storm sewer drain is below process sewer in grade	Clean oil residue; repaint storm sewer green; ensure proper draining procedures are followed
44	Crude	Storm sewer drain has fresh oil residue; storm sewer drain is located adjacent to process sewer drain with a lip; storm sewer drain is below process sewer drain in grade	Clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed
45	Gas Con	Storm sewer drain has fresh oil residue; storm sewer drain is located near recent spill	Clean oil residue; ensure proper draining procedures are followed
46	Gas Con	Storm sewer drain is located near a process sewer drain; observed oil residue that may have been the result of drain overflow	Clean oil residue; ensure proper draining procedures are followed
47	Gas Con	Significant and recurrent risk of cross-contamination	Permanently plug stormwater sewer drain
48	Gas Con	Location of new storm sewer drain; clean; no oil residue is present	No corrective action is required
49	Gas Con	Location of new storm sewer drain; clean; no oil residue is present	No corrective action is required
50	Isom	Storm sewer drain is clean; no oil residue	No corrective action is required
51	Isom	Storm sewer grate has old oil residue	Clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed

Table 2: Storm Sewer Drain Locations, Conditions, and Recommendations
Ciniza Refinery, Giant Refining, Gallup, New Mexico

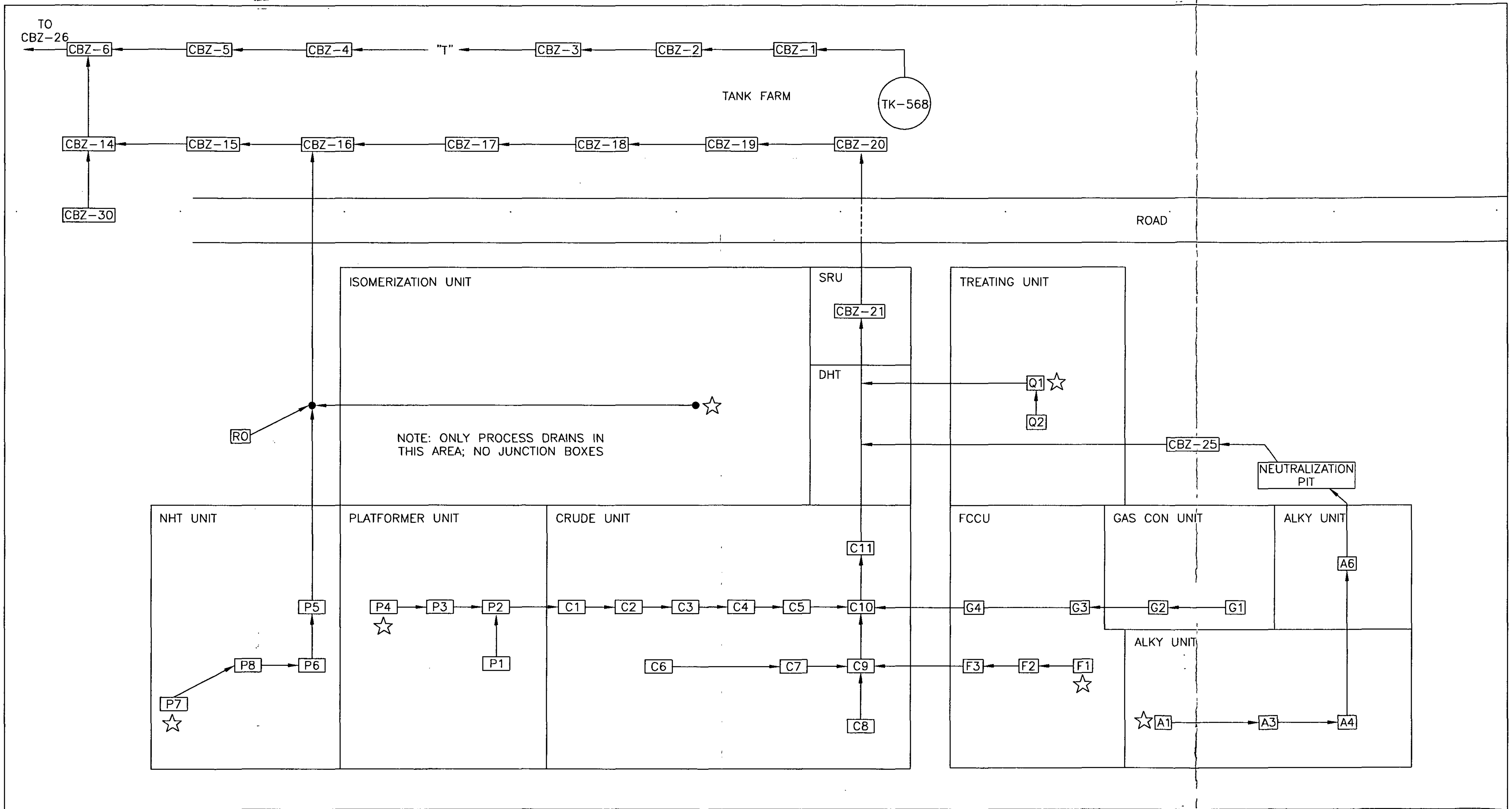
Storm Sewer ID #	Process Unit	Description	Recommendation
52	Isom	Storm sewer grate has old oil residue	Clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed
53	Alky	Significant risk of cross-contamination; observed fresh oil residue near storm sewer drain; storm sewer drain located near process sewer drain	install lip on storm sewer drain; clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed
54	Alky	Storm sewer grate has old oil residue	install lip on storm sewer drain; clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed
55	Alky	Dirty but no evidence of oil residue	Repaint storm sewer grate green
56	Gas Con	Significant risk of cross-contamination; storm sewer drain located near a process sewer drain; observed heavy oil residue on storm sewer drain	Install lip on storm sewer drain; clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed
57	Gas Con	Storm sewer grate has fresh oil residue	Clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed
58	Gas Con	Storm sewer drain is located adjacent to plugged process sewer drain	Unplug process sewer drain, if possible and install lip on storm sewer drain; otherwise permanently plug storm sewer drain
59	Gas Con	Storm sewer grate has old oil residue	Clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed
60	Gas Con	Storm sewer grate has old oil residue	Clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed
61	Gas Con	Storm sewer grate is clean; no oil residue	No corrective action is required
62	Gas Con	Storm sewer grate has oil residue	Clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed
63	Gas Con	Storm sewer grate has fresh oil residue	Clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed

Table 2: Storm Sewer Drain Locations, Conditions, and Recommendations
Ciniza Refinery, Giant Refining, Gallup, New Mexico

Storm Sewer ID #	Process Unit	Description	Recommendation
64	Gas Con	Significant and recurrent risk of cross-contamination; observed fresh oil residue	Consider permanently plugging storm sewer drain; otherwise clean oil residue; ensure proper draining procedures are followed
65	Gas Con	Storm sewer grate is clean; no oil residue	Repaint storm sewer grate green
66	Treating Unit	Storm sewer grate is clean; no oil residue	No corrective action is required
67	Treating Unit	Storm sewer grate is clean; no oil residue	No corrective action is required
68	Treating Unit	Storm sewer grate is clean; no oil residue	Repaint storm sewer grate green
69	Treating Unit	Storm sewer grate is clean; no oil residue	Repaint storm sewer grate green
70	SRU	Location of new storm drain; located in the north end of north-south drain grate system; no oil residue	Paint drain grate system green; ensure proper draining procedures are followed
71	Walkway	Storm sewer grate is clean; no oil residue	Repaint storm sewer grate green
72	Walkway	Storm sewer grate is clean; no oil residue	Repaint storm sewer grate green
73	SRU	Storm sewer drain is permanently plugged	No corrective action is required
74	DHT	Newly constructed storm drain	Paint storm sewer grate green
75	Isom	Storm sewer drain is located in the west end south drain grate system	Paint drain grate system green; ensure proper draining procedures are followed
76	SRU	Location of new storm drain; storm sewer drain is located in the west end of north grate system	Paint drain grate system green; ensure proper draining procedures are followed
77	Isom	Appears to be hole in concrete; unable to verify stormwater sewer drain location	Permanently plug hole in concrete
78	Isom	Risk of cross-contamination; storm sewer drain has old oil residue	Install a lip on storm sewer drain; clean oil residue; repaint storm sewer drain green; ensure proper draining procedures are followed
79	Isom	Storm sewer drain is muddy; no oil residue	Repaint storm sewer drain green; ensure proper draining procedures are followed

FIGURES

Trihydro



EXPLANATION

SRU = SULFUR RECOVERY UNIT
DHT = DIESEL HYDROTREATING UNIT
NHT = NAPHTHA HYDROTREATING UNIT
FCCU = FLUID CATALYTIC CRACKING UNIT
GAS CON = GAS CONCENTRATION UNIT
ALKY = ALKYLATION UNIT
RO = REVERSE OSMOSIS AREA
ISOM = ISOMERIZATION

← FLOW LINE
● ISOM MANHOLE
☆ DYE PLACEMENT LOCATION

N

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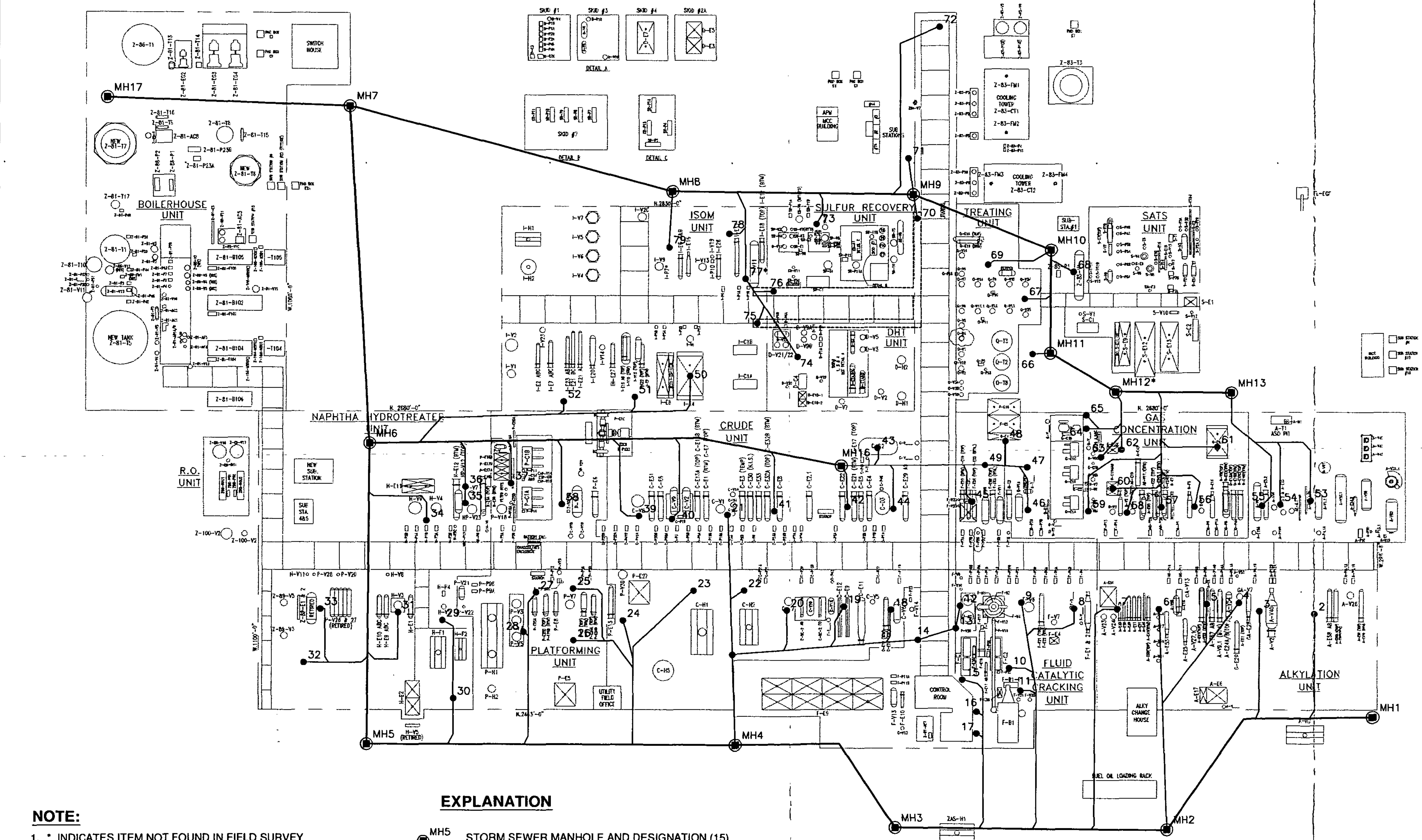
FIGURE 1

PROCESS WASTEWATER SEWER 2006

**GIANT REFINING COMPANY,
CINIZA REFINERY,
GALLUP, NEW MEXICO**

Drawn By: REP	Checked By: RA	Scale: NONE	Date: 6/16/06	File: 072SEWFLO_2006



NOTE:

1. * INDICATES ITEM NOT FOUND IN FIELD SURVEY
2. SEWER MANHOLE, DRAIN, AND PIPING LOCATIONS ARE APPROXIMATE

EXPLANATION

MH5	STORM SEWER MANHOLE AND DESIGNATION (15)
33	STORM SEWER DRAIN AND DESIGNATION (78)
(heavy line)	STORM SEWER PRIMARY PIPING RUN (14)
(thin line)	STORM SEWER SECONDARY PIPING RUN (70)
(dashed line)	DRAIN GRATE SYSTEM

0 80'

Rev.	Date	Description	By	Chk'd
A	6/2/06	ISSUE FOR CLIENT REVIEW	DJR	RA

REVISIONS

Drawn By: DJR | Checked By: RA | Scale: 1" = 80' | Date: 6/16/06

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FIGURE 2

STORMWATER / NON-PROCESS WASTEWATER SEWER SYSTEM 2006

GIANT REFINING COMPANY, CINIZA REFINERY, GALLUP, NEW MEXICO

File: 072STORMSEWER | Rev: A

APPENDIX A

DYE TRACE STUDY DETAILS

April 18, 2006 Activities

Initial Dye Trace Test of Entire System

The dye quantities for the initial test were selected under the assumption that there would be very little dilution because the Refinery was in turnaround during the on-site visit; thus, sewer flow would be minimal. On the low flow sewers, approximately 2 ounces (oz) of dye was used; however, because the Alkylation (Alky) process sewer is routed through the neutralization box approximately 3 oz was introduced upstream in the process sewer. Table 1 lists the date, time, location, amount, and color of dye introduced into the process sewer system.

The Gas Concentration (Gas Con), Fluid Catalytic Cracking Unit (FCCU), Crude, and Platformer Unit process sewers join together at junction box C10 (see Figure 1). Junction box C10 was observed for green dye beginning at approximately 1440. Dye was not detected visually in this junction box. A sample was collected at this time and examined with UV light. The sample had a light green fluorescence. Therefore it was confirmed that the dye was flowing through the process sewer.

Since the dye was confirmed to be flowing through the process sewer a sample was taken from stormwater sewer MH17 at approximately 1540. Dye was not detected visually or with UV light in this sample.

In order to ensure that the dye had reached to the end of the process sewer system a sample of the new API separator (NAPIS) effluent was taken at approximately 1555. Dye was not detected visually in this sample. However, the sample did fluoresce lightly when it was examined with UV light. Therefore, it was confirmed that the dye had reached the end of the process sewer system.

For completeness, a sample of the old API separator (OAPIS) water was taken at approximately 1600. Dye could not be confirmed in this sample because it was too cloudy.

A sample of the NAPIS influent was taken at 1620. This sample contained hydrocarbon that interfered with visual observations because the hydrocarbon fluoresced white when the sample was examined with UV light. Thus we were unable to determine if dye was present in this sample. The sample was left to separate overnight. The sample was observed on the morning of April 19, 2006 but the sample still had not separated.

After April 18, 2006 activities, green dye was never definitively detected. It was determined that the dye could not be definitively detected because the dilution ratio was significantly higher than originally thought. It was decided to reintroduce the dye into the entire process sewer system on April 19, 2006 using approximately 8 oz of dye at each of the dye introduction locations.

April 19, 2006 Activities

Second Dye Trace Test of Entire System

A sample of stormwater sewer MH17 was taken, prior to the introduction of dye into the process sewer, for a reference sample. Dye was not detected visually or with UV light. Therefore, it was determined that the stormwater sewer system was free of dye. Table 1 lists the date, time, location, amount, and color of dye introduced into the process sewer system on April 19, 2006. Dye was introduced into the process sewer at the farthest upstream locations as possible in each branch of the sewer system.

Junction box C-2, (see Figure 1), was observed for dye at approximately 1045 to verify the dye was flowing through the process sewer. There was a strong presence of green dye, visually, in junction box C-2. Therefore dye was confirmed to be flowing through the process sewer.

Stormwater sewer MH17 was sampled at approximately 1110. The sample was murky and it was difficult to determine, visually or with the aid of UV light, if green dye was present. The sample was filtered in order to obtain a clearer sample. The sample had a light green hue under the UV light indicating dye may be present in this sample. However, the sample did not visually appear to be green but orange and did not fluoresce green. Thus it remained unclear, at this time, if a cross-connect between the storm sewer system and process sewer system existed.

To ensure the green dye had reached the end of the process sewer system the aeration ponds were observed at approximately 1100. There was a highly visible dark green plume flowing into the pond (outlet of the NAPIS). This stream was sampled and examined with UV light. The sample had a bright green fluorescence under UV light indicting a strong presence of green dye.

The OAPIS effluent was sampled at 1125 and examined for green dye. There was no indication of green dye visually or when the sample was examined with UV light. Stormwater sewer MH17 was sampled again at 1417. This sample was cloudy and subsequently filtered. Dye was not detected visually or with the aid of UV light in the filtered sample. The OAPIS inlet was sampled at 1435.

Dye was not detected visually or with the aid of UV light. The OAPIS effluent was sampled again at 1442; and again no dye was detected visually or with the aid of UV light. Therefore, it remained unclear if the green huet in the stormwater sewer MH17 sample taken at 1110 was green dye or interference because green was not detected down stream in the storm sewer system or in subsequent samples of stormwater sewer MH17. If green dye was in the stormwater system, it would have been detected downstream of stormwater sewer MH17 and in subsequent samples.

Because it was still unclear if a cross-connect existed between the sewer systems, it was decided that each unit would be examined in more detail. Because the Alky Unit underwent major renovations (due to a fire) in 2004 it is believed that this area is most likely to have a cross-connect, if there is one. Therefore, it was decided to begin with the Alky Unit.

April 20, 2006 Activities

Alkylation Unit (Test 1)

In order to avoid confusion with previous dye colors, red was used to test the Alky process sewer system. Table 1 lists the date, time, location, amount, and color of dye introduced into the system on April 20, 2006. Junction box A1 was examined for the presence of red dye to ensure the dye was flowing through the process sewer. It was confirmed that the dye was flowing through the process sewer system.

The stormwater sewer MH17 was examined at 0845 and 0900. Dye (red or green) was not detected visually. The 0900 sample was filtered and the sample appeared to have a light green hue under UV light. Thus, there is still a possibility of a cross-connect from residual green dye in the process sewer system. However, the green hue is similar to the green hue observed previously, therefore it is still unclear if there is a cross-connect between the two sewer systems.

Stormwater sewer MH17 was sampled at 1015 and had a red hue. However, this red color did not fluoresce when examined with UV light. If the red hue, that could be seen visually, was red dye the sample would have fluoresced brightly under the UV light. Therefore, it is clear that the red hue was not the result of red dye in the storm sewer system. However, because a previous sample had a green hue, it is still unclear, at this time, if there is a cross-connect between the Alky process sewer and the stormwater sewer systems.

Samples were collected from aeration pond #1 at 1032, OAPIS at 1040, and NAPIS influent at 1047 to determine if red dye had reached the effluents of the sewer systems. Dye was not detected visually or with the aid of UV light. Thus, it is unclear if the dye had reached the sewer system's effluent or if the dye had reached the effluents but was too diluted to detect even with the aid of UV light.

Thus it was decided between Trihydro and Giant personnel that the Alky sewer systems needed to be investigated further. However, the system needed to be flushed prior to the addition of more dye. A water hose was placed in the process sewer system drains near A-V24 and AE44 for approximately 10 minutes. Additionally, it was learned that the deluge systems in the NHT and Platformer units were to be tripped at approximately 1200. Thus, the deluge system provided additional flow throughout the entire storm sewer system and any residual dye would be flushed out of these stormwater sewer system branches at this time.

Stormwater sewer MH17 was observed approximately one hour after the deluge systems had been tripped (1300). Adequate flow was observed in the stormwater sewer. Dye (red or green) was not detected visibly or with the aid of UV light.

Treating Unit

In order to allow the process and storm sewers in the Alky unit time to flush dye out of the system, it was decided to conduct a dye trace test in the Treating Unit using orange dye. Orange dye was introduced into the process sewer system at 1442 and 1525. Table 1 lists the date, time location, amount, and color of dye introduced into the system in the Treating unit.

Stormwater sewer MH17 was sampled at 1454 and orange dye was not detected visually or with the aid of UV light. The NAPIS inlet was sampled at 1500 and orange dye was not detected visually. It was decided to use additional dye incase the original dye had been diluted. Additional dye was introduced into same location in the process sewer system at 1525.

NAPIS samples were taken at 1548 and 1555. Orange dye was not detected visually. However the NAPIS samples did fluoresce orange under UV light. Stormwater sewer MH17 samples were taken at 1550, 1606, and 1612. Orange dye was not detected visually or when the samples were examined with UV light.

Because orange dye was not present in the stormwater sewer MH17 but was detected in NAPIS influent samples, it is conclusive that there is not a cross-connect between the process and storm sewers in the Treating Unit. It is also conclusive that there is a not a cross-connect between the process and stormwater sewer systems downstream of the units because the samples, that were clear of dye, were taken from EOL locations. Further the dye was introduced into the Treating unit; the furthest unit down stream in the process sewer system.

<u>April 21, 2006 Activities</u>

Isomerization (Isom) and Naphtha Hydrotreating Units

Red dye was used to test for cross-connects between the process and stormwater sewer system in the Isom Unit. Table 1 lists the date, time location, amount, and color of dye introduced into the process sewer system for this unit. The process and storm sewer end-of-line locations, NAPIS influent and stormwater sewer MH17 respectively, were observed for the presence of red dye. Red dye was not detected in the NAPIS influent nor stormwater sewer MH17.

To verify the dye was flowing through and out of the Isom unit, process sewer drain hubs were checked for red dye. Red dye was present in subsequent drain hubs (drain hubs were checked because there are no junction boxes in the Isom unit). However, red dye was not detected in the Isom manhole (see Figure 1), the first location outside of the unit. Because red dye was not detected in the NAPIS influent, stormwater sewer MH17 or Isom manhole but was detected in subsequent drain hubs within the unit, it was determined that the process sewer flow from the Isom unit was not adequate to move the dye through the unit. Therefore, at 1205, additional dye was placed into the process sewer followed by a water hose, with a flow rate of approximately 2 gallons per minute.

The Isom manhole was sampled at approximately 0950 and had a light green hue. When this sample was examined with UV light, it fluoresced brightly. Therefore, there was residual green dye in the process sewer system either from the Isom or Naphtha Hydrotreating (NHT) units. In order to flush the NHT unit (the Isom unit was being flushed at the time), a water hose was also inserted into the process sewer in the Naphtha Hydrotreating (NHT) Unit.

After water hoses were placed in the NHT and Isom units, the Isom manhole was observed continuously. Flow, from both the Isom and NHT units, with a heavy green dye concentration was observed in the Isom manhole beginning at approximately 1220. Because it was clear the green dye was flowing from the Isom and NHT units, it is believed the dye was residual dye from previous doses. Red dye, from the Isom unit, was observed in Isom manhole at approximately 1255. Therefore, it was confirmed that red dye was flowing from the Isom unit. The NAPIS influent was sampled at 1315 to verify the dye was reaching the process sewer EOL. The sample was too murky to observe green dye visually; however, the sample fluoresced green under UV light. Therefore the dye was reaching process system EOL.

Stormwater sewer MH17 was sampled at approximately 1315 as well. Dye (green or red) was not observed visually or when the sample was examined with UV light. Because no red or green dye was observed in the stormwater sewer MH17 but green dye was detected in NAPIS influent samples, it is conclusive that there is not a cross-connect between the process and stormwater sewers in the Isom or NHT units. It is believed that the red dye was diluted in the green dye in the NAPIS influent sample. Therefore, the Isom, NHT, and Treating units have been eliminated for cross-connects.

Red dye was used to test for cross-connects between the process sewer system and storm sewer systems in the FCCU. Table 1 lists the date, time location, amount, and color of dye introduced into the system for this unit. The dye was followed visually through junction boxes F1, F2, F3, and C10. Junction box C10 was sampled at 1627. Red dye was observed visually and the sampled fluoresced when examined with UV light. Therefore the dye was flowing through the process sewer system.

Stormwater sewer MH17 was sampled at 1700. Dye was not detected visually or when the sample was examined with UV light. Because no red dye was observed in the stormwater sewer MH17 but was observed in the process sewer leaving the FCCU, it is conclusive that there is not a cross-connect between the process and storm sewers in the FCCU. Therefore, the Isom, NHT, Treating, and FCC units have been eliminated for cross-connects.

<u>April 24, 2006 Activities</u>

Alkylation Unit (Test 2)

They Alky unit was tested again for a cross-connect using green dye on April 24, 2006. Table 1 lists the date, time location, amount, and color of dye introduced into the system for this unit. Green dye was present in Junction box A1 subsequent to dye introduction. Therefore it was confirmed that dye was flowing through the process sewer system.

Stormwater sewer MH17 was sampled at 0945. Dye was not detected visually. However, a light green hue was detected when the sample was examined with UV light. It is important to note that this hue was lighter than the hue of the sample taken on 4/19/06 at 1110. This is another indication that the green hue could be due to interference because a higher green dye concentration was used for this test. Thus, a higher concentration would result in a brighter green hue (if it were dye) in the storm sewer; if a cross-connect existed.

Process sewer junction boxes CBZ-25 and CBZ-21 were examined at approximately 1100 for green dye. Green dye was highly visible in both junction boxes. Therefore the dye was flowing out of the Alky process unit.

The stormwater sewer MH17 was sampled at 1057 and again at 1150. Green dye was not detected visually. A green hue was not visible when the samples were examined with UV light. Stormwater manhole #4 (MH4) was sampled at 1200. Green dye was not detected visually or when the sample was examined with UV light. Thus, because a green hue was detected in the 0945 sample, it is still unclear if there is a cross-connect in the Alky Unit.

<u>April 25, 2006 Activities</u>

Alkylation Unit (Test 3)

Upon further inspection of the storm sewer system, it was discovered that there are two storm sewer branches located in the Alky Unit. It was decided to examine the storm sewer system at locations further upstream of stormwater sewer MH17 but outside of the unit. Therefore, stormwater MH4 and MH13 were observed after dye was introduced into the process sewer system.

Green dye was used to re-test for cross-connects between the process sewer and stormwater sewer systems in the Alky Unit on April 25, 2006. Table 1 lists the date, time location, amount, and color of dye introduced into the system in this unit.

Stormwater MH4 was observed for green dye at 0843; however, there not enough water for sample. Dye was not detected visually.

Process storm sewer junction box CBZ-25 was observed at 0913 to verify the dye was flowing through the system. Green dye was detected visually. Therefore it was conclusive that the dye was flowing through and out of the Alky process sewer system.

Stormwater sewer MH13 was sampled at 0917. Dye was not detected visually. However, the sample did have a light green hue when it was examined with UV light. It is important to note that there was no flow through the storm manhole. Therefore this may be due to interference from some other type of liquid that had not been flushed out of the system. Note that this storm sewer manhole had not been sampled previously.

A water hose was used to facilitate flow in the stormwater system. Stormwater MH4 and MH13 were observed for the presence of green dye. Dye was not detected visually. There was adequate flow through MH4 with the aid of the water hose.

Because there was no flow in the storm sewer when the first set of storm sewer samples was taken (the 0917 sample had a green hue) and there was no dye detected in the second set of storm sewer samples, it is still unclear if there is a cross-connect between the sewer systems in the Alky Unit.

Gas Concentration (Gas Con) Unit

The Gas Con Unit was tested next to give the Alky system time to flush dye out for a subsequent test later. Red dye was used to test for cross-connects between the process sewer system and storm sewer system in the Gas Con Unit. Table 1 lists the date, time location, amount, and color of dye introduced into the system for this unit.

Process sewer junction box G4 was examined for red dye at 1504. Red dye was observed visually and when the sample was examined with UV light. Therefore, it was confirmed that the dye was flowing through and out of the Gas Con Unit.

Stormwater sewer MH17 was observed from 1505 to 1535. Red dye was not observed visually or when samples were examined with UV light. Therefore it was certain that there was not a cross-connect between the process and storm sewer systems in the Gas Con Unit. Therefore, the Isom, NHT, Treating, FCC, and Gas Con units have been eliminated for cross-connects.

<u>April 26, 2006 Activities</u>

Crude Unit

The Crude Unit was tested for a cross-connect between the process and storm sewer systems using green dye. Table 1 lists the date, time location, amount, and color of dye introduced into the system for this unit. Green dye was present in junction boxes C2 at 1145, C3 at 1146, and C10 at 1200 subsequent to dye introduction. Therefore dye was flowing through the process sewer system and out of the Crude unit.

A water hose was positioned over a storm sewer grate in the Crude unit to aid in stormwater sewer flow. Stormwater sewer manhole #6 (MH6) was sampled at 1231. This storm sewer location was sampled because it is furthest location upstream but also outside of the Crude unit. Green dye was not detected visually; however, when the sample was examined with UV light it had a green hue.

The stormwater sewer MH6 was sampled again at 1412. This sample looked slightly green when collected. When the sample was examined with UV light, it was unclear if the sample fluoresced. This sample was similar in color to the sample collected on 4/19/06 at 1110 (the original green-hued sample). Therefore we believe there may be some interference with the green dye. It is possible that the green hue maybe due to green gas oil, green antifreeze, or green coolant. Therefore, it was decided to avoid using green dye in future dye tests at this site. Thus the Crude Unit was re-examined with red dye.

We are confident that there is interference by green-colored coolant, gas oil or antifreeze because we were unable to create the same green hue observed in previous samples in control samples. Control samples were created using clean water and enough dye so that green dye was still barely visible. This sample still fluoresced brightly when it was examined with the UV light. Then the sample was diluted to a point where the green dye was not visible. The control sample still fluoresced when it was examined with UV light. Thus we could not match the color and therefore we are confident that there is interference with the green dye from other green liquid sources.

The Crude unit was re-tested for a cross-connect using red dye. Table 1 lists the date, time location, amount, and color of dye introduced into the Crude process sewer system. Red dye was present in junction box C2 subsequent to dye introduction. Therefore, dye was flowing through the process sewer system and out of the Crude Unit.

A water hose was, again, placed at a storm sewer grate furthest upstream in the Crude unit to aid in storm sewer flow. Stormwater sewer MH6 was examined for red dye at 1608 and 1611. Red dye was not detected visibly or when the sample was examined with UV light. The sample collected at 1608 did not have a green hue but the sample collected at 1611 did. However, the green hue did not fluoresce. A sample of stormwater sewer MH6 was collected at 1650 and again there was no dye detected visually or when the sample was examined with UV light. This sample also had a green hue; however, due to previous conclusions about interference with green dye and the fact that this sample did not fluoresce green, we are confident that there is not a cross-connect in the Crude Unit.

Therefore, the Isom, NHT, Treating, FCC, Gas Con, and Crude units have been eliminated for cross-connects.

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Alkylation Unit (Test 4)

In order to conclusively eliminate a cross-connect in the Alky Unit, three bottles of red dye were used in the final test. Table 1 lists the date, time location, amount, and color of dye introduced into the Alky process sewer system on April 27, 2006. A water hose was placed in the process sewer system, at the location where the dye was introduced, for approximately 15 minutes. The process sewer system did not require a constant water flow because it had already been shown that there was adequate flow through the process sewer for the dye to be moved through and out of the unit. A water hose was then placed at the furthest upstream locations of each storm sewer branch in the Alky unit.

A sample from storm sewer MH13 was collected at 0934 and examined for red dye. Dye was not detected visually or when the sample was examined with UV light.

The flow rate was verified to be good in MH4 at approximately 0953. The flow was observed to be free of dye; however, there was some green oil present. A sample from MH4 was collected at 0953 and examined for red dye. Red dye was not detected visually or when the sample was examined with UV light. The green oil observed in MH4 was believed to be slurry from the FCCU (the adjacent unit).

Storm sewer MH13 was observed at 1057. Red dye was not detected visually. It is believed that, combined with the amount of dye placed in the system, if a cross-connect existed in the Alky unit, red dye would be easily detected visually. Thus a sample was not collected from this location for further examination.

Stormwater sewer MH4 was examined again at 1102. Red dye was not detected visually in this section of the Alky stormwater system. Therefore it was certain that there is not a cross-connect in the Alky unit. Therefore, the Isom, NHT, Treating, FCC, Gas Con, Crude, and Alky units have been eliminated for cross-connects.

Platformer Unit

In order to eliminate a cross-connect in the Platformer Unit, two bottles of red dye were used. Red dye was used to avoid any interference from green liquid. Table 1 lists the date, time location, amount, and color of dye introduced into the Platformer process sewer system. A water hose was inserted into the process sewer drain hub (the same location that the dye was inserted) for approximately 20 minutes to aid the dye flow through and out the unit.

There are two branches of storm sewer system in the Platformer unit (See Figure 2). To aid the flow in the storm sewer system a water hose was placed at the storm drain furthest upstream in the South branch of the Platformer Unit storm sewer system. A water hose was also place at the storm drain furthest upstream in the North branch of the Platformer Unit storm sewer system.

The Platformer stormwater sewer system flows to stormwater sewer MH6; therefore, this manhole was observed for red dye. Samples were collected at 1521, 1523, and 1538. The storm sewer system had adequate flow (from the water hoses) when these samples were collected. Dye was not detected visually or when the samples were examined with UV light.

Therefore, it is clear that there are no cross-connects in the Platformer Unit. Thus the Isom, NHT, Treating, FCC, Gas Con, Crude, Alky, and Platformer units have been eliminated for cross-connects.