GW - 032

REPORTS

Year(s)

Storm Drain Extension Report 12/18/2007

GIANT

Giant Refining Company
Route 3, Box 7
Gallup, NM 87301

December 18, 2007

Mr. Carl Chavez
Environmental Engineer
Oil Conservation Division
Environmental Bureau
1220 S. Saint Francis Street
Santa Fe, NM 87505

Ms. Hope Monzeglio
Environmental Specialist
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Drive East, Bldg 1
Santa Fe, NM 87505

Sent By Federal Express

RE: Giant Refining – Gallup Refinery
Conceptual Design Report
Storm Drain System Extension

Dear Carl and Hope:

Enclosed is the engineering design report for the more efficient storm water management system that Giant will install to replace the Old API separator (OAPIS). The system will include the two large slop oil tanks down by our 90 day storage pad. The OAPIS will be taken out of service and rendered inoperable when the new storm water management system has been implemented. This report is being submitted to comply with the Additional Site Specific Condition A. as found on Page 6 of the recently renewed Discharge Permit (GW-032) dated August 23, 2007.

Giant expects to begin construction work on the system in mid 2008.

At some point in the future we will be replacing our aeration lagoons with a tank based treatment system. The tanks based treatment system will likely be located in an open area just to the north of the New API separator. In the interest of consolidating all waste water treatment devices in a central location, we may move the two storm water tanks to this area when the tank based treatment system is installed.

Please review the design report and if you have any questions, please contact me at (505) 722-0227 or at jim.lieb@wnr.com

Sincerely,

Jim Lieb
Environmental Engineer

\Enclosure: Conceptual Design Report

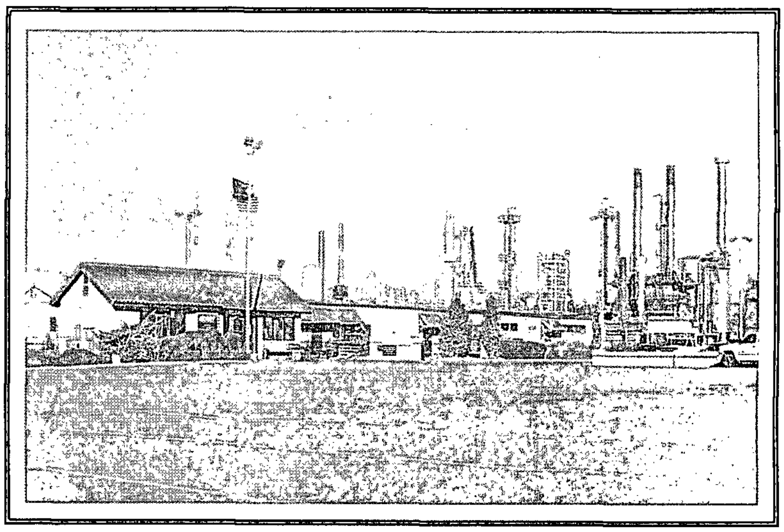
\Cc: Ed Rios
Ed Riege
Ann Allen

TETRA TECH

Conceptual Design Report

Storm Drain System Extension

Giant Refining Company



October 2007

complex world CLEAR SOLUTIONS™

Storm Drain System Extension

Conceptual Design

Giant Refining Company

Prepared for:

Giant Refining Company
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Tetra Tech Project No. 320619

October 2007

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STORM DRAIN SYSTEM EXTENSION
GIANT REFINING COMPANY

The following document has been prepared by the staff of Tetra Tech under the direct supervision of the **ENGINEER** of Record, whose seal and signature appear below.

The findings, **PLANS**, and **SPECIFICATIONS** presented herein, as specified within the limits described by Giant Refining Company, were prepared in accordance with generally accepted professional engineering principles and practices.

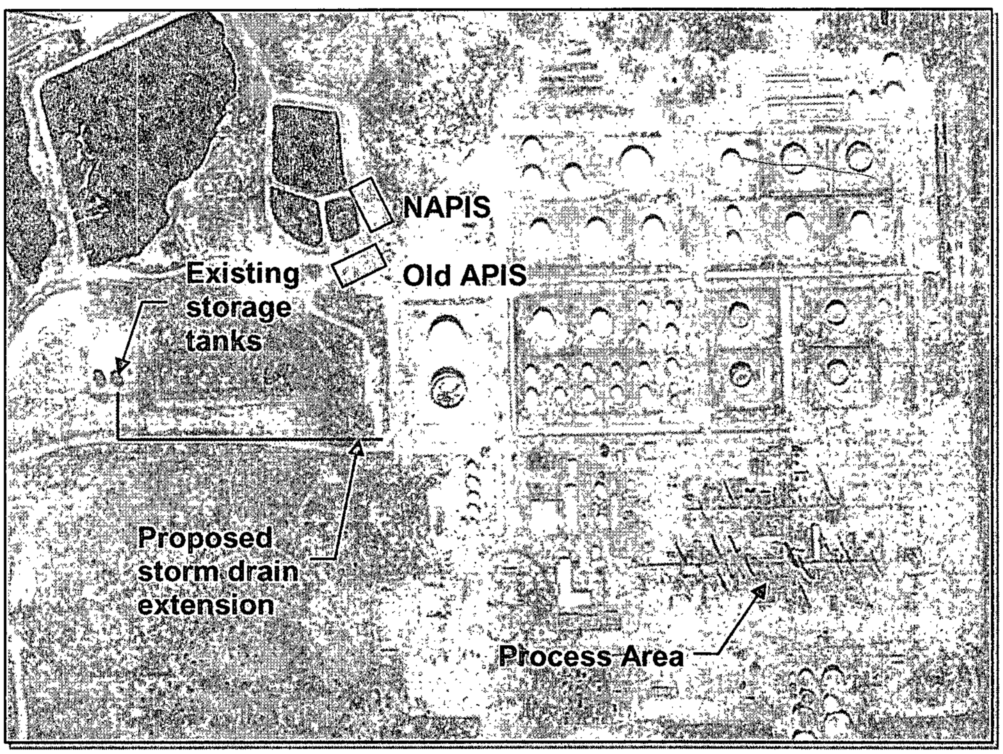
David Krizek, P.E.

1.0 INTRODUCTION

Tetra Tech Mining and Manufacturing, Inc. (Tetra Tech) has been contracted by Giant Refining Company (Giant) to perform an evaluation of stormwater flows in the two drainage systems located within their Process Area. The Giant Refinery site is located approximately seventeen miles east of the City of Gallup, New Mexico on 810 acres along I-40. The property includes several offices and processing related facilities (see Figure 1). The Giant Refinery receives and processes crude oil and other feedstocks, and then produces a variety of fuels such as propane, butane, gasoline, kerosene, jet fuel, diesel, and residual fuel.

Giant wishes to route stormwater from their Process Area to two existing 210,000-gallon tanks (total capacity of 420,000 gallons) that are not currently in use via a new pipeline. From these tanks, stormwater will be routed to the New API Separator (NAPIS) for treatment before being discharged to the evaporation ponds. This project involved the analysis of stormwater runoff volumes and flows and the capacity of the piping systems to convey stormwater to the tanks and to the NAPIS.

Figure 1: Overview of Project Area



There are two existing piping systems within the Process Area; one system for stormwater and one system for process waste water. The stormwater system currently conveys water to the Old API Separator (OAPIS) where it is discharged to the NAPIS prior to entering the aeration lagoons. However in the past, stormwater flows have exceeded the capacity of the OAPIS and discharged directly to the lagoons. The process drain system conveys waste water flows directly to the NAPIS for treatment before being discharged to the aeration lagoons. The New Mexico Environmental Department's (NMED) Oil Conservation Division (OCD) has requested that Giant find an alternative discharge solution for stormwater from the Process Area.

2.0 PROJECT CRITERIA

On November 28, 2006, Tetra Tech (then Vector Arizona) was tasked with revising an original Scope of Work to include an analysis of stormwater flows to two tanks proposed for stormwater storage. In addition to the stormwater analyses, Giant requested a determination on the capability of the NAPIS processing additional flows, i.e. from two proposed stormwater storage tanks. The following tasks were included in the project as Preliminary Design:

- Define the areas where stormwater reports either to the storm drain system inlets or to the process drain system inlets;
- Determine the storage capacity of the tanks in relation to precipitation events;
- Based on information provided by Giant regarding maximum process water flows, determine if the NAPIS is able to handle process flows combined with stormwater flows; and
- Based on a given capacity of the NAPIS (from Giant), determine the allowable pumping rate to the NAPIS from the storage tanks.

2.1 Conceptual Design- Pipeline and Pumping Design

Based on the information acquired in the Preliminary Design, a determination of appropriate pipe sizes was made for the required pipeline leading to the storage tanks from the storm drain system and for the pipeline required to return stormwater from the storage tanks to the NAPIS for treatment. Flow to the NAPIS from the storage tanks will require pumping. The design of the pump station and all appurtenant structures, as well as the preparation of the engineering report, and design drawings are included in the Conceptual Design.

2.2 Exclusions to the Scope

A letter from Mr. Carl Chavez of the New Mexico Energy, Minerals & Natural Resources Department's Oil Conservation Division (OCD) to Giant indicated that monitoring wells would be required near the NAPIS to determine the effectiveness of the secondary containment. The design of these monitoring wells was not part of this engineering effort.

2.3 Assumptions

In order to analyze flows in both of the drainage systems located within the Process Area, various plans (provided by Giant) were reviewed for critical geometric information such as pipe diameters, pipe slopes, and inlet configurations. The plans provided were not as-built reports; therefore not all information could be verified.

In 2006, Giant contracted Trihydro Corporation of Laramie, Wyoming to perform a dye trace study of both drainage systems. The maps produced from this study were used to determine the location of the inlets and pipes pertaining to each system. However, these locations are considered approximate. The lack of as-built information required that assumptions be made regarding the pipe system details. From the available information, it was determined that the minimum pipe slope within the process area is 0.005 ft/ft. This slope was applied to all pipe lengths in both systems, as this slope is relatively flat and is considered to be indicative of the overall system.

Additionally, point surveys were performed by DePauli Engineering and Surveying, LLC. The data generated by DePauli was used to confirm the pipeline and process area piping elevations for the flows and inlets developed during Phase 1.

3.0 DESIGN CRITERIA

For the storm drain system, it was assumed that the lateral or tributary pipes were 8 inch diameter PVC, and the main pipes were 10 inch diameter PVC. Although there are larger pipes within the system, these assumptions are conservative and are believed to reflect a majority of the pipes within the Process Area serviced by the storm drain system. The storm drain system eventually empties into a 24 inch diameter pipe leading to the OAPIS. All inlets were assumed to be equal to the corresponding pipe diameter.

The process drain system had less information available. It was assumed that the lateral pipes were all 4 inch diameter PVC, and the main pipes were 8 inch PVC. This system eventually empties into a 16 inch diameter pipe that leads to the NAPIS. This 16 inch pipe has the capacity to convey all flows from the process sewer pipes.

4.0 SITE CONDITIONS

4.1 Topography

An overall aerial view of the facility is shown in Figure 1. Elevations on site range from approximately 6870 to 6970 feet above mean sea level (amsl) with an overall slope to the west. The process and tank farm areas are located on an elevated plateau with approximately a 1% slope to the west. In the areas surrounding the process and tank farm areas, the slopes increase to approximately 10% to 15%. Past the immediate area, surrounding the plant site, the ground gradually slopes (approximately 1%) towards the west to the Rio Puerco River.

4.2 Geology

Gallup, New Mexico lies on the eastern flank of the Colorado Plateau, between the highly deformed Rocky Mountains and the Basin and Range Provinces. The Colorado Plateau is a series of plateaus separated by north-south trending faults or monoclines. Several areas of nearly flat lying sedimentary rocks are separated by abrupt bends due to the deep seated faults. Most of the major faults within the Plateau were formed by a large continental scale compression that occurred approximately 1.7 billion years ago. From about 570 to 360 million years ago (the Cambrian through the Mississippian), the Plateau was tectonically stable and sedimentary rocks were deposited in shallow seas. Faulting was then reactivated from the Pennsylvanian through the Triassic (320 and 245 million years ago). This resulted in the uplift of the Ancestral Rocky Mountains and the formation of a series of elevated land and sedimentary basins. The sediments deposited in the Chinle Formation during this time are found in the subsurface at the Giant Refinery. Additional mountain building periods, followed by depositional events, occurred up until the Tertiary period (66 million years ago). Finally, approximately 5 million years ago, the entire Rocky Mountains and Colorado Plateau were uplifted 4,000 to 6,000 feet.

Based on boring logs completed by Precision Engineering in 2005, the subsurface below the Giant Refinery consists of a dark red clay layer overlying the Petrified Forest and Sonsela members of the Chinle Formation. The dark red clay, approximately 23 feet thick, was mostly saturated and contained varying amounts of silt and sand. Below the clay layer lies approximately 57 feet of the Petrified Forest member which consists of a dry, red brown mudstone/siltstone. Underneath the Petrified Forest member lies the Upper Sonsela and Sonsela members, respectively. The Upper Sonsela member is approximately 18 feet thick and consists of a dry, red brown fine grained sandstone with 6 to 12 inch bedding layers. The Sonsela member is a water bearing fine to medium grained sandstone.

4.3 Climate

The following is a discussion of the climate for the state of New Mexico. This discussion was obtained from the Western Regional Climate Center's (WRCC) website. It was prepared by the State Climatologist. Climate summary data for the Fort Wingate weather station (293305) is also provided.

TOPOGRAPHIC FEATURES – New Mexico, fifth largest State in the Union, with a total area of 121,412 square miles, is approximately 350 miles square, and lies mostly between latitudes 32° and 37° N and longitudes 103° and 109° W. The State's topography consists mainly of high plateaus or mesas, with numerous mountain ranges, canyons, valleys, and normally dry arroyos. Average elevation is about 4,700 feet above sea level. The lowest point is just above the Red Bluff Reservoir at 2,817 feet where the Pecos River flows into Texas. The highest point is Wheeler Peak at 13,161 feet. The principal sources of moisture for the scant rains and snows that fall on the State are the Pacific Ocean, 500 miles to the west, and the Gulf of Mexico, 500 miles to the southeast. New Mexico has a mild, arid or semiarid, continental climate characterized by light precipitation totals, abundant sunshine, low relative humidities, and a relatively large annual and diurnal temperature range. The highest mountains have climate characteristics common to the Rocky Mountains.

The State is divided into three major areas by mountain ranges and highlands, oriented in a general north-south directions, which merge in the north. The Northern Mountains and Central Highlands, between longitudes 105° and 106° W, are the western boundary of the Northeastern and southeastern Plains which slope gradually eastward and southeastward. The northern part of these eastern plains lies within the Arkansas River Basin and is drained mostly by the Canadian River, which flows southward then eastward into Oklahoma to its confluence with the Arkansas, and the Cimarron River in the extreme northeastern corner. The Pecos River rises in the Sangre de Cristo Mountains and flows southward through the Southeastern Plains into Texas, and then southeastward to join the Rio Grande. West of the mountain ranges that form the Continental Divide, whose height decreases to a markedly lower elevation in southern New Mexico, rivers drain into the Gulf of California through the Colorado River system. Principal tributaries flowing westward into the Colorado River are the San Juan River in the north, the Gila River in the south, and the San Francisco tributary of the Gila and other headwater streams of the Little Colorado River in the west-central area. The largest closed basins in the west are the Plains of St. Augustine in Catron County and the Rio members Basin in Grant and Luna Countries. Between the Northern Mountains and the Central Highland system and the Continental Divide system is the Rio Grande Valley which widens toward the south. The Rio Grande rises in the San Juan Mountains of southern Colorado, flows southward through New Mexico, then southeastward along the Texas-Mexico border into the Gulf of Mexico. The closed Tularosa Basin in southern New Mexico is an intermountain area east of the Central Valley.

TEMPERATURE – Mean annual temperatures range from 64° F in the extreme southeast to 40° F or lower in high mountains and valleys of the north; elevation is a greater factor in determining the temperature of any specific locality than its latitude. This is shown by only a 3° F difference in mean temperature between stations at similar elevations, one in the extreme northeast and the other in the extreme southwest; however, at two stations only 15 miles apart, but differing in elevation by 4,700 feet, the mean annual temperature are 61° and 45° F – a difference of 16° F or a little more than 3° decrease in temperature for each 1,000-foot increase in elevation.

During the summer months, individual daytime temperatures quite often exceed 100° F at elevations below 5,000 feet; but the average monthly maximum temperatures during July, the warmest month, range from slightly above 90° F at lower elevations to the upper 70's at high elevations. Warmest days quite often occur in June before the thunderstorm season sets in; during July and August, afternoon convective storms tend to decrease solar insolation, lowering temperatures before they reach their potential daily high. The highest temperatures of record in New Mexico are 116° at Orogrande on July 14, 1934, and at Artesia on June 29, 1918. A preponderance of clear skies and low relative humidities permit rapid cooling by radiation from the earth after sundown; consequently, nights are usually comfortable in summer. The average range between daily high and low temperatures is from 25° to 35° F.

In January, the coldest month, average daytime temperatures range from the middle 50s in the southern and central valleys to the middle 30s in the higher elevations of the north. Minimum temperatures below freezing are common in all sections of the State during the winter, but subzero temperatures are rare except in the mountains. The lowest temperature recorded at regular observing stations in the State was -50° F at Gavilan on February 1, 1951. An unofficial low temperature of -57° F at Ciniza on January 13, 1963, was widely reported by the press.

The freeze-free season ranges from more than 200 days in the southern valleys to less than 80 days in the northern mountains where some high mountain valleys have freeze in summer months.

PRECIPITATION – Average annual precipitation ranges from less than 10 inches over much of the southern desert and the Rio Grande and San Juan Valleys to more than 20 inches at higher elevations in the State. A wide variation in annual totals is characteristic of arid and semiarid climates as illustrated by annual extremes of 2.95 and 33.94 inches at Carlsbad during a period of more than 71 years.

Summer rains fall almost entirely during brief, but frequently intense thunderstorms. The general southeasterly circulation from the Gulf of Mexico brings moisture for these storms into the State, and strong surface heating combined with orographic lifting as the air moves over higher terrain causes air currents and condensations. July and August are the rainiest months over most of the State, with from 30 to 40 percent of the year's total moisture falling at that time. The San Juan Valley area is least affected by this summer circulation, receiving about 25 percent of its annual rainfall during July and August. During the warmest 6 months of the year, May through October, total precipitation averages from 60 percent of the annual total in the Northwestern Plateau to 80 percent of the annual total in the eastern plains.

Winter precipitation is caused mainly by frontal activity associated with the general movement of Pacific Ocean storms across the country from west to east. As these storms move inland, much of the moisture is precipitated over the coastal and inland mountains ranges of California, Nevada, Arizona, and Utah. Much of the remaining moisture falls on the western slope of the Continental Divide and over northern and high central mountain ranges. Winter is the driest season in New Mexico except for the portion west of the Continental Divide. This dryness is most noticeable in the Central Valley and on eastern slopes of the mountains.

Much of the winter precipitation falls as snow in the mountain areas, but it may occur as either rain or snow in the valleys. Average annual snowfall ranges from about 3 inches at the Southern Desert and Southeastern Plains stations to well over 100 inches at Northern Mountain stations. It may exceed 300 inches in the highest mountains of the north.

FLOODS – General floods are seldom widespread in New Mexico. Heavy summer thunderstorms may bring several inches of rain to small areas in a short time. Because of the rough terrain and sparse vegetation in many areas, runoffs from these storms frequently cause local flash floods. Normally dry arroyos may overflow their banks for several hours, halting traffic where water crosses highways; damaging bridges, culverts, and roadways; and if in an urban area, possibly causing considerable property damage. Snowmelt during April to June, especially in combination with a warm rain, and heavy general rains during August to October may occasionally cause flooding of the larger rivers. Although streams in New Mexico have risen substantially during several floods, the overflows cannot be termed disastrous because comparatively little real property damage has resulted in this lightly industrialized and sparsely populated State. During spring snowmelt, main rivers may exceed flood stage and cause some damage to property along their banks.

Years in which there have been high flood discharges in major New Mexico river basins since 1903 are: Rio Grande – 1904, 1905, 1929, 1935, and 1941; Pecos – 1904, 1905, 1915, 1916, 1937, 1941, 1942, and 1966; Canadian – 1904, 1913, 1937, and 1965; San Juan – 1909, 1911, 1927, 1929, and 1942; and Gila – 1941 and 1965.

SEVERE STORMS – On rare occasions, a tropical hurricane may cause heavy rain in eastern and central New Mexico as it moves inland from the western part of the Gulf of Mexico, but there is no record of serious wind damage from these storms. Also on rare occasions, a tropical storm moving inland from the Gulf of California area may cause heavy rain in southwestern New Mexico.

Tornadoes are occasionally reported in New Mexico, most frequently during afternoon and early evening hours from May through August. There is an average of nine tornadoes a year, but damage has been light because most occur over open, sparsely populated country. The tornado causing the most loss of life and injuries occurred in 1930 at Wagon Mound with 3 deaths, 19 injuries, and property loss of $150,000. Greater property damage, $450,000, but fewer casualties – 1 death and 8 injuries – resulted from a destructive tornado at Maxwell in 1964.

Thunderstorms are relatively frequent in summer, averaging from 40 in the south to more than 70 in the northeast, the latter area having the second greatest thunderstorm frequency in the country. Occasionally, these heavy thunderstorms are accompanied by hail, with the greatest hail frequency occurring near and to the east of Los Alamos. When hail falls over an agricultural area, considerable local crop damage may result.

SUNSHINE – Plentiful sunshine occurs in New Mexico, with from 75 to 80 percent of the possible sunshine being received. In winter, this is particularly noticeable with from 70 to 75 percent of the possible sunshine being received. It is not uncommon for as much as 90 percent of the possible sunshine to occur in November and in some of the spring months. The average number of hours of annual sunshine ranges from near 3,700 in the southwest to 2,800 in the north-central portions.

RELATIVE HUMIDITY – Average relative humidities are lower in the valleys but higher in the mountains because of the lower mountain temperatures. Relative humidity ranges from an average of near 65 percent about sunrise to near 30 percent in mid-afternoon; however, afternoon humidities in warmer months are often less than 20 percent and occasionally may go as low as 4 percent. The low relative humidities during periods of extreme temperatures ease the effect of summer and winter temperatures.

WIND – Wind speeds over the State are usually moderate, although relatively strong winds often accompany occasional frontal activity during late winter and spring months and sometimes occur just in advance of thunderstorms. Frontal winds may exceed 30 mph for several hours and reach peak speeds of more than 50 mph. Spring is the windy season. Blowing dust and serious soil erosion of unprotected fields may be a problem during dry spells. Winds are generally stronger in the eastern plains than in other parts of the State. Winds generally predominate from the southeast in summer and from the west in winter, but local surface wind directions will vary greatly because of local topography and mountain and valley breezes.

EVAPORATION – Potential evaporation in New Mexico is much greater than average annual precipitation. Evaporation from a Class A pan ranges from near 56 inches in the north-central mountains to more than 110 inches in southeastern valleys. During the warm months, May through October, evaporation ranges from near 41 inches in the north-central to 73 inches in the southeast portions of the State.

DROUGHT – Periods of recent extreme meteorological drought, as defined by palmer drought index of –4.0 or lower, have been noted in the mid-1930's in the Northeastern Plains and Central Highlands, in 1947 in the Central Highlands, in the 1950's throughout the State, in 1963-64 in the Northern Mountains, in 1964 in the Southeastern Plains, and in 1967 in the Northern Mountains. The largest general drought since 1930 was in the 1950's.

RECREATION AND HEALTH – Large primitive areas and many campgrounds are in the more than 8 million acres of forestland. There are many national Monuments and State Parks and one national Park – Carlsbad Caverns. Hunting and fishing areas are available in most sections of the State, and several reservoirs have facilities for boating. Snows in mountain areas permit skiing during winter months. These features, combined with generally mild, dry, sunny climate, make New Mexico a mecca for outdoor recreation. Many people seeking a mild and dry climate from health reasons find the State a desirable place to settle

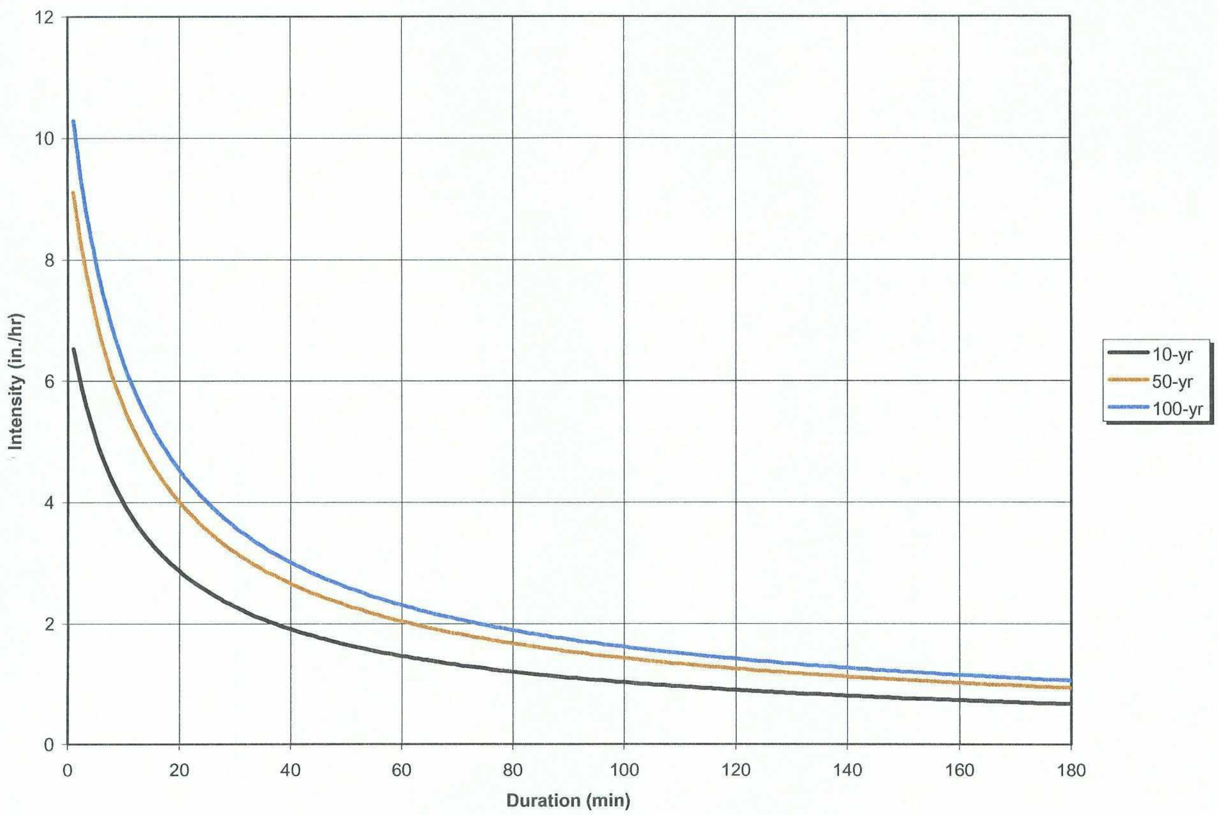
CLIMATE AND THE ECONOMY – Principal industries of New Mexico are agriculture, mining, lumbering, gas and oil production, and recreation. Of these, the influence of climate upon agriculture and recreation is of major importance. Less than 4 percent of the State's area is under cultivation, and about one-third of this area is irrigated. Farming on this latter portion is intensive. More than one-half of the area of the State is pastureland; about 28 percent is woodland. The remainder is generally classified as wasteland and urban. Most irrigated land is in the southern valleys, although some is found in the middle Rio Grande Valley, the Canadian Valley in the northeast, the San Juan Valley in the northwest, and in east-central counties. These irrigated lands draw on stored surface water as well as underground water supplies for irrigation. Most dry-land farming is in the eastern plains, but short season dry-land summer crops are grown in some small areas in the Central Highlands. Dry-land crops are divided primarily between winter grains, which require favorable moisture conditions from early fall throughout winter and spring, and short-season row and feed crops, which depend mainly on summer showers to produce a yield. Stored surface water for irrigation, used principally for cotton, truck and feed crops, and fruit, depends on adequate winter snows in the mountains of both the northern part of the State and in southern Colorado for its initial source. Livestock raising is the most extensive agricultural pursuit. Sufficient moisture usually falls, providing for the growth of good range forage. Because of the mild climate, livestock can live on the open range throughout the year, grazing in the higher mountain ranges during the summer and in the lower valleys and plains during the winter.

(From the Western Regional Climate Center (http://www.wrcc.dri.edu/narratives/NEWMEXICO.htm).)

5.0 SURFACE HYDROLOGY

To determine the amount of stormwater runoff from the Process Area, several storms were analyzed utilizing intensity duration frequency curves obtained from NOAA's Precipitation Frequency Data Server (Figure 2). Runoff volumes for three one-hour storms (10-year, 50-year, and 100-year return intervals) were calculated using the Rational Method. This method takes into account the ground conditions, intensity of the storm, and the contributing area.

Figure 2: Intensity-duration-frequency curves



$$Q = C_f * C * i * A$$

where: Q = peak flow rate,

C_f = frequency factor

C = runoff coefficient,

i = intensity of precipitation and

A = drainage area

The frequency factor is 1.0 when design storms of 2- to 10-year recurrence intervals are used. For storms of higher return periods, the coefficients are higher because of smaller infiltration and other losses, and the product of the frequency factor and the runoff coefficient can never be greater than 1.0. Table 1 shows the frequency factor applied for each return period.

Table 1: Frequency Factor

Return Interval (years)	C_f
10	1.0
50	1.2
100	1.25

The area was subdivided into 29 separate basins. These divisions were based on storm drain system drawings and a contour map provided by Giant. The areas contributing flow to the storm drain system were delineated from a 2-ft contour map and are shown on Figure 3. Due to the relative flatness of the Process Area, the contributing areas were approximated as the 2-ft contour interval did not provide enough resolution to provide clear drainage boundaries. The hydrologic parameters for each basin are shown in Table 2.

Figure 3: Areas contributing to flow

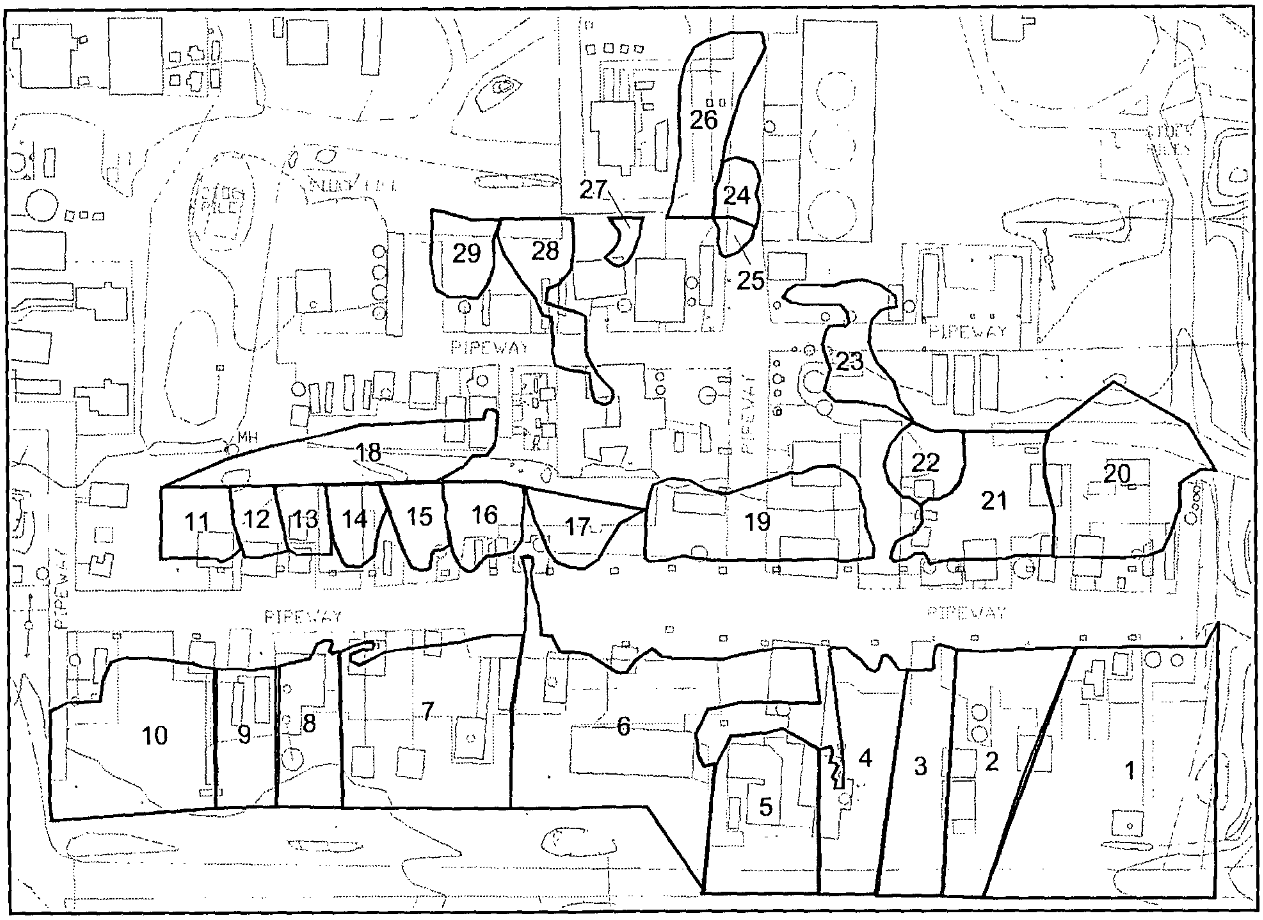


Table 2: Hydrologic Parameters

Basin ID	Frequency Factor (C) [Dimensionless]	Runoff Coefficient (C) [Dimensionless]	Area (A) [acres]	Flowrate 10-yr (Q) [cfs]	Flowrate 50-yr (Q) [cfs]	Flowrate 100-yr (Q) [cfs]
1	1.25	0.90	0.52	2.62	3.66	4.13
2	1.25	0.90	0.21	1.06	1.48	1.67
3	1.25	0.90	0.14	0.71	0.98	1.11
4	1.25	0.90	0.17	0.86	1.20	1.35
5	1.25	0.90	0.19	0.96	1.34	1.51
6	1.25	0.90	0.42	2.12	2.95	3.33
7	1.25	0.90	0.30	1.51	2.11	2.38
8	1.25	0.90	0.10	0.50	0.70	0.79
9	1.25	0.90	0.09	0.45	0.63	0.71
10	1.25	0.90	0.25	1.26	1.76	1.99
11	1.25	0.90	0.06	0.30	0.42	0.48
12	1.25	0.90	0.04	0.20	0.28	0.32
13	1.25	0.90	0.04	0.20	0.28	0.32
14	1.25	0.90	0.04	0.20	0.28	0.32

Table 2: Hydrologic Parameters

Basin ID	Frequency Factor (C_f) [Dimensionless]	Runoff Coefficient (C) [Dimensionless]	Area (A) [acres]	Flowrate 10-yr (Q) [cfs]	Flowrate 50-yr (Q) [cfs]	Flowrate 100-yr (Q) [cfs]
15	1.25	0.90	0.05	0.25	0.35	0.40
16	1.25	0.90	0.06	0.30	0.42	0.48
17	1.25	0.90	0.06	0.30	0.42	0.48
18	1.25	0.90	0.15	0.76	1.05	1.19
19	1.25	0.90	0.19	0.96	1.34	1.51
20	1.25	0.90	0.23	1.16	1.62	1.83
21	1.25	0.90	0.16	0.81	1.12	1.27
22	1.25	0.90	0.05	0.25	0.35	0.40
23	1.25	0.90	0.08	0.40	0.56	0.64
24	1.25	0.90	0.03	0.15	0.21	0.24
25	1.25	0.90	0.01	0.05	0.07	0.08
26	1.25	0.90	0.11	0.55	0.77	0.87
27	1.25	0.90	0.01	0.05	0.07	0.08
28	1.25	0.90	0.08	0.40	0.56	0.64
29	1.25	0.90	0.05	0.25	0.35	0.40

The runoff coefficient (C) used was 0.90 which corresponds to asphalt paving generating high runoff and is consistent with existing site conditions. Intensity of precipitation is equal to the time of concentration and the return period. Intensity of precipitation for each of the storm return periods is show in Table 3. Time of concentration (t_c) is defined as the travel time required for runoff from the hydraulically most remote point in the basin to the outflow location. The t_c used on all basins was 5 minutes due to the small size of each basin.

Table 3: Intensity of Precipitation

Return Interval (years)	*i* (in./hr)
10	5.04
50	7.03
100	7.94

Stormwater from the Process Area will be routed to two existing tanks not currently in use. These tanks have a storage capacity of 210,000 gallons each, for total available storage of 420,000 gallons. From the stormwater calculations, a 100-year, 1-hour storm would require 415,886 gallons of storage capacity (Table 4). These tanks have the capacity to store stormwater from the Process Area for a storm of this size until such time as it can be pumped to the NAPIS for treatment.

Table 4: Storm Runoff Volumes

Return Interval (years)	Runoff Volume (gallons)
10	263,998
50	368,222
100	415,886

A model was constructed to determine the flow capacity of the pipes in the storm drain system. The 100-yr, 1-hr peak flow was calculated at 31 cubic feet per second. The 1-hr peak flows for selected events are shown on Table 5. The existing 24 inch pipe is only able to convey 26 cubic feet per second at the current slope. Therefore, the new pipeline size was also selected to be 24 inches in diameter to match the maximum capacity of the existing incoming pipe. Pumping out of the tanks to the NAPIS will be performed through a separate 6 inch pipeline running parallel to the proposed 24 inch pipe. The maximum pumped flow, however, is anticipated to be 150 gallons per minute (approximately 20 cubic feet per minute or 0.33 cubic feet per second).

420,000 gal

24" = 26 ft^3/min → Storage Tanks

6" = 20 ft^3/min → NAPIS

Table 5: Storm Peak Flows

Return Interval (years)	Peak Flow (cfs)
10	20
50	27
100	31

194 gal/min · 60 min/hr = 11640 gal/hr

$\frac{420,000 \text{ gal}}{150 \text{ gal/min}}$ = 2800 min
47 hrs

7.46 ft^3/gal

MAX flow Storage Tanks → 26 ft^3/min · 7.46 gal/ft^3 = 193.96 gal/min

Fill up time Storage Tanks ≈ $\frac{420,000 \text{ gal}}{11,640 \text{ gal/hrs}}$ = ~~11640~~ 36.1 hrs

MAX flow to NAPIS → 20 ft^3/min = 149.2 gpm

NAPIS MAX 300gpm

120
+ 150
270

6.0 FACILITY CONDITIONS

6.1 New API Separator Capacity

Giant is currently utilizing approximately 120 gallons per minute of the NAPIS maximum treatment capacity of 300 gallons per minute with occasional surges up to 150 gallons per minute from the process waste water piping system. For purposes of design, it was assumed that the average flow rate was 150 gallons per minute leaving a maximum allowable flow capacity of 150 gallons per minute for the treatment of stormwater from the tanks. If Giant pumps stormwater from the tanks associated with a 100-year, 1-hour storm event to the NAPIS at a rate of 150 gallons per minute, it will take approximately 46 hours to completely empty both tanks assuming no additional stormwater inflow occurs.

While stormwater routed to the tanks and subsequently pumped to the NAPIS can be pumped at a controlled rate to ensure the system capacity is not exceeded, the same cannot be said for the surface inlets to the process drain system. Although only a small number of process drain system inlets are open to surface flow, a large storm event could easily overwhelm the NAPIS. For instance, one 4 inch pipe can convey up to 90 gallons per minute. Therefore, two inlets that are open to surface flow could possibly exceed the capacity of the NAPIS.

Raised cups are used at the process sewer opening locations to preferentially cause stormwater to flow into the storm sewer drain openings. The raised cups enable most of the storm runoff to flow into the storm sewers so that the NAPIS is not overwhelmed during storm events.

ok. Length of cups ?
Process area

7.0 FACILITY DESIGN

7.1 Piping Design

The storm drain extension pipeline consists of two separate pipes running parallel to each other. One pipeline diverts the existing storm drain pipe, routing stormwater from the Process Area into existing storage Tank No.1. This proposed pipeline will be constructed out of HDPE and will be 24 inches in diameter. This will be a gravity pipeline and will convey stormwater at approximately 31 cubic feet per second during the peak of the 100-year 1-hour storm event.

The second pipeline is a pumping line routing stormwater from storage Tank No. 2 to the NAPIS. This pipeline will be constructed out of HDPE and will be 6 inches in diameter. This pipeline will convey a controlled flow of up to 150 gallons per minute and will be connected to the existing 16 inch process drain pipe leading to the NAPIS. The process sewer can be diverted to the storage tanks allowing no flow to the NAPIS for maintenance purposes. Similarly, stormwater can also be diverted temporarily to the NAPIS allowing no flow to the tanks. This allows for the storm pipe, swirl concentrator and tank to be serviced.

A swirl concentrator will be installed in the pipeline to remove sediment and trash before entering the storage tanks. Check valves, gate valves, pipe reducers, bends, and other piping accessories will be installed as per the drawings.

7.2 Pumping

Pumping of the stormwater stored in the tanks to the NAPIS will be through the 6 inch pipeline. There will be two identical pumps in the pumping line and only one will be operating at any given time. One will act as the primary pump and the other as the back-up pump. The pump will pump at a maximum rate of 150 gallons per minute. The flow from the tanks will be controlled by a flow control valve. Details of the pumping and piping arrangement near the tank are shown on the drawings.

8.0 OPERATING AND MAINTENANCE PROCEDURES

With the process drain pipe flowing at approximately 150 gallons per minute at any given time, a heavy storm event could exceed the capacity of the NAPIS. Raised cups on the process sewer drains prevent overwhelming of the NAPIS. For this reason, the storm drain system's default configuration is to divert all storm runoff to the tanks. This configuration will store runoff from a 100-year 1-hour rainfall event.

In the event of a storm the tanks will begin to fill. When the tanks reach a high enough level, the pump becomes operational. Pumping to the NAPIS will be controlled by a flow control valve as not to exceed the capacity of the NAPIS. Pumping shall continue until the tanks have reached a minimum pumping level. The pump must be turned off so not to "pump dry".

If the process sewer pipe or the NAPIS needs to be serviced, the design allows process sewer flow to be diverted to the tanks. This is accomplished by closing the process sewer line valve. The stormwater can also be diverted temporarily to the NAPIS to allow for maintenance on the stormwater pipe, swirl concentrator and storage tanks. This is accomplished by closing the stormwater valve. If the stormwater line needs to be serviced it should be done so during a dry period so not to retard stormwater flow.

9.0 MONITORING AND INSPECTION PLAN

This pipeline will be incorporated into Giant's regular stormwater inspection plan. Inspection of pumps, storage tanks, and stormwater controls is performed on a weekly basis. This includes visual inspections of all valves and clean-outs to ensure they are functioning and clean of debris.

The stormwater controls in the Process Area will be inspected on a quarterly basis. If a small number of process drain system inlets were open to surface flow; a large storm event could overwhelm the NAPIS. As stated previously, one 4-inch pipe can convey up to 90 gpm; therefore, two inlets that are open to surface flow could possibly overwhelm the NAPIS. Raised cups are used at the process sewer opening locations to preferentially cause stormwater to flow into the storm sewer drain openings.

Inspections of the pumps should be made at least quarterly to check for proper operation. Record operation hours, and check for drips and leaks. In addition, the valve leading from the manhole to the tanks should be locked and/or inspected by environmental personnel at least quarterly to ensure the valve is switched only at the appropriate time. Tetra Tech suggests that all valves be open for normal operating conditions.

10.0 SUMMARY

System design drawings and construction specifications are included in the appendices that follow. The system is composed of two pipelines and will require excavation to tie into the existing piping system.

Because we do not have specifics regarding the electrical orientation or existing control systems, Tetra Tech has not incorporated control into the design of the system. These two items should be considered in the pump control system when the pumps are ordered/installed:

- Pump shut-off(s) to ensure the pump does not run dry once the tanks are empty or pump against a closed valve.
- A flow control valve to limit flow to the NAPIS to 150 gpm.

APPENDIX A
HYDRAULIC CALCULATIONS

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

New Mexico 35.4878 N 108.4256 W 6899 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 4
G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2006
Extracted: Fri May 4 2007

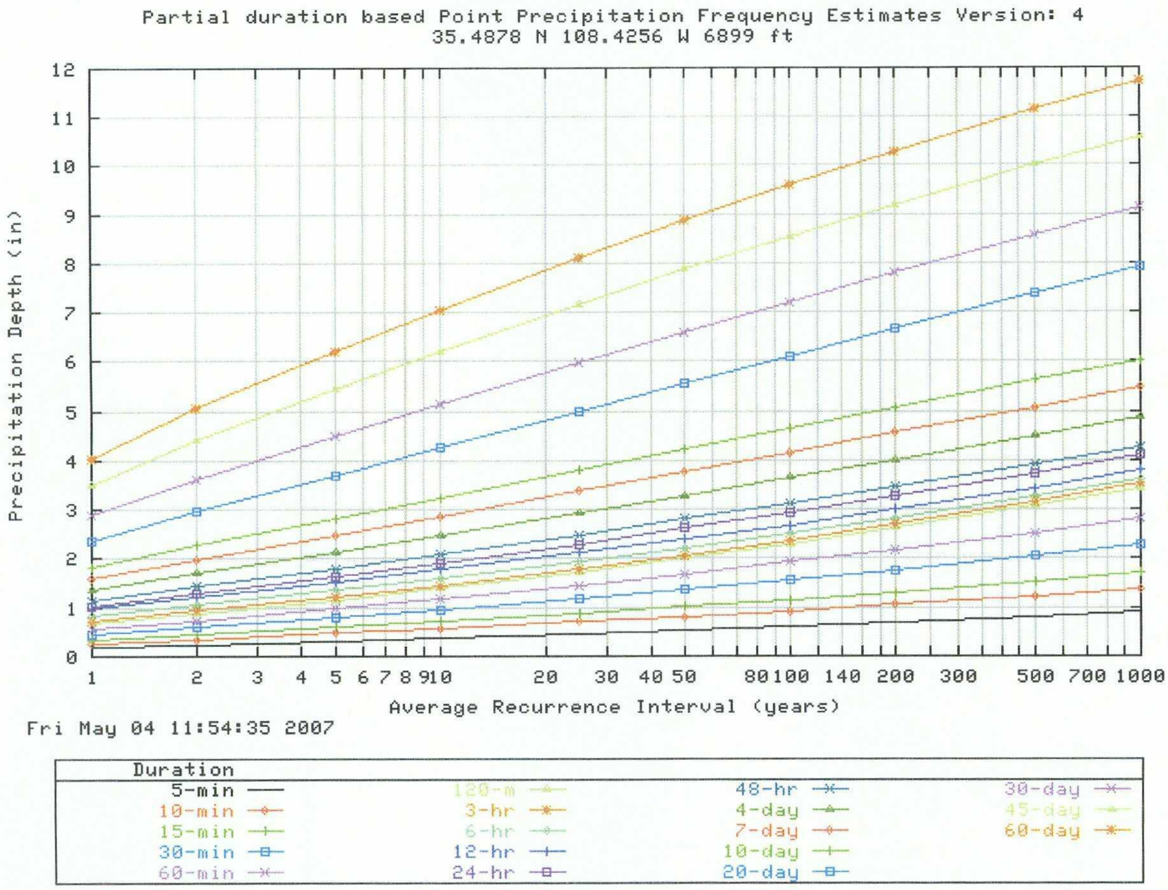
Confidence Limits | Seasonality | Location Maps | Other Info. | GIS data | Maps | Help | Docs | U.S. Map

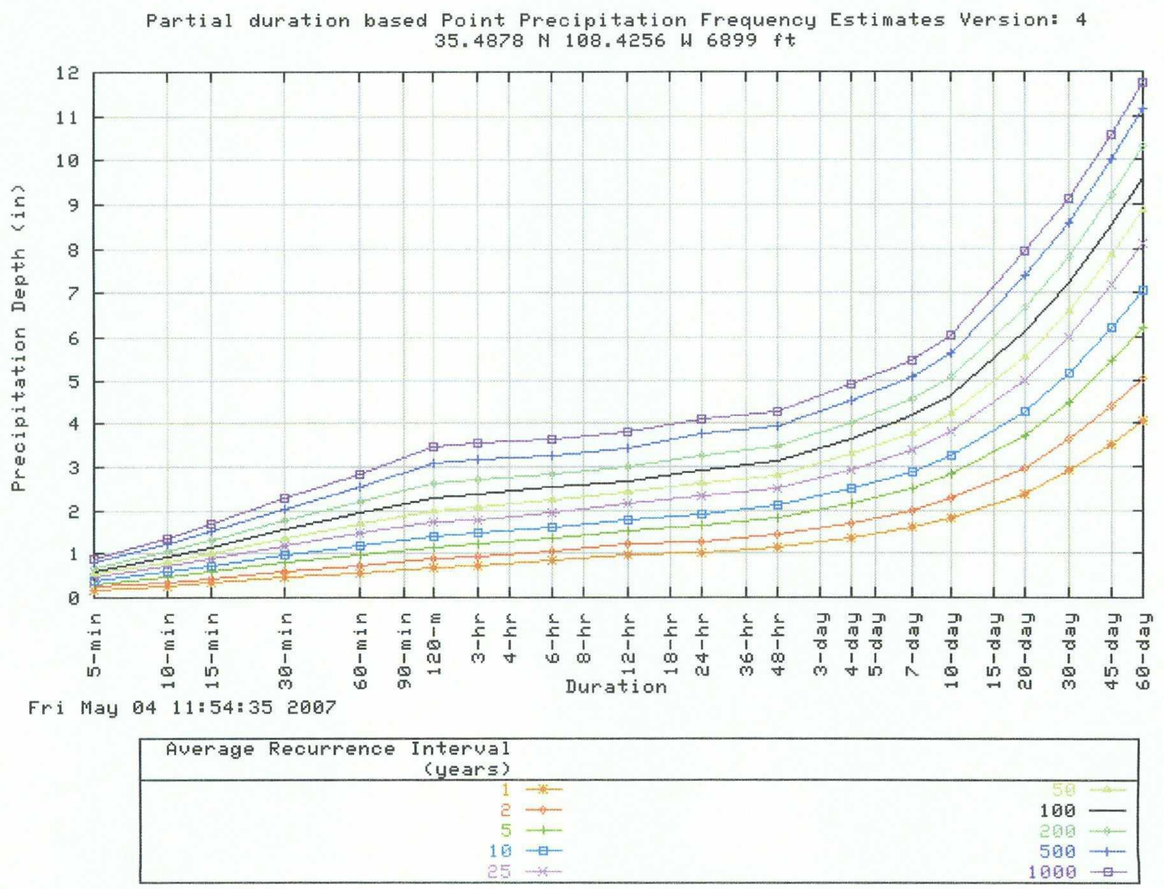
Precipitation Frequency Estimates (inches)

ARI* (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.18	0.27	0.34	0.46	0.57	0.68	0.74	0.86	0.98	1.02	1.14	1.37	1.60	1.82	2.38	2.90	3.52	4.04
2	0.23	0.35	0.44	0.59	0.73	0.87	0.94	1.08	1.22	1.28	1.43	1.71	2.00	2.28	2.98	3.62	4.41	5.05
5	0.31	0.48	0.59	0.80	0.99	1.16	1.22	1.37	1.54	1.63	1.80	2.14	2.49	2.83	3.70	4.49	5.44	6.20
10	0.38	0.57	0.71	0.96	1.19	1.39	1.46	1.61	1.79	1.91	2.09	2.48	2.87	3.25	4.26	5.14	6.20	7.04
25	0.47	0.71	0.88	1.19	1.47	1.73	1.79	1.95	2.13	2.30	2.49	2.94	3.38	3.81	5.00	5.98	7.17	8.11
50	0.54	0.82	1.01	1.36	1.69	2.00	2.07	2.22	2.40	2.61	2.81	3.29	3.77	4.24	5.55	6.60	7.87	8.87
100	0.61	0.93	1.15	1.55	1.92	2.30	2.37	2.52	2.68	2.93	3.13	3.65	4.17	4.66	6.11	7.21	8.55	9.60
200	0.69	1.05	1.31	1.76	2.18	2.62	2.69	2.83	3.00	3.27	3.47	4.02	4.56	5.08	6.67	7.82	9.20	10.29
500	0.81	1.23	1.52	2.04	2.53	3.07	3.15	3.26	3.43	3.74	3.92	4.51	5.08	5.62	7.39	8.58	10.00	11.14
1000	0.90	1.37	1.70	2.28	2.83	3.45	3.54	3.63	3.81	4.11	4.28	4.88	5.47	6.02	7.93	9.14	10.58	11.75

Text version of table

* These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.


Partial duration based Point Precipitation Frequency Estimates Version: 4
35.4878 N 108.4256 W 6899 ft
Precipitation Depth (in)
Average Recurrence Interval (years)
Fri May 04 11:54:35 2007
Duration
5-min
10-min
15-min
30-min
60-min
120-m
3-hr
6-hr
12-hr
24-hr
48-hr
4-day
7-day
10-day
20-day
30-day
45-day
60-day


Partial duration based Point Precipitation Frequency Estimates Version: 4
35.4878 N 108.4256 W 6899 ft
Precipitation Depth (in)
Duration
Fri May 04 11:54:35 2007
Average Recurrence Interval (years)
1
2
5
10
25
50
100
200
500
1000

Confidence Limits -

*** Upper bound of the 90% confidence interval**
Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.22	0.33	0.41	0.55	0.68	0.81	0.86	0.99	1.11	1.14	1.27	1.52	1.77	2.00	2.62	3.18	3.86	4.42
2	0.28	0.42	0.52	0.70	0.87	1.04	1.10	1.24	1.39	1.43	1.59	1.91	2.21	2.50	3.28	3.98	4.83	5.53
5	0.37	0.57	0.70	0.95	1.17	1.38	1.43	1.57	1.75	1.81	1.99	2.38	2.76	3.10	4.08	4.93	5.96	6.78
10	0.45	0.68	0.84	1.14	1.41	1.66	1.71	1.85	2.03	2.12	2.32	2.76	3.17	3.56	4.68	5.64	6.78	7.69
25	0.55	0.84	1.04	1.41	1.74	2.05	2.10	2.24	2.42	2.55	2.76	3.27	3.74	4.18	5.49	6.56	7.83	8.84
50	0.64	0.97	1.20	1.62	2.00	2.37	2.41	2.56	2.73	2.88	3.11	3.66	4.17	4.64	6.10	7.24	8.61	9.67
100	0.73	1.11	1.37	1.85	2.29	2.72	2.77	2.89	3.04	3.24	3.46	4.07	4.61	5.10	6.72	7.92	9.35	10.47
200	0.82	1.25	1.55	2.09	2.58	3.09	3.14	3.24	3.39	3.62	3.83	4.47	5.04	5.56	7.34	8.57	10.06	11.23
500	0.96	1.46	1.81	2.44	3.02	3.64	3.69	3.75	3.90	4.13	4.34	5.02	5.62	6.17	8.15	9.43	10.96	12.18
1000	1.07	1.63	2.03	2.73	3.38	4.10	4.15	4.19	4.34	4.55	4.73	5.45	6.06	6.62	8.75	10.06	11.60	12.86

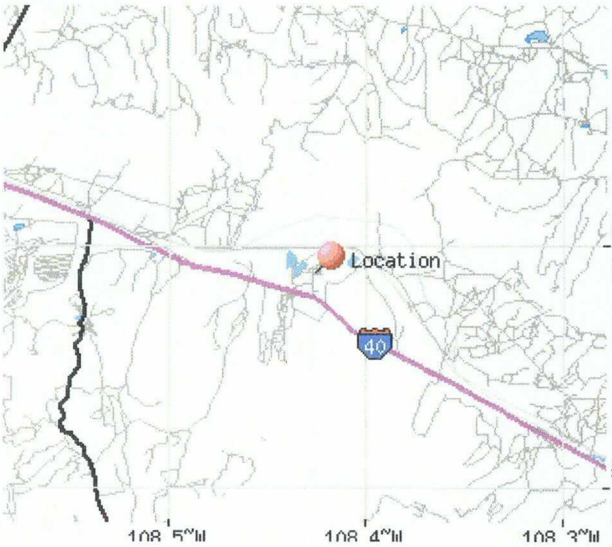
* The **upper** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **greater** than.
** These precipitation frequency estimates are based on a partial duration series. **ARI** is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

*** Lower bound of the 90% confidence interval**
Precipitation Frequency Estimates (inches)

ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.15	0.23	0.29	0.39	0.48	0.58	0.64	0.75	0.86	0.92	1.03	1.23	1.44	1.65	2.16	2.62	3.19	3.67
2	0.20	0.30	0.37	0.50	0.62	0.74	0.81	0.94	1.08	1.16	1.29	1.54	1.80	2.07	2.70	3.29	4.00	4.59
5	0.27	0.40	0.50	0.67	0.83	0.98	1.05	1.19	1.35	1.47	1.62	1.93	2.25	2.57	3.36	4.07	4.94	5.63
10	0.32	0.48	0.60	0.80	0.99	1.18	1.25	1.40	1.57	1.71	1.89	2.23	2.59	2.95	3.86	4.65	5.62	6.39
25	0.39	0.59	0.73	0.99	1.22	1.44	1.52	1.69	1.87	2.05	2.24	2.63	3.04	3.45	4.52	5.40	6.49	7.34
50	0.45	0.68	0.84	1.13	1.40	1.66	1.74	1.91	2.09	2.32	2.51	2.93	3.38	3.83	5.01	5.95	7.11	8.04
100	0.50	0.77	0.95	1.28	1.59	1.89	1.98	2.15	2.32	2.60	2.78	3.25	3.71	4.19	5.49	6.48	7.71	8.68
200	0.56	0.86	1.07	1.44	1.78	2.13	2.22	2.39	2.57	2.87	3.06	3.55	4.05	4.55	5.96	7.00	8.27	9.29
500	0.65	0.99	1.22	1.65	2.04	2.46	2.56	2.72	2.90	3.26	3.43	3.96	4.48	5.01	6.57	7.65	8.97	10.03
1000	0.71	1.09	1.35	1.82	2.25	2.73	2.84	3.00	3.19	3.55	3.71	4.27	4.80	5.35	7.01	8.11	9.46	10.54

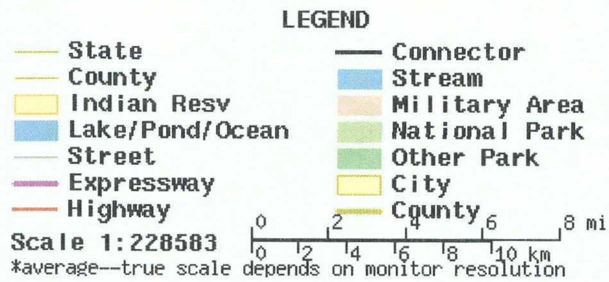
* The **lower** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **less** than.
** These precipitation frequency estimates are based on a partial duration maxima series. **ARI** is the Average Recurrence Interval.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

Maps -



These maps were produced using a direct map request from the [U.S. Census Bureau Mapping and Cartographic Resources](#) **[Tiger Map Server](#)**.

Please read [disclaimer](#) for more information.



Other Maps/Photographs -

[View USGS digital orthophoto quadrangle (DOQ)](#) covering this location from TerraServer; **USGS Aerial Photograph** may also be available
from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the [USGS](#) for more information.

Watershed/Stream Flow Information -

[Find the Watershed](#) for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

*Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information
about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study,
please refer to our documentation.*

Using the **[National Climatic Data Center's (NCDC)](#)** station search engine, locate other climate stations within:
+/-30 minutes ...OR... +/-1 degree

of this location (35.4878/-108.4256). Digital ASCII data can be obtained directly from **NCDC**.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the **Western Regional Climate Center's state-specific SNOTEL station maps**.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910
(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

NeoUDS Results Summary

Project Title: Giant Refining
Project Description: Storm Drain Extension
Output Created On: 5/4/2007 at 11:22:12 AM
Using NeoUDSewer Version 1.5.
Rainfall Intensity Table **Used.**
Return Period of Flood is 100 **Years.**

Sub Basin Information

Manhole ID #	Basin Area * C	Time of Concentration: Overland (Minutes)	Gutter (Minutes)	Basin (Minutes)	Rain I (Inch/Hour)	Peak Flow (CFS)
1	0.00	0.0	0.0	0.0	0.00	23.0
2	0.00	0.0	0.0	0.0	0.00	23.0
3	0.00	0.0	0.0	0.0	0.00	23.0
4	0.00	0.0	0.0	0.0	0.00	23.0
5	0.04	386.8	0.0	0.0	0.61	23.0

The shortest design rainfall duration is 5 minutes.
For rural areas, the catchment time of concentration is always => 10 minutes.
For urban areas, the catchment time of concentration is always => 5 minutes.
At the first design point, the time constant is <= (10+Total Length/180) in minutes.
When the weighted runoff coefficient => 0.2, then the basin is considered to be urbanized.
When the Overland Tc plus the Gutter Tc does not equal the catchment Tc, the above criteria supersedes the calculated values.

Summary of Manhole Hydraulics

Manhole ID #	Contributing Area * C	Rainfall Duration (Minutes)	Rainfall Intensity (Inch/Hour)	Design Peak Flow (CFS)	Ground Elevation (Feet)	Water Elevation (Feet)	Comments
1	0	0.0	0.00	23.0	190.00	186.22	
2	37.7	5.0	0.61	23.0	188.98	190.67	**Surface Water Present**
3	37.7	5.0	0.61	23.0	203.80	201.09	
4	37.7	5.0	0.61	23.0	218.66	205.68	
5	37.7	386.8	0.61	23.0	246.07	231.69	

Summary of Sewer Hydraulics

Note: The given depth to flow ratio is 0.9.

	Manhole ID Number			Calculated	Suggested	Existing	
Sewer ID #	Upstream	Downstream	Sewer Shape	Diameter (Rise) (Inches) (FT)	Diameter (Rise) (Inches) (FT)	Diameter (Rise) (Inches) (FT)	Width (FT)
1	2	1	Round	18.7	21	24	N/A
2	3	2	Round	18.7	21	24	N/A
3	4	3	Round	18.7	21	24	N/A
4	5	4	Round	16.7	18	24	N/A

Round and arch sewers are measured in inches.
Box sewers are measured in feet.
Calculated diameter was determined by sewer hydraulic capacity.
Suggested diameter was rounded up to the nearest commercially available size
All hydraulics where calculated using the existing parameters.
If sewer was sized mathematically, the suggested diameter was used for hydraulic calculations.

Sewer ID	Design Flow (CFS)	Full Flow (CFS)	Normal Depth (Feet)	Normal Velocity (FPS)	Critical Depth (Feet)	Critical Velocity (FPS)	Full Velocity (FPS)	Froude Number	Comment
1	23.0	44.7	1.02	14.3	1.69	8.1	7.3	2.82	
2	23.0	44.7	1.02	14.3	1.69	8.1	7.3	2.82	
3	23.0	44.7	1.02	14.3	1.69	8.1	7.3	2.82	
4	23.0	61.1	0.85	18.1	1.69	8.1	7.3	3.97	

A Froude number = 0 indicated that a pressured flow occurs.

Summary of Sewer Design Information

		Invert Elevation		Buried Depth		
Sewer ID	Slope %	Upstream (Feet)	Downstream (Feet)	Upstream (Feet)	Downstream (Feet)	Comment
1	2.30	188.98	186.22	-2.00	1.78	Sewer Too Shallow
2	2.30	199.40	188.98	2.40	-2.00	Sewer Too Shallow
3	2.30	203.99	199.39	12.67	2.41	
4	4.30	230.00	201.45	14.07	15.21	

Summary of Hydraulic Grade Line

			Invert Elevation		Water Elevation		
Sewer ID #	Sewer Length (Feet)	Surcharged Length (Feet)	Upstream (Feet)	Downstream (Feet)	Upstream (Feet)	Downstream (Feet)	Condition

1	120	0	188.98	186.22	190.67	186.22	Jump
2	453	0	199.40	188.98	201.09	190.67	Jump
3	200	0	203.99	199.39	205.68	201.09	Jump
4	664	66.33	230.00	201.45	231.69	205.68	Jump

Summary of Energy Grade Line

Upstream Manhole				Juncture Losses				Downstream Manhole	
Sewer ID #	Manhole ID #	Energy Elevation (Feet)	Sewer Friction (Feet)	Bend K Coefficient	Bend Loss (Feet)	Lateral K Coefficient	Lateral Loss (Feet)	Manhole ID #	Energy Elevation (Feet)
1	2	191.69	5.47	0.03	0.00	0.25	0.00	1	186.22
2	3	202.11	10.40	0.03	0.02	1.00	0.00	2	191.69
3	4	206.70	4.57	0.03	0.02	1.00	0.00	3	202.11
4	5	232.71	25.99	0.03	0.02	1.00	0.00	4	206.70

Bend loss = Bend K * Flowing full vhead in sewer.
Lateral loss = Outflow full vhead - Junction Loss K * Inflow full vhead.
A friction loss of 0 means it was negligible or possible error due to jump.
Friction loss includes sewer invert drop at manhole.
Notice: Vhead denotes the velocity head of the full flow condition.
A minimum junction loss of 0.05 Feet would be introduced unless Lateral K is 0.
Friction loss was estimated by backwater curve computations.

Summary of Earth Excavation Volume for Cost Estimate

The user given trench side slope is 1.

Manhole ID #	Rim Elevation (Feet)	Invert Elevation (Feet)	Manhole Height (Feet)
1	190.00	186.22	3.78
2	188.98	188.98	0.00
3	203.80	199.39	4.41
4	218.66	201.45	17.21
5	246.07	230.00	16.07

	Upstream Trench Width		Downstream Trench Width				
Sewer ID #	On Ground (Feet)	At Invert (Feet)	On Ground (Feet)	At Invert (Feet)	Trench Length (Feet)	Wall Thickness (Inches)	Earth Volume (Cubic

							Yards)
1	-0.5	4.5	7.1	4.5	120	3.00	75
2	8.3	4.5	4.5	4.5	453	3.00	366
3	28.8	4.5	8.3	4.5	200	3.00	913
4	31.6	4.5	33.9	4.5	664	3.00	6878

Total earth volume for sewer trenches = 8232.97 Cubic Yards. The earth volume was estimated to have a bottom width equal to the diameter (or width) of the sewer plus two times either 1 foot for diameters less than 48 inches or 2 feet for pipes larger than 48 inches.
If the bottom width is less than the minimum width, the minimum width was used.
The backfill depth under the sewer was assumed to be 1 foot.
The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1

```
Sewer System Summary
        Title: Giant Refining
        Description: Storm Drain Extension
--------------------------------------------------------------------------------
Sewer System Information
        Minimum Buried Depth (FT): 2
        Minimum Pipe Diameter (IN): 12
        Maximum Velocity in the Sewer (FPS): 25
        Minimum Velocity in the Sewer (FPS): 2
        Maximum Flow Depth to Sewer Size Ratio: 0.9
        Minimum Trench Width (FT): 4
        Trench Slide Slope z (1V:zH): 1
        Maximum Rural Overland Flow Length (FT): 500
        Max Urban Overland Flow Length (FT): 300
        Urbanization Factor: 0.2
--------------------------------------------------------------------------------
Rainfall Parameters
        Rainfall Return Period (Years): 100
        Rainfall Calculation Method:    Table Method
        Rainfall Values:
                5 Minutes: 0.61
                10 Minutes: 0.93
                20 Minutes: 1.3
                30 Minutes: 1.55
                40 Minutes: 1.75
                60 Minutes: 1.92
                120 Minutes: 2.3
--------------------------------------------------------------------------------
Manhole Information
        Manhole ID# 1
                Ground Elevation (FT): 190
                Manhole Network Information
                        Outgoing Sewer: System Exit
                        Incoming Sewer: 1
                Sub-Basin Information
                        Total Known Flow (CFS): 23
                        Locally Contributed Flow (CFS): 23
                        Drainage Area (Acres): 0
                        Weighted (Average) Runnoff Coefficient: 0.04
                        5 Year Runnoff Coefficient: 0.04
                        Overland Flow Length (FT): 0
                        Overland Flow Slope (%): 0
                        Gutter Flow Length (FT): 0
                        Gutter Flow Velocity (FPS): 0
        Manhole ID# 2
                Ground Elevation (FT): 189
                Manhole Network Information
                        Outgoing Sewer: 1
                        Incoming Sewer: 2
                Sub-Basin Information
                        Total Known Flow (CFS): 23
                        Locally Contributed Flow (CFS): 23
                        Drainage Area (Acres): 0
                        Weighted (Average) Runnoff Coefficient: 0.04
                        5 Year Runnoff Coefficient: 0.04
                        Overland Flow Length (FT): 0
                        Overland Flow Slope (%): 0
                        Gutter Flow Length (FT): 0
                        Gutter Flow Velocity (FPS): 0
        Manhole ID# 3
                Ground Elevation (FT): 204
                Manhole Network Information
                        Outgoing Sewer: 2
                        Incoming Sewer: 3
                Sub-Basin Information
                        Total Known Flow (CFS): 23
                        Locally Contributed Flow (CFS): 23
                        Drainage Area (Acres): 0
                        Weighted (Average) Runnoff Coefficient: 0.04
                        5 Year Runnoff Coefficient: 0.04
                        Overland Flow Length (FT): 0
                        Overland Flow Slope (%): 0
                        Gutter Flow Length (FT): 0
```

```
                Gutter Flow Velocity (FPS): 0
        Manhole ID# 4
                Ground Elevation (FT): 219
                Manhole Network Information
                        Outgoing Sewer: 3
                        Incoming Sewer: 4
                Sub-Basin Information
                        Total Known Flow (CFS): 23
                        Locally Contributed Flow (CFS): 23
                        Drainage Area (Acres): 0
                        Weighted (Average) Runnoff Coefficient: 0.04
                        5 Year Runnoff Coefficient: 0.04
                        Overland Flow Length (FT): 0
                        Overland Flow Slope (%): 0
                        Gutter Flow Length (FT): 0
                        Gutter Flow Velocity (FPS): 0
        Manhole ID# 5
                Ground Elevation (FT): 246
                Manhole Network Information
                        Outgoing Sewer: 4
                Sub-Basin Information
                        Total Known Flow (CFS): 23
                        Locally Contributed Flow (CFS): 23
                        Drainage Area (Acres): 1
                        Weighted (Average) Runnoff Coefficient: 0.04
                        5 Year Runnoff Coefficient: 0.04
                        Overland Flow Length (FT): 0
                        Overland Flow Slope (%): 0
                        Gutter Flow Length (FT): 0
                        Gutter Flow Velocity (FPS): 0
--------------------------------------------------------------------------------
Sewer Information
        Sewer ID# 1
                Length of the Sewer (FT): 120
                Sewer Slope (%): 2.3
                Upstream Crown Elevation (FT): 191
                Mannings Roughness: 0.01
                Bend Loss Coefficient at Downstream End: 0.03
                Lateral Loss Coefficient on Mainline: 0.25
                Sewer Type: Round
                Sewer Diameter (IN): 24
        Sewer ID# 2
                Length of the Sewer (FT): 453
                Sewer Slope (%): 2.3
                Upstream Crown Elevation (FT): 201
                Mannings Roughness: 0.01
                Bend Loss Coefficient at Downstream End: 0.03
                Lateral Loss Coefficient on Mainline: 1
                Sewer Type: Round
                Sewer Diameter (IN): 24
        Sewer ID# 3
                Length of the Sewer (FT): 200
                Sewer Slope (%): 2.3
                Upstream Crown Elevation (FT): 206
                Mannings Roughness: 0.01
                Bend Loss Coefficient at Downstream End: 0.03
                Lateral Loss Coefficient on Mainline: 1
                Sewer Type: Round
                Sewer Diameter (IN): 24
        Sewer ID# 4
                Length of the Sewer (FT): 664
                Sewer Slope (%): 4.3
                Upstream Crown Elevation (FT): 232
                Mannings Roughness: 0.01
                Bend Loss Coefficient at Downstream End: 0.03
                Lateral Loss Coefficient on Mainline: 1
                Sewer Type: Round
                Sewer Diameter (IN): 24
```

```
          ****** STDRAIN ******* (Version 6.5) *****         Date 04-26-
2007
                                                                 Page No
1


   100-year


 +++ Commands Read From File X:\Clients\Giant Ciniza\Storm Drain System
Extensi
   JOB
   SWI 2
   CRI 0
   PDA 0.009 12 4 3 2 0.005
   HGL 1
   RAI 5,6.88645  10,5.4389  15,4.53894  20,3.91958  30,3.11445
    60,1.99895

                                           IDF CURVE

       7.*-----+------------+------------+------------+------------
+------------
 R     6.+     .            .            .            .            .
+
 a       |     .            .            .            .            .
|
 i       |     .            .            .            .            .
|
 n       |     *            .            .            .            .
|
 f       |     .            .            .            .            .
|
 a       |     .      *     .            .            .            .
|
 l     4.+     .            .            .            .            .
+
 l       |     .            *            .            .            .
|
         |     .            .            .            .            .
|
 i       |     .            .            *            .            .
|
 n       |     .            .            .            .            .
|
         |     .            .            .            .            .
|
 i     2.+     .            .            .            .            .
+
 n       |     .            .            .            .            .
|
 /       |     .            .            .            .            .
|
 h       |     .            .            .            .            .
```

```
|
 r        |      .            .            .            .            .
|
          |      .            .            .            .            .
|
        0.*-----+------------+------------+------------+------------
+------------
        5.    10.          20.          30.          40.          50.
60.
```

Duration, t (min)

PLOT-DATA (Time, t(min) vs. Intensity, i(in/h))

t	i	t	i	t	i	t	i	t	i
5.	6.89	30.	3.11	0.	0.00	0.	0.00	0.	0.00
10.	5.44	60.	2.00	0.	0.00	0.	0.00	0.	0.00
15.	4.54	0.	0.00	0.	0.00	0.	0.00	0.	0.00
20.	3.92	0.	0.00	0.	0.00	0.	0.00	0.	0.00

```
   100-year


   TWE 0.000
   NEW Path 13
   STO 0.52 0.95 5.00
   PDA 0.009 8 4 3 2 0.005 18
   PIP 34.25 0.00 0.00
 +++ Tc =   5.0 min
 +++ CA =   0.494
 +++ Link #  1,  Flow depth =   0.77 ft, Critical depth =   0.79 ft
   PNC 13 12 0 280.912 1
   STO 0.21 0.95 5.00
   PIP 52.63 0.00 0.00
 +++ Tc =   5.1 min
 +++ CA =   0.693
 *** WARNING: Pipe invert at U/S dropped to meet cover criterion at U/S
end
 +++ Link #  2,  Flow depth =   0.79 ft, Critical depth =   0.88 ft
   PNC 12 11 0 167.727 1
   STO 0.14 0.95 5.00
   PIP 42.11 0.00 0.00
 +++ Tc =   5.3 min
 +++ CA =   0.826
 +++ Link #  3,  Flow depth =   0.90 ft, Critical depth =   0.96 ft
   PNC 11 10 0 180.479 1
   STO 0.17 0.95 5.00
   PIP 39.00 0.00 0.00
 +++ Tc =   5.4 min
 +++ CA =   0.988
 +++ Link #  4,  Flow depth =   0.87 ft, Critical depth =   1.00 ft
   PNC 10 9 0 161.807 1
   STO 0.19 0.95 5.00
   PIP 207.34 0.00 0.00
 +++ Tc =   5.5 min
 +++ CA =   1.169
 +++ Link #  5,  Flow depth =   0.96 ft, Critical depth =   1.09 ft
   PNC 9 8 0 199.465 1
   STO 0.42 0.95 5.00
   PIP 73.30 0.00 0.00
 +++ Tc =   6.0 min
 +++ CA =   1.568
 +++ Link #  6,  Flow depth =   1.19 ft, Critical depth =   1.24 ft
   PNC 8 7 0 179.247 1
   STO 0.30 0.95 5.00
   PIP 79.00 0.00 0.00
 +++ Tc =   6.2 min
 +++ CA =   1.853
```

```
+++ Link #  7,  Flow depth =    1.23 ft, Critical depth =    1.32 ft
  PNC 7 6 0 180.892 1
  STO 0.10 0.95 5.00
  PIP 54.10 0.00 0.00
+++ Tc =    6.3 min
+++ CA =    1.948
```

```
   100-year


 +++ Link #  8,  Flow depth =    1.23 ft, Critical depth =    1.34 ft
   PNC 6 5 0 118.497 1
   STO 0.09 0.95 5.00
   PIP 160.10 0.00 0.00
 +++ Tc =    6.5 min
 +++ CA =    2.033
 +++ Link #  9,  Flow depth =    1.23 ft, Critical depth =    1.35 ft
   PNC 5 4 0 150.763 1
   STO 0.25 0.95 5.00
   PIP 81.60 0.00 0.00
 +++ Tc =    6.8 min
 +++ CA =    2.270
 +++ Link # 10,  Flow depth =    1.23 ft, Critical depth =    1.39 ft
   PNC 4 3 0 179.572 1
   STO 0.06 0.95 5.00
   PDA 0.009 8 4 2 2 0.005 18
   PIP 35.90 0.00 0.00
 +++ Tc =    6.9 min
 +++ CA =    2.327
 +++ Link # 11,  Flow depth =    1.23 ft, Critical depth =    1.40 ft
   PNC 3 14 0 184.064 1
   HOL 1
   NEW Path 22
   STO 0.19 0.95 5.00
   PDA 0.009 8 4 3 2 0.005 18
   PIP 51.22 0.00 0.00
 +++ Larger flow from subarea ---> Tc =    5.0 min
 +++ CA =    0.181
 +++ Link # 12,  Flow depth =    0.48 ft, Critical depth =    0.51 ft
   PNC 22 21 0 183.689 1
   STO 0.06 0.95 5.00
   GUT 43.400 0.000 0.000 0.001 1 2 1 1
 +++ Slope    0.00000 will reset to 0.0001

 +++ Gutter: Computed Hydraulic Characteristics
             Discharge           0.39 ft^3/s
             Flow Depth          0.08 ft
             Velocity             2.5 ft/s
             Width of Spread      2.1 ft
             Gutter Slope      0.0001 ft/ft

   INL 681 1 1 101 0.5 0.5

 +++ Inlet:  Computed Hydraulic Characteristics
             Inlet Capacity       0.24 ft^3/s
```

```
          Overland Flow          0.39 ft^3/s
          Intercepted Flow       0.24 ft^3/s
          Bypass Flow            0.15 ft^3/s

  PIP 70.01 0.00 0.00
+++ Tc =    5.2 min
+++ CA =    0.237
+++ Link # 13,  Flow depth =   0.59 ft, Critical depth =   0.59 ft
  PNC 21 20 0 189.47 1
  STO 0.06 0.95 5.00
```

100-year

```
  PIP 44.60 0.00 0.00
+++ Tc =   5.5 min
+++ CA =   0.294
+++ Link # 14,  Flow depth =   0.53 ft, Critical depth =   0.60 ft
  PNC 20 19 0 180.797 1
  STO 0.05 0.95 5.00
  PIP 39.81 0.00 0.00
+++ Tc =   5.6 min
+++ CA =   0.342
+++ Link # 15,  Flow depth =   0.58 ft, Critical depth =   0.65 ft
  PNC 19 18 0 179.958 1
  STO 0.04 0.95 5.00
  PIP 36.91 0.00 0.00
+++ Tc =   5.8 min
+++ CA =   0.380
+++ Link # 16,  Flow depth =   0.62 ft, Critical depth =   0.68 ft
  PNC 18 17 0 180.669 1
  STO 0.04 0.95 5.00
  PIP 31.66 0.00 0.00
+++ Tc =   5.9 min
+++ CA =   0.418
+++ Link # 17,  Flow depth =   0.66 ft, Critical depth =   0.71 ft
  PNC 17 16 0 179.251 1
  STO 0.04 0.95 5.00
  PIP 28.60 0.00 0.00
+++ Tc =   6.0 min
+++ CA =   0.456
+++ Link # 18,  Flow depth =   0.70 ft, Critical depth =   0.74 ft
  PNC 16 15 0 178.531 1
  STO 0.15 0.95 5.00
  PIP 37.07 0.00 0.00
+++ Tc =   6.1 min
+++ CA =   0.598
+++ Link # 19,  Flow depth =   0.70 ft, Critical depth =   0.80 ft
  PNC 15 14 0 93.5777 1
  REC 1
  PDA 0.009 12 4 3 2 0.005 18
  PIP 246.04 0.00 0.00
+++ Tc =   7.0 min
+++ CA =   2.926
+++ Link # 20,  Flow depth =   1.23 ft, Critical depth =   1.46 ft
  PNC 14 2 0 180 1
  HOL 2
  NEW Path 31
  STO 0.23 0.95 5.00
```

```
  PDA 0.009 8 4 3 2 0.005 18
  PIP 51.80 0.00 0.00
+++ Larger flow from subarea ---> Tc =   5.0 min
```

100-year

```
+++ CA =   0.219
+++ Link # 21,  Flow depth =   0.56 ft, Critical depth =   0.56 ft
  PNC 31 30 0 181.364 1
  STO 0.16 0.95 5.00
  PIP 29.41 0.00 0.00
+++ Tc =   5.2 min
+++ CA =   0.370
+++ Link # 22,  Flow depth =   0.62 ft, Critical depth =   0.68 ft
  PNC 30 29 0 113.097 1
  STO 0.05 0.95 5.00
  PIP 131.00 0.00 0.00
+++ Tc =   5.3 min
+++ CA =   0.418
+++ Link # 23,  Flow depth =   0.67 ft, Critical depth =   0.72 ft
  PNC 29 28 0 220.358 1
  STO 0.08 0.95 5.00
  PIP 97.40 0.00 0.00
+++ Tc =   5.7 min
+++ CA =   0.494
+++ Link # 24,  Flow depth =   0.75 ft, Critical depth =   0.78 ft
  PNC 28 32 0 204.258 1
  STO 0.03 0.95 5.00
  PDA 0.009 12 4 3 2 0.005
  PIP 1.22 0.00 0.00
+++ Tc =   6.0 min
+++ CA =   0.522
+++ Link # 25,  Flow depth =   0.78 ft, Critical depth =   0.79 ft
  PNC 32 27 0 179.694 1
  STO 0.01 0.95 5.00
  PDA 0.009 8 4 3 2 0.005 18
  PIP 26.24 0.00 0.00
+++ Tc =   6.0 min
+++ CA =   0.532
+++ Link # 26,  Flow depth =   0.79 ft, Critical depth =   0.80 ft
  PNC 27 26 0 181.535 1
  STO 0.11 0.95 5.00
  PIP 52.61 0.00 0.00
+++ Tc =   6.1 min
+++ CA =   0.637
+++ Link # 27,  Flow depth =   0.73 ft, Critical depth =   0.83 ft
  PNC 26 25 0 179.611 1
  STO 0.01 0.95 5.00
  PIP 58.83 0.00 0.00
+++ Tc =   6.3 min
+++ CA =   0.646
```

```
+++ Link # 28,  Flow depth =    0.74 ft, Critical depth =   0.83 ft
  PNC 25 24 0 180.636 1
  STO 0.08 0.95 5.00
```

100-year

```
  PIP 44.97 0.00 0.00
+++ Tc =   6.4 min
+++ CA =   0.722
+++ Link # 29,  Flow depth =   0.79 ft, Critical depth =   0.88 ft
  PNC 24 23 0 164.35 1
  STO 0.05 0.95 5.00
  PDA 0.009 12 4 3 2 0.005 18
  PIP 239.57 0.00 0.00
+++ Tc =   6.6 min
+++ CA =   0.770
+++ Link # 30,  Flow depth =   0.81 ft, Critical depth =   0.90 ft
  PNC 23 2 0 180 1
  REC 2
  PDA 0.009 12 4 3 2 0.005 24
  PIP 124.80 0.00 0.00
+++ Tc =   7.3 min
+++ CA =   3.695
+++ Link # 31,  Flow depth =   1.64 ft, Critical depth =   1.71 ft
  PNC 2 1 0 180 2
  END
 END OF INPUT DATA.
```

100-year

*** Path 13 Pipe Design

Link	Length (ft)	Diam (in)	Invert Up/Dn (ft)	Slope (ft/ft)	Depth Up/Dn (ft)	Min. Cover (ft)	Velocity Act/Full (ft/s)	--Flow-- Act/Full (cfs)	Estimated Cost ($)
1	34	12	-4.08	0.00500	4.1	3.0	5.3	3.40	0.
			-4.25		4.3		4.6	3.64	
2	53	15	-4.35	0.00500	4.4	3.0	5.9	4.75	0.
			-4.62		4.6		5.4	6.60	
3	42	15	-4.62	0.00500	4.6	3.3	6.0	5.63	0.
			-4.83		4.8		5.4	6.60	
4	39	18	-4.83	0.00500	4.8	3.2	6.4	6.70	0.
			-5.02		5.0		6.1	10.73	
5	207	18	-5.02	0.00500	5.0	3.4	6.6	7.89	0.
			-6.06		6.1		6.1	10.73	
6	73	18	-6.06	0.00500	6.1	4.4	6.9	10.34	0.
			-6.43		6.4		6.1	10.73	
7	79	18	-6.43	0.00649	6.4	4.8	7.9	12.13	0.
			-6.94		6.9		6.9	12.22	
8	54	18	-6.94	0.00706	6.9	5.3	8.2	12.66	0.
			-7.32		7.3		7.2	12.75	

9	160	18	-7.32	0.00761	7.3	5.7	8.5	13.15
0.								
			-8.54		8.5		7.5	13.23
10	82	18	-8.54	0.00920	8.5	6.9	9.4	14.48
0.								
			-9.29		9.3		8.2	14.56
11	36	18	-9.29	0.00954	9.3	7.7	9.6	14.74
0.								
			-9.63		9.6		8.4	14.82

Length = 859. ft Total length = 859. ft
Cost = 0. Total Cost = 0.

100-year

*** Path 22 Pipe Design

Link	Length (ft)	Diam (in)	Invert Up/Dn (ft)	Slope (ft/ft)	Depth Up/Dn (ft)	Min. Cover (ft)	Velocity Act/Full (ft/s)	--Flow-- Act/Full (cfs)	Estimated Cost ($)
12	51	9	-4.00	0.00500	4.0	3.2	4.2	1.24	0.
			-4.26		4.3		3.8	1.69	
13	70	9	-4.26	0.00500	4.3	3.4	4.4	1.62	0.
			-4.61		4.6		3.8	1.69	
14	45	12	-4.61	0.00500	4.6	3.5	4.7	1.99	0.
			-4.83		4.8		4.6	3.64	
15	40	12	-4.83	0.00500	4.8	3.7	4.9	2.29	0.
			-5.03		5.0		4.6	3.64	
16	37	12	-5.03	0.00500	5.0	3.9	5.0	2.53	0.
			-5.21		5.2		4.6	3.64	
17	32	12	-5.21	0.00500	5.2	4.1	5.1	2.77	0.
			-5.37		5.4		4.6	3.64	
18	29	12	-5.37	0.00500	5.4	4.3	5.2	3.01	0.
			-5.51		5.5		4.6	3.64	
19	37	15	-5.51	0.00500	5.5	4.2	5.6	3.93	0.
			-5.70		5.7		5.4	6.60	

```
    20   246    18    -9.63 0.01494   9.6    8.0    12.0      18.48
0.
                    -13.31          13.3           10.5      18.54

------------------------------------------------------------------------
--------
              Length =     586. ft  Total length =   1445. ft
              Cost   =       0.     Total Cost   =       0.
```

100-year

*** Path 31 Pipe Design

Link	Length (ft)	Diam (in)	Invert Up/Dn (ft)	Slope (ft/ft)	Depth Up/Dn (ft)	Min. Cover (ft)	Velocity Act/Full (ft/s)	--Flow-- Act/Full (cfs)	Estimated Cost ($)
21	52	9	-4.00	0.00500	4.0	3.2	4.3	1.50	0.
			-4.26		4.3		3.8	1.69	
22	29	12	-4.26	0.00500	4.3	3.2	5.0	2.53	0.
			-4.41		4.4		4.6	3.64	
23	131	12	-4.41	0.00500	4.4	3.3	5.1	2.84	0.
			-5.06		5.1		4.6	3.64	
24	97	12	-5.06	0.00500	5.1	4.0	5.2	3.30	0.
			-5.55		5.5		4.6	3.64	
25	1	12	-5.55	0.00500	5.5	4.5	5.3	3.44	0.
			-5.55		5.6		4.6	3.64	
26	26	12	-5.55	0.00500	5.6	4.5	5.3	3.50	0.
			-5.69		5.7		4.6	3.64	
27	53	15	-5.69	0.00500	5.7	4.3	5.7	4.18	0.
			-5.95		5.9		5.4	6.60	
28	59	15	-5.95	0.00500	5.9	4.6	5.7	4.21	0.
			-6.24		6.2		5.4	6.60	

29	45	15	-6.24	0.00500	6.2	4.9	5.8	4.67	0.
			-6.47		6.5		5.4	6.60	
30	240	15	-6.47	0.00500	6.5	5.1	5.9	4.95	0.
			-7.67		7.7		5.4	6.60	
31	125	24	-13.31	0.00500	13.3	11.1	8.4	22.97	0.
			-13.93		13.9		7.4	23.11	

Length = 858. ft Total length = 2303. ft
Cost = 0. Total Cost = 0.

100-year

Hydraulic Gradeline Computations

Link #	Down-stream Node #	Hydraulic Gradeline Elevation	Crown Elev.	Possible Surcharge	Ground Elev.	Super-crit.?	Depth	Manhole Loss Coef
1	12	-3.47	-3.25	N	0.00	Y	1.38	1.68
2	11	-3.73	-3.37	N	0.00	Y	1.53	0.30
3	10	-3.87	-3.58	N	0.00	Y	1.56	0.24
4	9	-4.02	-3.52	N	0.00	Y	1.71	0.33
5	8	-4.97	-4.56	N	0.00	Y	2.04	0.48
6	7	-5.19	-4.93	N	0.00	Y	2.35	0.32
7	6	-5.62	-5.44	N	0.00	Y	2.42	0.18
8	5	-5.98	-5.82	N	0.00	Y	2.52	1.15
9	4	-7.18	-7.04	N	0.00	Y	2.90	0.53
10	3	-7.90	-7.79	N	0.00	Y	2.88	0.18
11	14	-8.23	-8.13	N	0.00	Y	3.89	0.45
12	21	-3.74	-3.51	N	0.00	Y	0.96	0.39
13	20	-3.70	-3.86	Y	0.00	N	0.90	0.28
14	19	-4.23	-3.83	N	0.00	Y	0.98	0.21
15	18	-4.38	-4.03	N	0.00	Y	1.04	0.17
16	17	-4.53	-4.21	N	0.00	Y	1.10	0.17

17	16	-4.66	-4.37	N	0.00	Y	1.16	0.17
18	15	-4.77	-4.51	N	0.00	Y	1.24	0.33
19	14	-4.90	-4.45	N	0.00	Y	3.89	0.21
20	2	-11.85	-11.81	N	0.00	Y	2.87	0.49
21	30	-3.69	-3.51	N	0.00	Y	1.06	0.54
22	29	-3.72	-3.41	N	0.00	Y	1.11	1.26
23	28	-4.34	-4.06	N	0.00	Y	1.23	0.66
24	32	-4.77	-4.55	N	0.00	Y	1.26	0.30
25	27	-4.76	-4.55	N	0.00	Y	1.26	0.10
26	26	-4.89	-4.69	N	0.00	Y	1.27	0.26
27	25	-5.12	-4.70	N	0.00	Y	1.27	0.06
28	24	-5.41	-4.99	N	0.00	Y	1.36	0.19
29	23	-5.59	-5.22	N	0.00	Y	1.40	0.21
30	2	-6.76	-6.42	N	0.00	Y	2.87	0.14
31	1	-12.29	-11.93	N	0.00	Y	1.64	0.00

Link #	Terminal Node #	Hydraulic Gradeline Elevation	Ground Elevation	Loss Coef.

NORMAL END OF FHWA STORM DRAIN PROGRAM

APPENDIX B
PUMPING CALCULATIONS

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.009)
--------------------------------------------------------------


****************
Analysis Options
****************
Flow Units ............... GPM
Flow Routing Method ...... DYNWAVE
Starting Date ............ MAY-03-2007 00:00:00
Ending Date .............. MAY-05-2007 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Routing Time Step ........ 30.00 sec


**************************        Volume         Volume
Flow Routing Continuity        acre-feet      Mgallons
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........         0.000          0.000
External Outflow .........         0.002          0.001
Surface Flooding .........         0.000          0.000
Evaporation Loss .........         0.000          0.000
Initial Stored Volume ....         0.002          0.001
Final Stored Volume ......         0.000          0.000
Continuity Error (%) .....         3.186


******************
Node Depth Summary
******************


------------------------------------------------------------------------------------
----
                                Average  Maximum  Maximum  Time of Max     Total
Total
                                  Depth    Depth      HGL   Occurrence  Flooding
Minutes
  Node                 Type        Feet     Feet     Feet  days hr:min   acre-in
Flooded

------------------------------------------------------------------------------------
----
  3                    JUNCTION    0.00     0.12   225.52     0  00:05         0
    0
  2                    JUNCTION    0.00     0.21   233.00     0  00:03         0
    0
  4                    OUTFALL     0.00     0.12   210.74     0  00:06         0
    0
  1                    STORAGE     0.00     0.50   186.72     0  00:00         0
    0


*****************
Node Flow Summary
*****************
```

Node	Type	Maximum Lateral Inflow GPM	Maximum Total Inflow GPM	Time of Max Occurrence days hr:min	Maximum Flooding Overflow GPM	Time of Max Occurrence days hr:min
3	JUNCTION	0.00	197.60	0 00:04	0.00	
2	JUNCTION	0.00	166.67	0 00:00	0.00	
4	OUTFALL	0.00	140.16	0 00:06	0.00	
1	STORAGE	0.00	0.00	0 00:00	0.00	

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow GPM
1	0.000	0	0.107	0	0 00:00	166.67

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow GPM	Max. Flow GPM
4	2.71	9.62	140.16
System	2.71	9.62	140.16

****
Link Flow Summary
****

	Maximum Flow	Time of Max Occurrence	Maximum Velocity	Max/ Full	Max/ Full	Total Minutes

Output data - min level in tank.txt

Link Surcharged	Type	GPM	days	hr:min	ft/sec	Flow	Depth
P2 0	CONDUIT	197.60	0	00:04	5.01	0.01	0.08
P3 0	CONDUIT	140.16	0	00:06	4.31	0.01	0.06
P1 0	PUMP	166.67	0	00:00		0.56	

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Avg. Froude Number	Avg. Flow Change
P2	1.00	0.00	0.96	0.00	0.04	0.00	0.00	0.00	0.01	0.0000
P3	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.05	0.0000

(--- Fraction of Time in Flow Class ----)

****
Highest Continuity Errors
****

Node 2 (-5.94%)
Node 3 (4.57%)

****
Time-Step Critical Elements
****

None

****
Routing Time Step Summary
****

```
Minimum Time Step           :    30.00 sec
Average Time Step           :    29.99 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
```

Analysis begun on: Fri May 04 07:40:04 2007
Total elapsed time: 00:00:03

Output data - max level in tank.txt

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.0 (Build 5.0.009)
--------------------------------------------------------------

****************
Analysis Options
****************
Flow Units ............... GPM
Flow Routing Method ...... DYNWAVE
Starting Date ............ MAY-03-2007 00:00:00
Ending Date .............. MAY-05-2007 00:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:01:00
Routing Time Step ........ 30.00 sec

**************************        Volume         Volume
Flow Routing Continuity        acre-feet       Mgallons
**************************     ---------      ---------
Dry Weather Inflow .......         0.000          0.000
Wet Weather Inflow .......         0.000          0.000
Groundwater Inflow .......         0.000          0.000
RDII Inflow ..............         0.000          0.000
External Inflow ..........         0.000          0.000
External Outflow .........         0.638          0.208
Surface Flooding .........         0.000          0.000
Evaporation Loss .........         0.000          0.000
Initial Stored Volume ....         0.638          0.208
Final Stored Volume ......         0.000          0.000
Continuity Error (%) .....         0.014

******************
Node Depth Summary
******************

------------------------------------------------------------------------------------
----
                                Average  Maximum  Maximum  Time of Max    Total
Total
                                  Depth    Depth      HGL   Occurrence Flooding
Minutes
  Node                 Type        Feet     Feet     Feet  days hr:min  acre-in
Flooded

------------------------------------------------------------------------------------
----
  3                    JUNCTION    0.05     0.17   225.57     0  00:05        0
    0
  2                    JUNCTION    0.06     0.26   233.05     0  00:03        0
    0
  4                    OUTFALL     0.05     0.17   210.79     0  00:06        0
    0
  1                    STORAGE     5.16    33.00   219.22     0  00:00        0
    0

*****************
Node Flow Summary
*****************
```

Node	Type	Maximum Lateral Inflow GPM	Maximum Total Inflow GPM	Time of Max Occurrence days hr:min	Maximum Flooding Overflow GPM	Time of Max Occurrence days hr:min
3	JUNCTION	0.00	335.01	0 00:04	0.00	
2	JUNCTION	0.00	267.68	0 00:00	0.00	
4	OUTFALL	0.00	316.32	0 00:06	0.00	
1	STORAGE	0.00	0.00	0 00:00	0.00	

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow GPM
1	4.273	15	27.797	100	0 00:00	267.68

****
Outfall Loading Summary
****

Outfall Node	Flow Freq. Pcnt.	Avg. Flow GPM	Max. Flow GPM
4	35.86	201.24	316.32
System	35.86	201.24	316.32

****
Link Flow Summary
****

	Maximum Flow	Time of Max Occurrence	Maximum Velocity	Max/ Full	Max/ Full	Total Minutes

Output data - max level in tank.txt

```
  Link                    Type        GPM  days hr:min    ft/sec    Flow   Depth
Surcharged

--------------------------------------------------------------------------------------
------
  P2                      CONDUIT    335.01     0  00:04      4.63    0.02    0.10
     0
  P3                      CONDUIT    316.32     0  00:06      5.51    0.01    0.08
     0
  P1                      PUMP       267.68     0  00:00      0.11    0.89
     0
```

```
  ***************************
  Flow Classification Summary
  ***************************
```

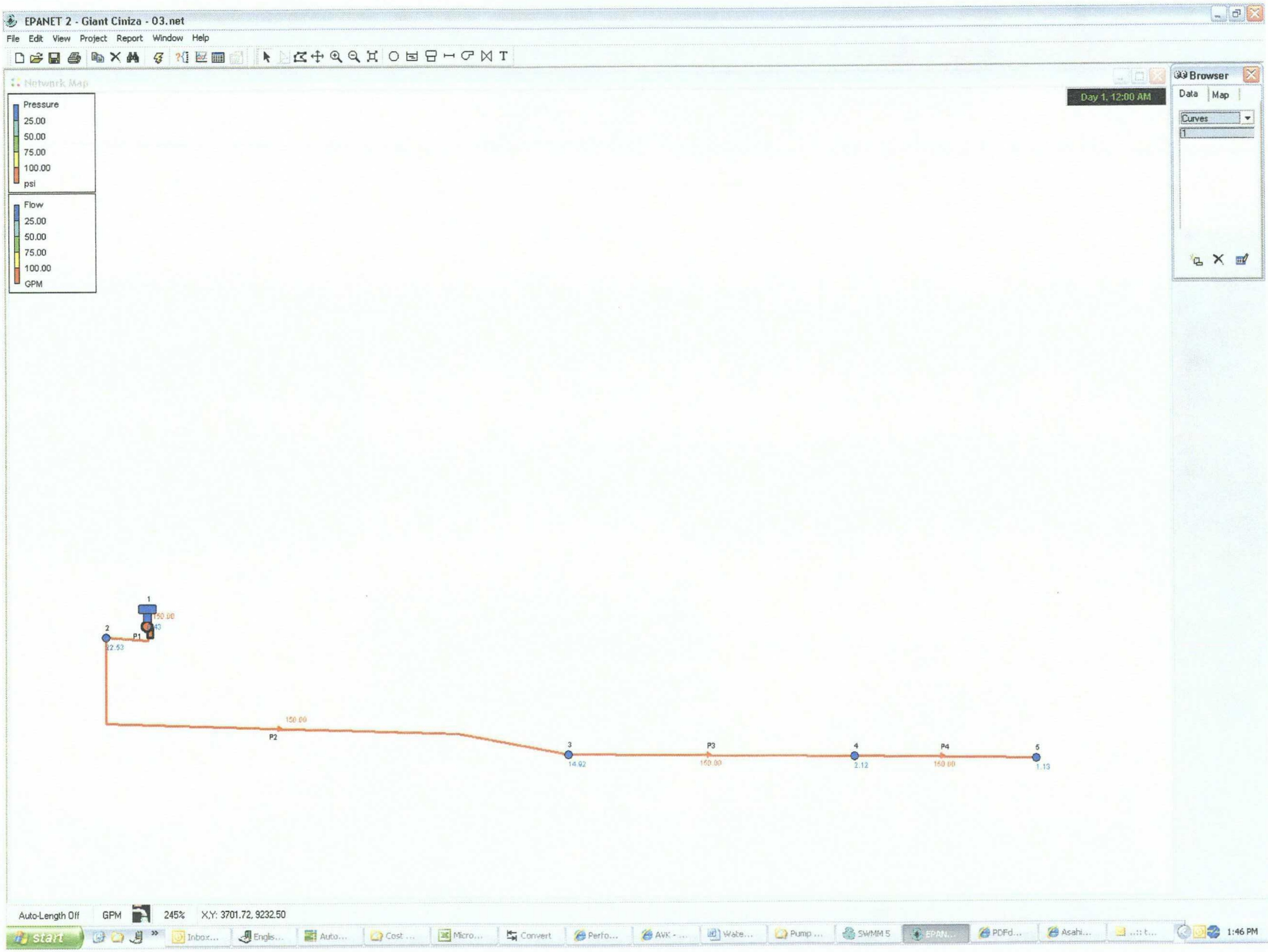
```
--------------------------------------------------------------------------------------
-----
                        Adjusted   --- Fraction of Time in Flow Class ----   Avg.
Avg.
                         /Actual        Up   Down  Sub   Sup   Up    Down   Froude
Flow
  Conduit                 Length   Dry  Dry  Dry   Crit  Crit  Crit  Crit   Number
Change
--------------------------------------------------------------------------------------
-----
  P2                        1.00  0.00 0.63 0.00  0.04  0.33  0.00  0.00     0.60
0.0000
  P3                        1.00  0.00 0.00 0.00  0.66  0.34  0.00  0.00     0.82
0.0000
```

```
  *************************
  Highest Continuity Errors
  *************************
  Node 2 (-0.02%)
  Node 3 (0.01%)


  ***************************
  Time-Step Critical Elements
  ***************************
  None


  *************************
  Routing Time Step Summary
  *************************
  Minimum Time Step           :     30.00 sec
  Average Time Step           :     29.99 sec
  Maximum Time Step           :     30.00 sec
  Percent in Steady State     :      0.00
  Average Iterations per Step :      2.00


  Analysis begun on:  Fri May 04 07:13:40 2007
  Total elapsed time: 00:00:03
```


EPANET 2 - Giant Ciniza - 03.net
File Edit View Project Report Window Help
Network Map
Pressure
25.00
50.00
75.00
100.00
psi
Flow
25.00
50.00
75.00
100.00
GPM
Day 1, 12:00 AM
Browser
Data
Map
Curves
1
2
P1
P2
150.00
3
14.92
P3
150.00
4
2.12
P4
150.00
5
1.13
Auto-Length Off
GPM
245%
X,Y: 3701.72, 9232.50
start
1:46 PM

```
**********************************************************************
*                    E P A N E T                                     *
*            Hydraulic and Water Quality                             *
*            Analysis for Pipe Networks                              *
*                    Version 2.0                                     *
**********************************************************************
```

Input File: Giant Ciniza - 03.net

Link - Node Table:

Link ID	Start Node	End Node	Length ft	Diameter in
P2	2	3	773	6
P3	3	4	217	6
P4	4	5	250	6
P1	1	2	#N/A	#N/A Pump

Node Results:

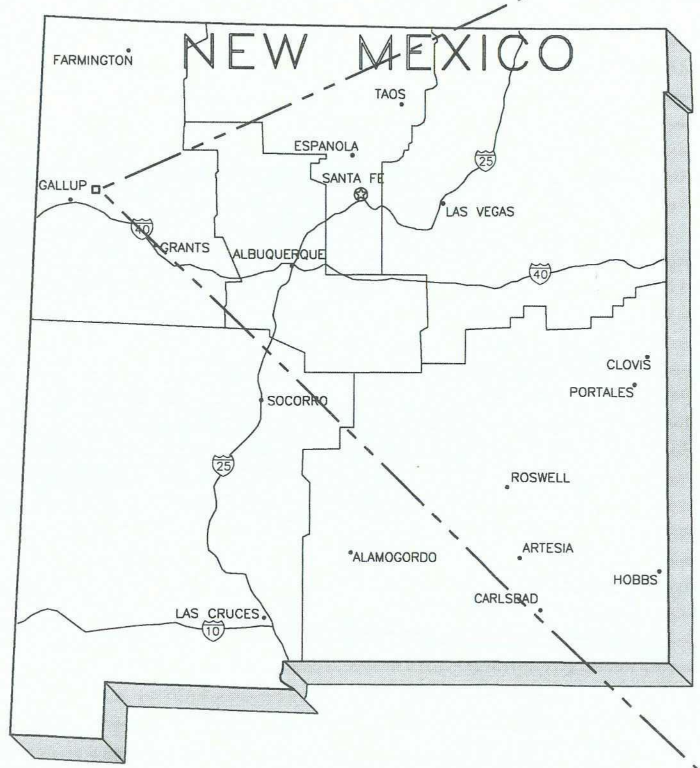
Node ID	Demand GPM	Head ft	Pressure psi	Quality
2	0.00	238.22	22.53	0.00
3	0.00	236.42	14.92	0.00
4	0.00	235.90	2.12	0.00
5	150.00	235.30	1.13	0.00
1	-150.00	186.22	0.43	0.00 Tank

Link Results:

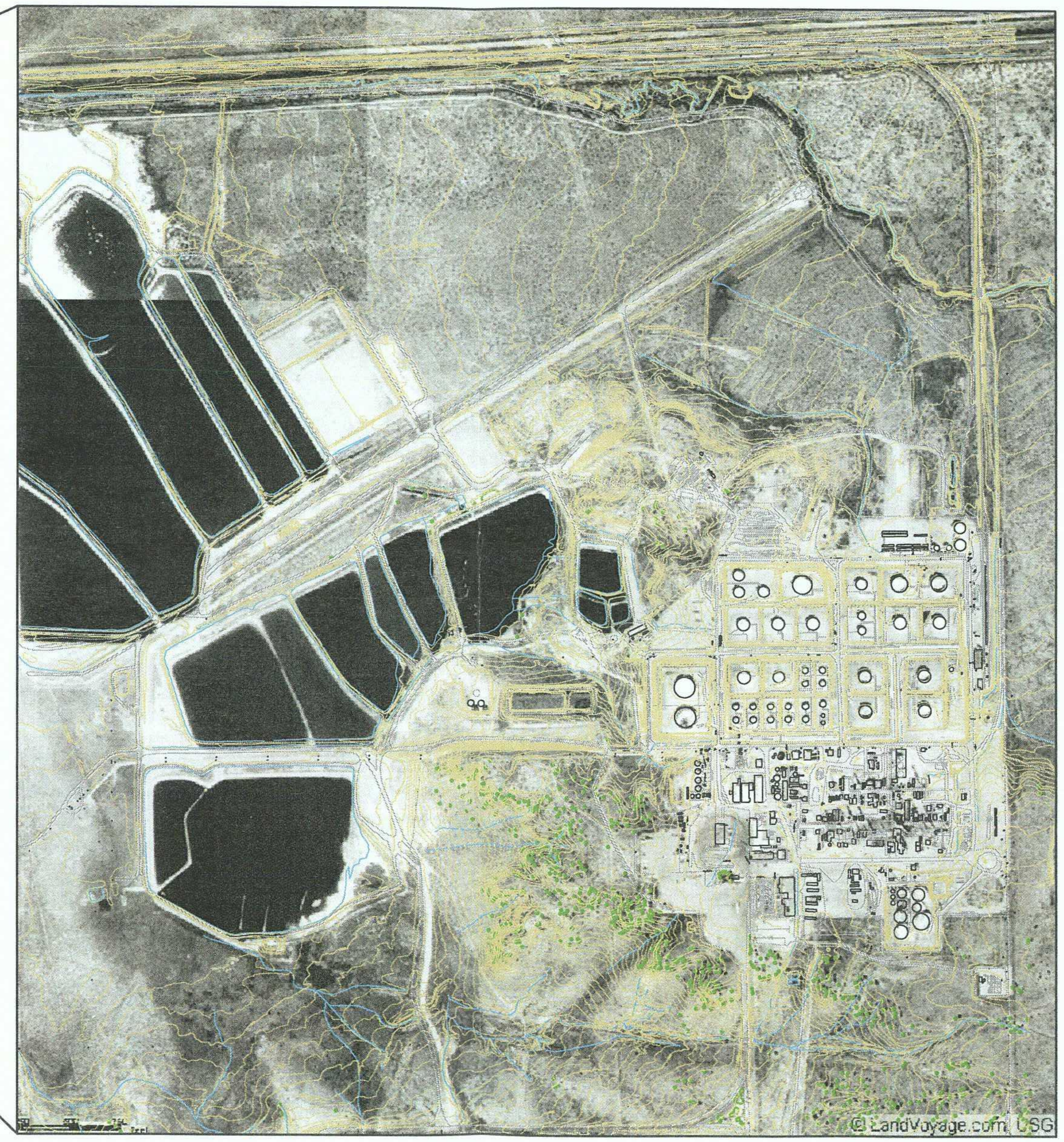
Link ID	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Status
P2	150.00	1.70	2.33	Open
P3	150.00	1.70	2.42	Open
P4	150.00	1.70	2.39	Open
P1	150.00	0.00	-52.00	Open Pump

APPENDIX C
DESIGN DRAWINGS

GIANT REFINING COMPANY
STORM DRAIN SYSTEM EXTENSION PROJECT
CONCEPTUAL DESIGN



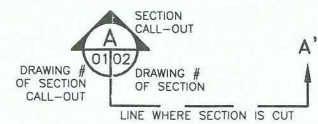
STATE OF NEW MEXICO
N.T.S.



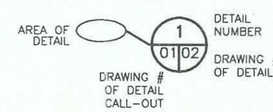
PROJECT LOCATION MAP
N.T.S.

DRAWING INDEX

DRAWING #	DRAWING TITLE	REVISION
01	TITLE SHEET	A
02	SITE PLAN	A
03	PLAN & PROFILE	A
04	PLAN, PROFILE & DETAILS	A
05	PLAN & PROFILE	A
06	DETAILS	A

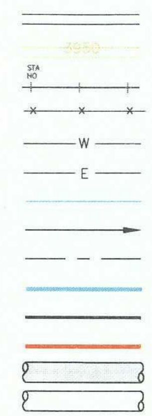


CROSS SECTION LOCATION



DETAIL CALL-OUT

LEGEND



REV.	DATE	DESCRIPTION	BY
A	8/07	ISSUED FOR REVIEW	DRK
B	9/07	ISSUED FOR REVIEW	DRK

PROJECT NO:	320619
DATE:	9/07
DESIGNED BY:	JAC
DRAWN BY:	WCP
CHECKED BY:	JAC
APPROVED BY:	DRK

PREPARED BY:

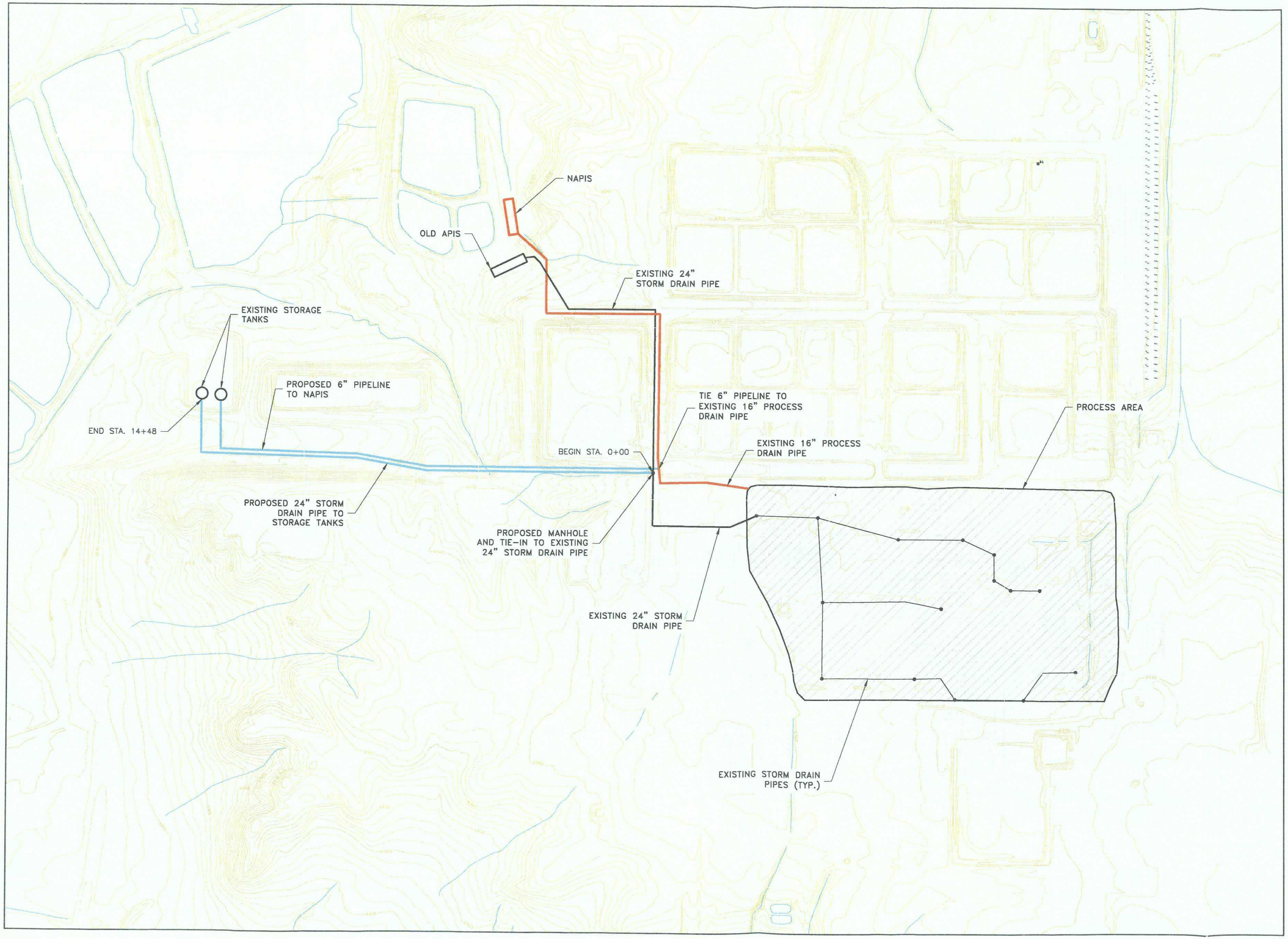
STORM DRAIN SYSTEM
EXTENSION
TITLE SHEET

PREPARED FOR:

GIANT REFINING CO.
A DIVISION OF GIANT INDUSTRIES

DRAWING NO.
1/6

X:\Clients\Giant Ciniza\Storm Drain System Extension\CADD\LDD-Ciniza\dwg\Design\Conceptual design_rev B\SHEET 01 TITLE SHEET.dwg SAVED:11/1/07 PRINTED:11/5/07 BY:LORI ANN LASTER



NORTH

SCALE IN FEET
150 0 300

GENERAL NOTES:

1. GRID LINES AND COORDINATES SHOWN ON PLANS ARE GIANT REFINERY LOCAL COORDINATE SYSTEM.
2. ELEVATIONS BASED ON EXISTING GIANT REFINERY DATUM. ADD 6704.50 TO LOCAL DATUM TO REACH N.G.V.D. 1929.

REV.	DATE	DESCRIPTION	BY
A	8/07	ISSUED FOR REVIEW	DRK
B	9/07	ISSUED FOR REVIEW	DRK

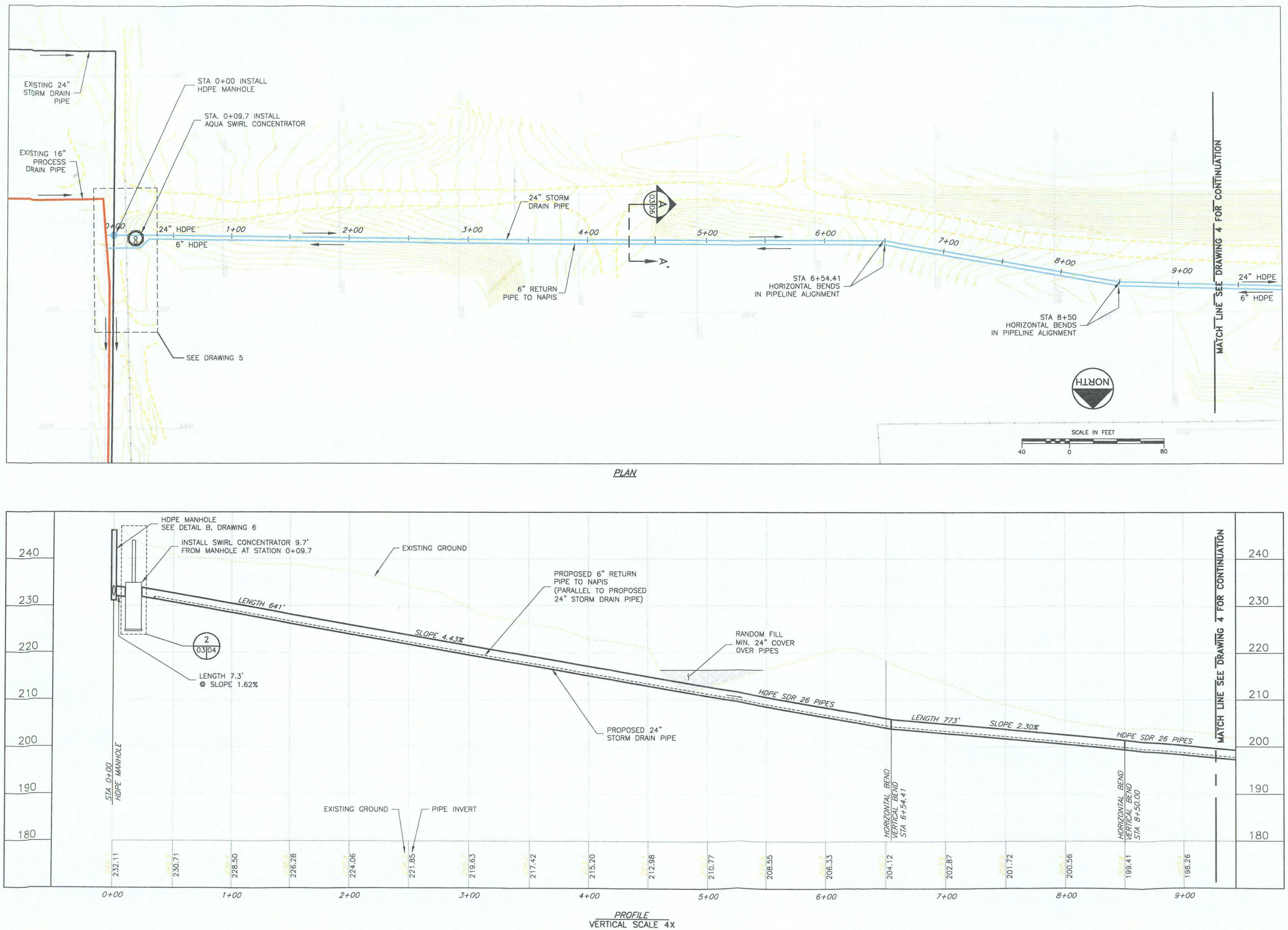
PROJECT NO.	320619
DATE:	9/07
DESIGNED BY:	JAC
DRAWN BY:	WCP
CHECKED BY:	JAC
APPROVED BY:	DRK

PREPARED BY:

STORM DRAIN SYSTEM EXTENSION SITE PLAN

PREPARED FOR:
GIANT REFINING CO.
A DIVISION OF GIANT INDUSTRIES

DRAWING NO.
2/6



GENERAL NOTES:

1. GRID LINES AND COORDINATES SHOWN ON PLANS ARE GIANT REFINERY LOCAL COORDINATE SYSTEM.
2. ELEVATIONS BASED ON EXISTING GIANT REFINERY DATUM. ADD 6704.50 TO LOCAL DATUM TO REACH N.G.V.D. 1929.

REV.	DATE	DESCRIPTION	BY
A	8/07	ISSUED FOR REVIEW	DRK
B	9/07	ISSUED FOR REVIEW	DRK

PROJECT NO.	320619
DATE:	9/07
DESIGNED BY:	JAC
DRAWN BY:	KMH
CHECKED BY:	JAC
APPROVED BY:	DRK

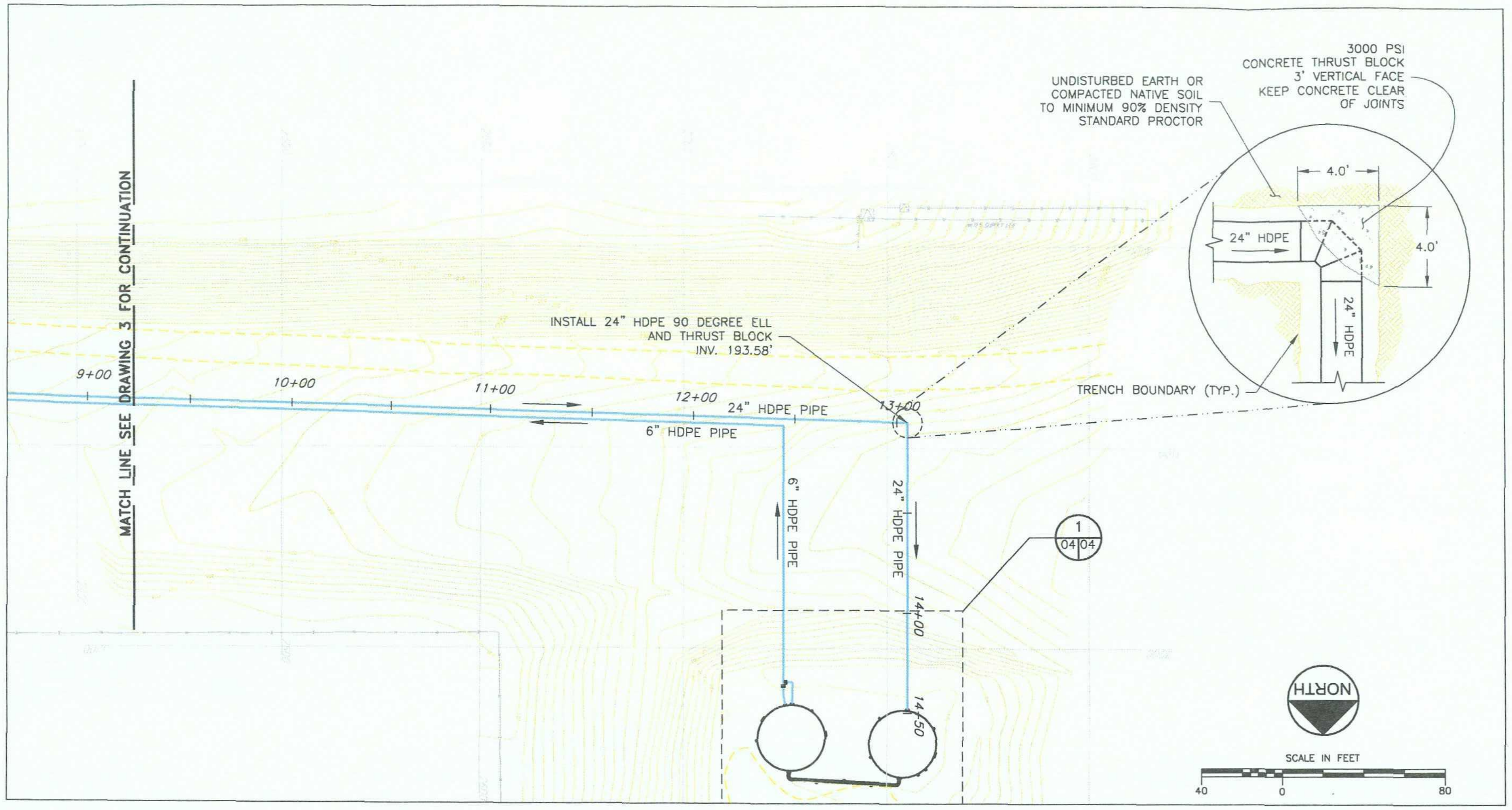
PREPARED BY:

STORM DRAIN SYSTEM EXTENSION PLAN & PROFILE

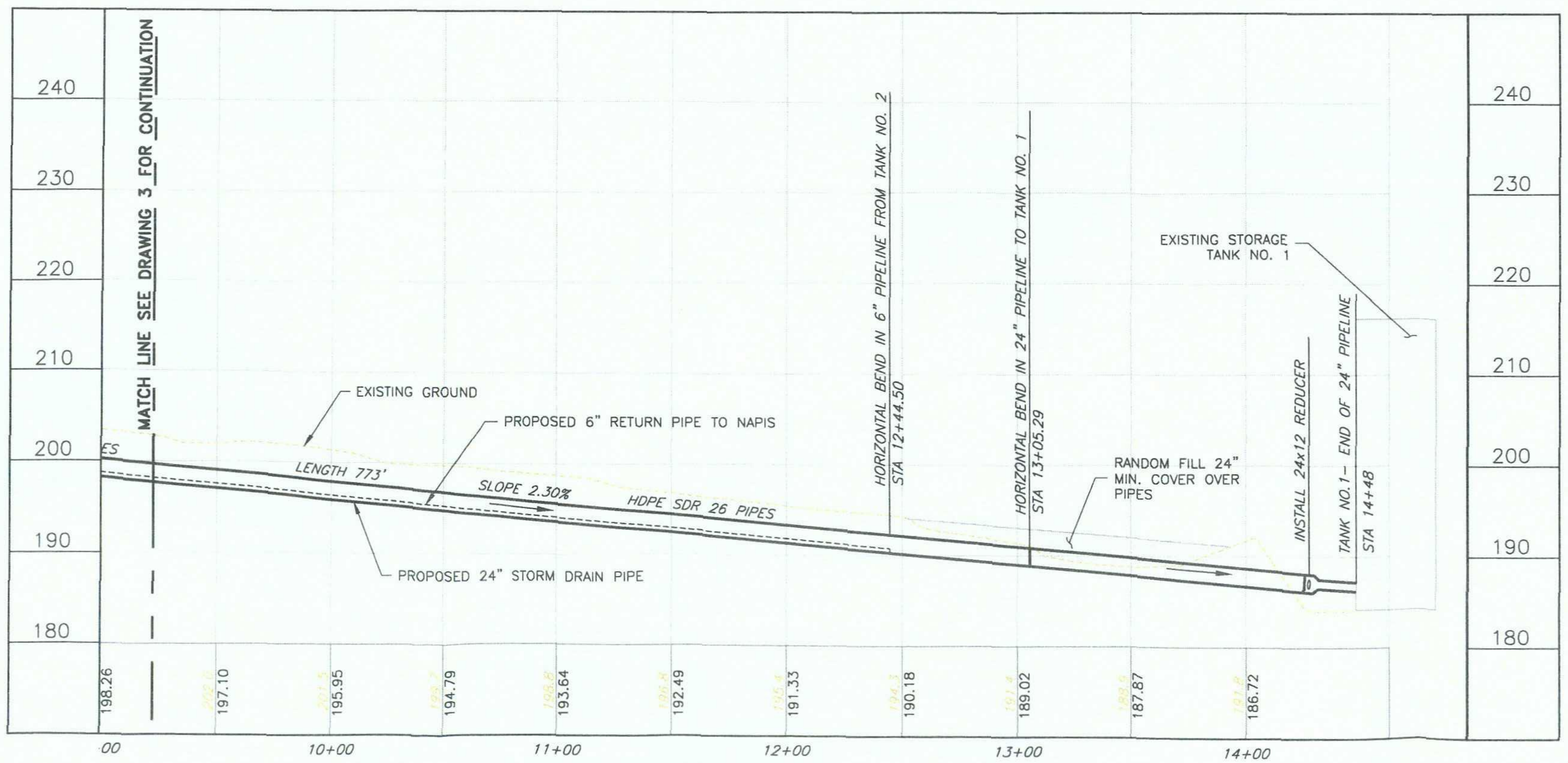
PREPARED FOR: GIANT REFINING CO. A DIVISION OF GIANT INDUSTRIES

DRAWING NO. 3/6

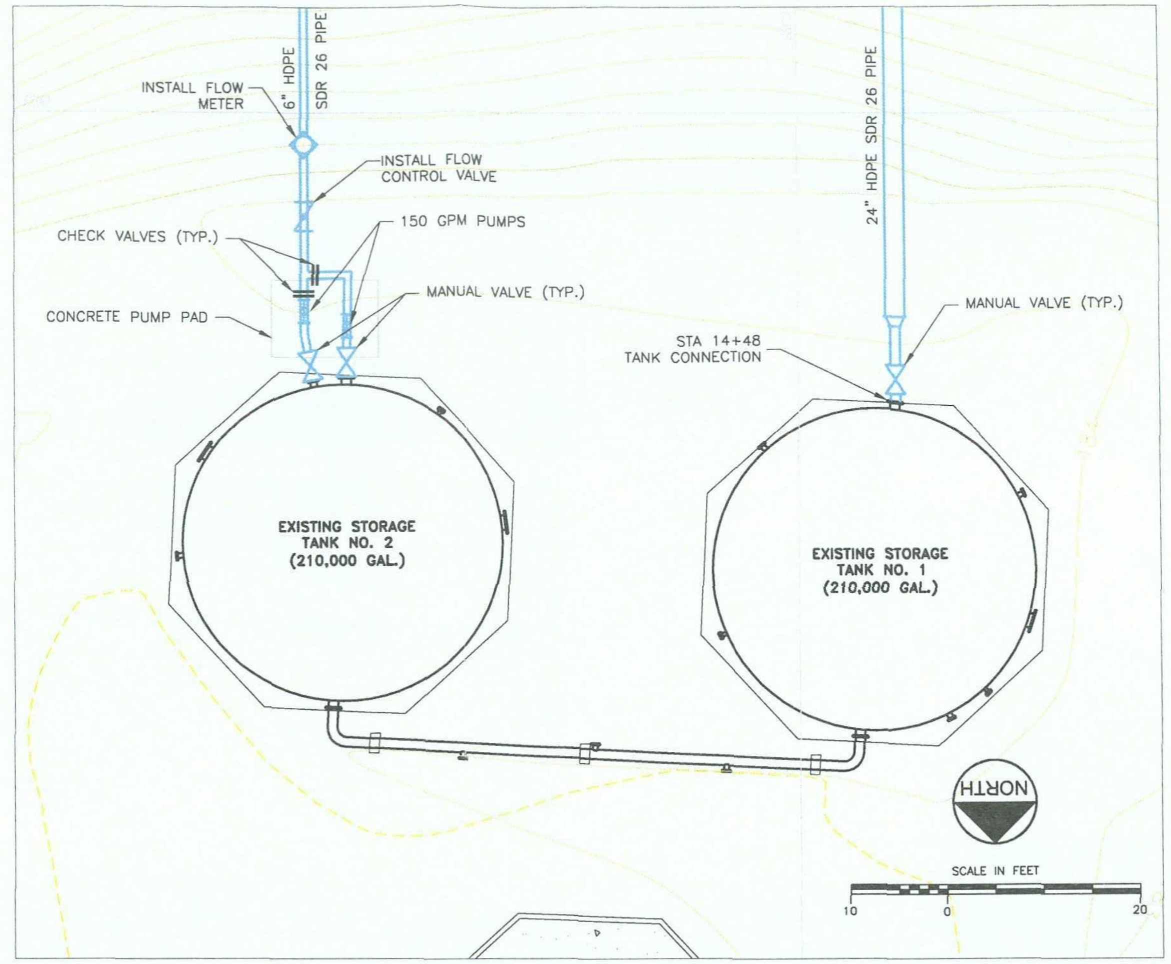
X:\Clients\Giant Cinizo\Storm Drain System Extension\CADD\LDD-Cinizo\dwg\Design\Conceptual design_rev B\SHEET 03-05 P&P..dwg SAVED:11/1/07 PRINTED:11/5/07 BY:LORI ANN LASTER



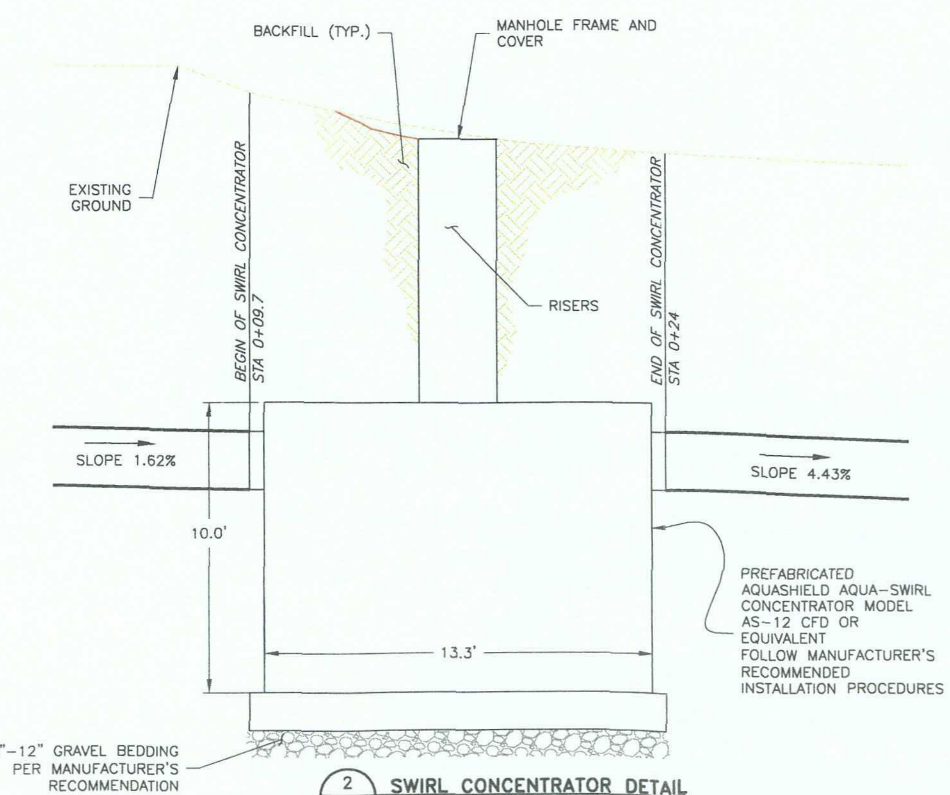
PLAN



PROFILE
VERTICAL SCALE 4X



1 04|04 STORAGE TANK PIPE DETAIL



2 03|04 SWIRL CONCENTRATOR DETAIL

GENERAL NOTES:

1. GRID LINES AND COORDINATES SHOWN ON PLANS ARE GIANT REFINERY LOCAL COORDINATE SYSTEM.
2. ELEVATIONS BASED ON EXISTING GIANT REFINERY DATUM. ADD 6704.50 TO LOCAL DATUM TO REACH N.G.V.D. 1929.

REV.	DATE	DESCRIPTION	BY
A	8/07	ISSUED FOR REVIEW	DRK
B	9/07	ISSUED FOR REVIEW	DRK

PROJECT NO.	320619
DATE:	9/07
DESIGNED BY:	JAC
DRAWN BY:	WCP
CHECKED BY:	JAC
APPROVED BY:	DRK

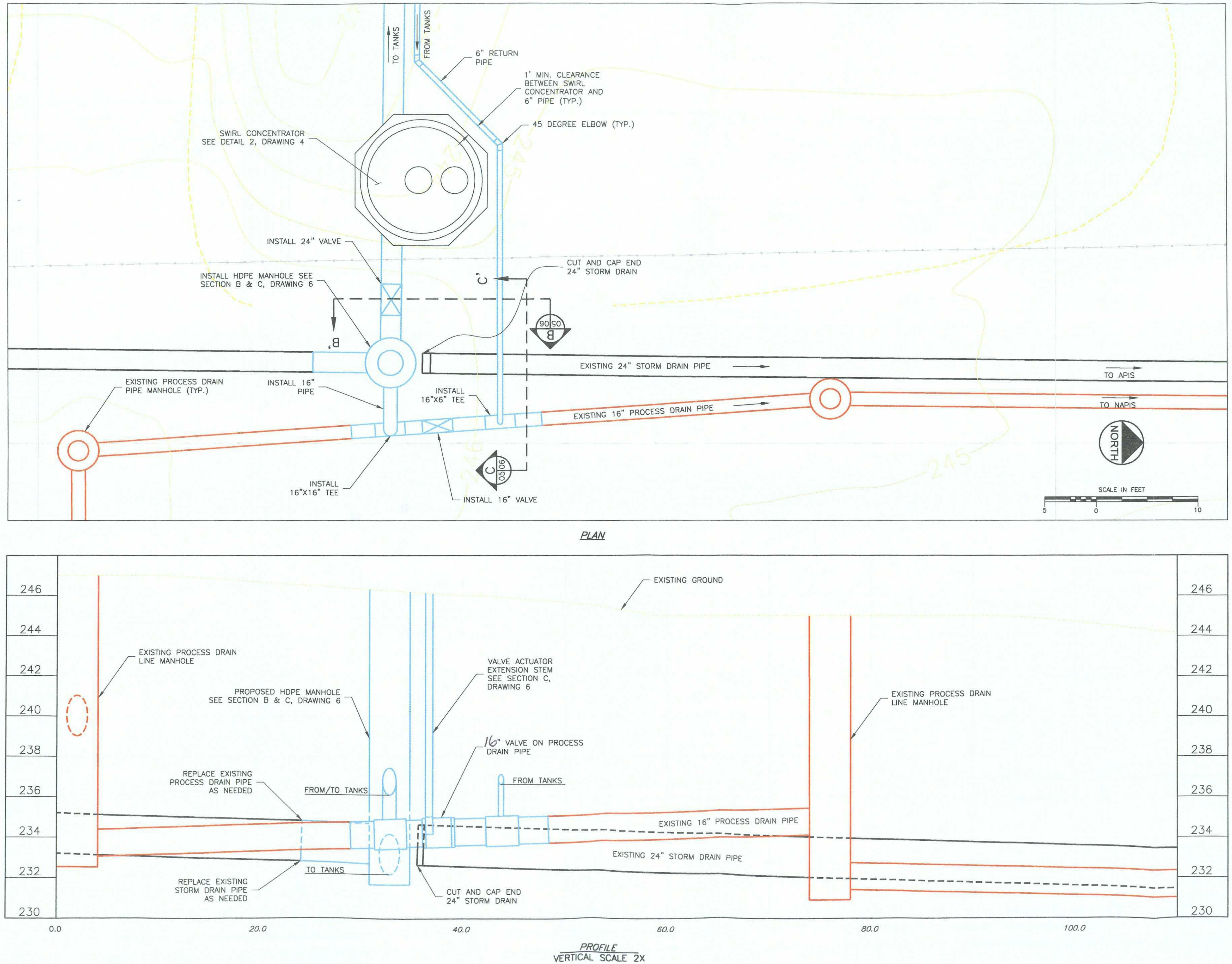
PREPARED BY:

STORM DRAIN SYSTEM EXTENSION
PLAN, PROFILE & DETAILS

PREPARED FOR:

GIANT REFINING CO.
A DIVISION OF GIANT INDUSTRIES

DRAWING NO. 4/6



GENERAL NOTES:

1. GRID LINES AND COORDINATES SHOWN ON PLANS ARE GIANT REFINERY LOCAL COORDINATE SYSTEM.
2. ELEVATIONS BASED ON EXISTING GIANT REFINERY DATUM. ADD 6704.50 TO LOCAL DATUM TO REACH N.G.V.D. 1929.

REV.	DATE	DESCRIPTION	BY
A	8/07	ISSUED FOR REVIEW	DRK
B	9/07	ISSUED FOR REVIEW	DRK

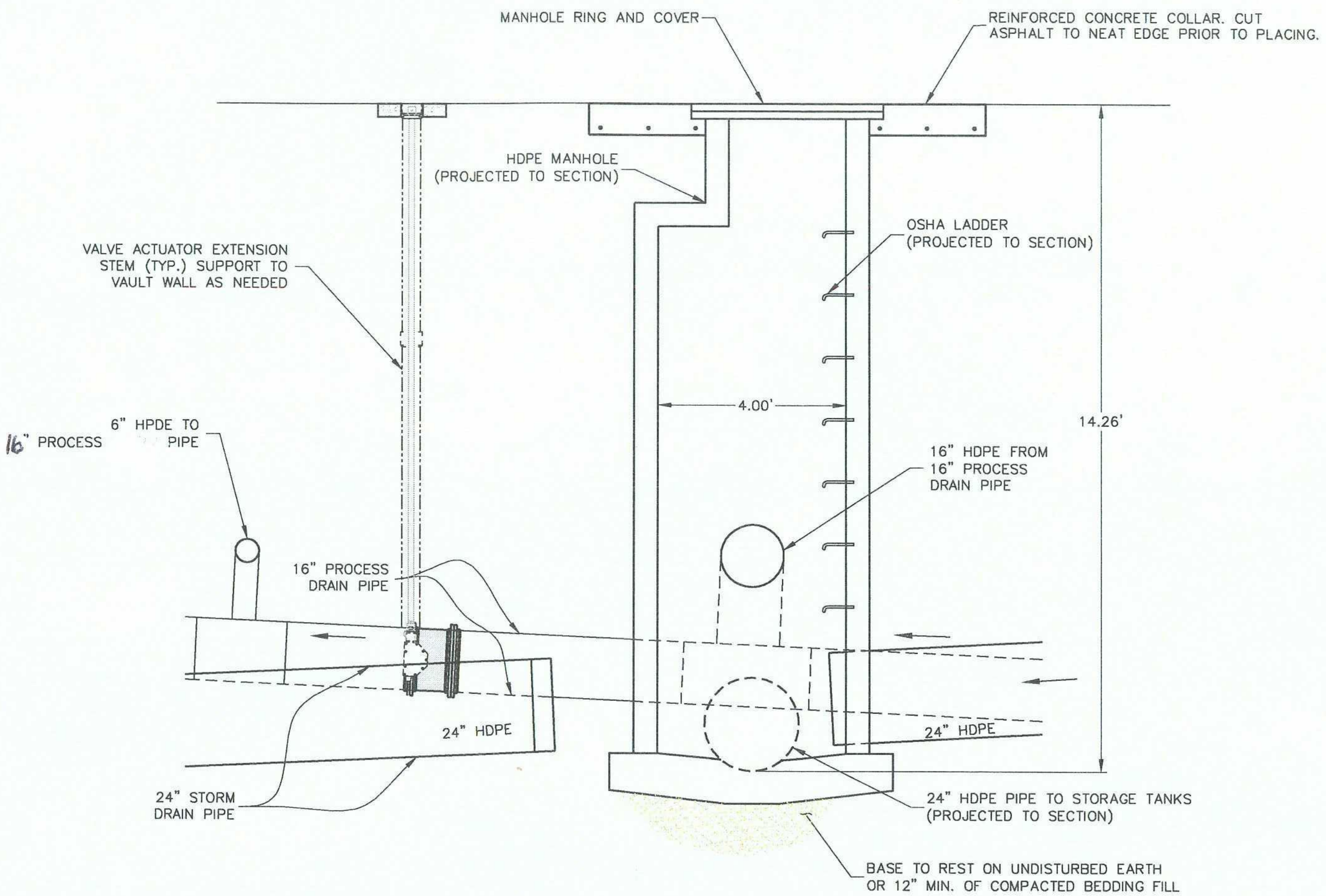
PROJECT NO:	320619
DATE:	9/07
DESIGNED BY:	JAC
DRAWN BY:	WCP
CHECKED BY:	JAC
APPROVED BY:	DRK

PREPARED BY:

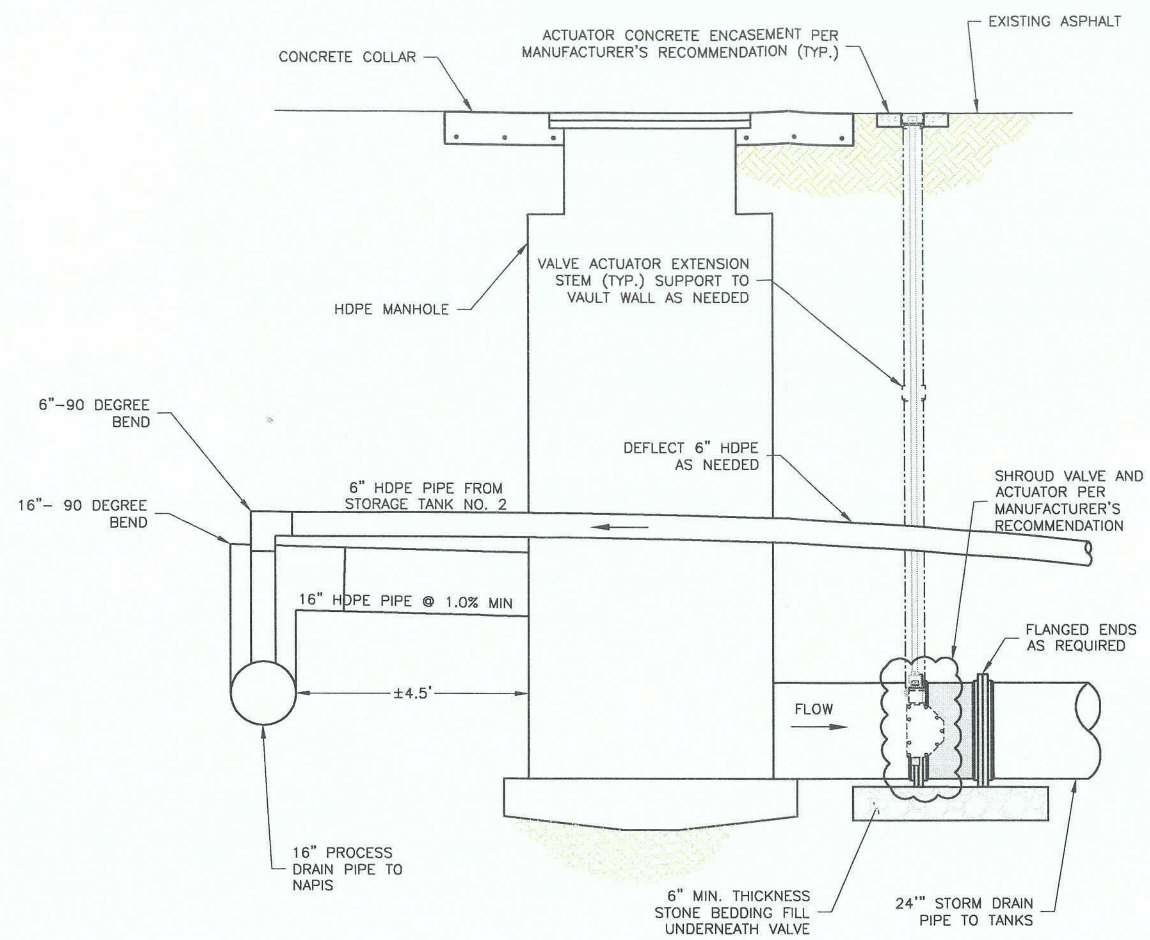
STORM DRAIN SYSTEM EXTENSION PLAN & PROFILE

PREPARED FOR: GIANT REFINING CO. A DIVISION OF GIANT INDUSTRIES

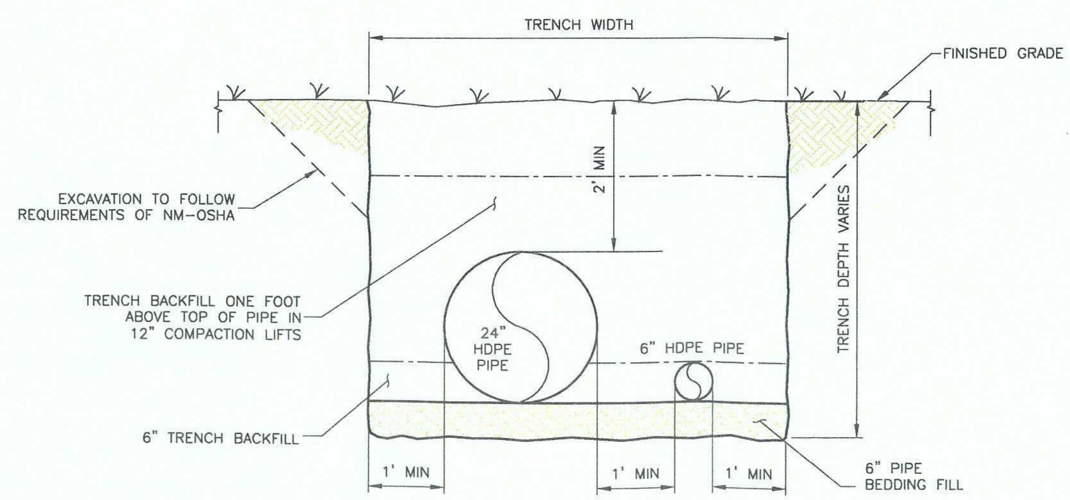
DRAWING NO. 5/6



B 06 06 **ELEVATION VIEW – STORM MANHOLE**
N.T.S.



C 06 06 **ELEVATION VIEW MANHOLE/PROCESS TIE IN**
N.T.S.



A 03 06 **TYPICAL TRENCH BACKFILL DETAIL**
N.T.S.

REV.	DATE	DESCRIPTION	BY
A	8/07	ISSUED FOR REVIEW	DRK
B	9/07	ISSUED FOR REVIEW	DRK

PROJECT NO:	320619
DATE:	9/07
DESIGNED BY:	JAC
DRAWN BY:	WCP
CHECKED BY:	JAC
APPROVED BY:	DRK

PREPARED BY:

Tt

STORM DRAIN SYSTEM EXTENSION DETAILS

PREPARED FOR:

GIANT REFINING CO.
A DIVISION OF GIANT INDUSTRIES

DRAWING NO
6/6

X:\Clients\Giant Cinizo\Storm Drain System Extension\CADD\LDD-Cinizo\dwg\Design\Conceptual design_rev B\SHEET 06 DETAILS .dwg SAVED:11/1/07 PRINTED:11/5/07 BY:LORI ANN LASTER