TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
Water Permits & Resource Management Division

A Drought Planning Guide for Public Water Systems in Texas

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A Drought Planning Guide for Public Water Systems in Texas

Prepared by
Water Permits & Resource Management Division

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Introduction

Public water systems in Texas are all different, but one thing they all have in common is the responsibility to provide safe, reliable water to their customers. This can be quite a challenge when Texans face drought conditions.

In these hard times, your customers count on you for a scarce but essential human need—drinking water. They also rely on you as a public health provider of water for basic sanitation in the community.

We hope this guide helps you prepare your public water system to meet the needs of your community and your customers during a crisis like drought.

As you read this guide, remember that drought is just one of the many conditions that can compromise your ability to provide safe water to your customers reliably. Consider, too, how your system might deal with floods, power outages, unusually cold weather, and other disruptions in service, whenever they occur.

This drought planning guide has been updated for use by all public water systems in Texas, including:

- city-owned public water systems,
- water districts,
- water supply corporations,
- investor-owned water utilities, and
- county-owned public water systems.

Who Should Read This Guide?

If you are the operator or manager of a public water system in Texas, this guide is for you.

Should I Share This Guide with Others?

Certainly. Share this guide with anyone who is involved in the management and day-to-day operation of your water system—for example, members of a board of directors or city council, if you have one.

If you need extra copies of this publication, you can print it from our Web site (click on "Publications" at the top of the page):

www.tnrcc.state.tx.us

or order a copy from TNRCC Publications one of these ways:

- Fax your order to 512/239-4488
- Mail your request to:
  TNRCC Publications, MC 195
  PO Box 13087
  Austin TX 78711-3087
- Call 512/239-0028

How to Contact Us

For information about topics covered in this guide, contact the appropriate TNRCC team in the following sections of the Water Permits & Resource Management Division of the TNRCC's Office of Permitting, Remediation & Registration:

- Public Drinking Water Section, 512/239-6020
- Utilities & Districts Section, 512/239-6960
- Water Rights Permitting & Availability Section, 512/239-4730

On the Web, go to **www.tnrcc.state.tx.us**. Click on "Index" and choose a topic under "Drought" or "Water."

Note: This drought planning publication is for general guidance only. It does not take the place of the rules and regulations covered by the guide.

Where to Find the Rules

The rules that pertain to public water systems are contained in Title 30 Texas Administrative Code (30 TAC), Chapter 290, Subchapter D. These rules have been published in TNRCC publication RG-195, *Rules and Regulations for Public Water Systems*. Rules for drought plans are in 30 TAC, Chapter 288, Subchapter B.

You can find both the rules and the publication on the TNRCC's Web site, **www.tnrcc.state.tx.us**. Click on "Publications" or choose "Rules" and follow the link to the Secretary of State's Web site.

How Well Do You Know Your Water System?

A Checklist with Some Helpful Hints

1. Are you in a drought? Is your area experiencing lower-than-normal rainfall? Is your area in a water-supply crisis?

   - ☐ **Yes**—Go to Question 2.
   - ☐ **No**—Go to Question 4.

2. Do you need help *now*?

   - ☐ **Yes**—Call staff members at the TNRCC's Austin offices. Contact information appears in the introduction and throughout the publication. Check Chapter 6 for more contact information, including numbers for the TNRCC regional offices and information about the Texas Water Development Board, which is another state agency involved with drought and water issues.
   - ☐ **No**—Go to Question 3.

3. Has this drought, emergency, or water shortage caused *any one or more* of these problems for your water system:
   - reduced water supply?
   - low pressure?
   - outages?
   - the need to issue a boil-water notice?

   - ☐ **Yes**—To find out how to deal with these crises, read Chapter 1, "Emergencies and Boil-Water Notices" now. When the crisis is over, come back to this checklist.
   - ☐ **No**—Go to Question 4.

4. Can you recognize your system's triggers for water-use restrictions?

   - ☐ **Yes**— Knowing when to restrict water use is an important step in managing your system's resources during a water emergency. Go to Question 5.
   - ☐ **No**—*Triggers* are signals, or weak links in your system, that tell you it's time for your customers to cut back on their use. Read "Identifying Your System's Drought Triggers" in Chapter 2, "Drought Contingency Plans."

5. Have you reviewed your system's drought contingency plan (DCP)?

   - ☐ **Yes**—It is always a good idea to review your DCP to make sure it is still effective and that it will help your system in the latest emergency. Now would also be a good time to decide if your DCP should be updated. You might especially want to read sections on "Getting the Public Involved" and "Educating the Public" in Chapter 2 on DCPs.
   - ☐ **No**—Now is the time to find it and make sure it's up to date. Read Chapter 2, "Drought Contingency Plans," to learn what elements your DCP should contain.

6. Do you know if *all* of the water you treat is actually reaching your customers?

   - ☐ **Yes**—Are you sure? Check your system's total number of gallons billed against the total number of gallons your well or treatment plant produced. If the difference is more than can be accounted for by flush valves, irrigation of public spaces, and other unmetered uses, it's possible that your system is losing water. Read Chapter 4, "Reducing Water Loss: Leak Detection and Preventive Maintenance."
   - ☐ **No**—When your water supply is critical, every drop counts. Water shortages can result from leaks in the system, not from actual shortages in supply. To learn more about finding leaks in your system, read Chapter 4, "Reducing Water Loss: Leak Detection and Preventive Maintenance."

7. When the next drought or water shortage arrives, will your system be ready?

   - ☐ **Yes**—Good. This means that you are a good manager, that you have learned from past experience, and that you have taken stock of what you need to do. Read Chapter 5, "Planning Ahead," to learn more about keeping on top of your system's needs.
   - ☐ **No**—Drought is a given in Texas. Your water system can experience shortages during nondrought seasons, too. Start preparing now! Look at your rate structure and consider options that encourage customers to conserve. Read Chapter 3, "Using a Rate Change as a Drought Strategy." Also read Chapter 5, "Planning Ahead" and begin completing the Master Plan Data Sheet, Appendix E.

8. Do you know where to get information on these topics:
   - funding sources and other financial issues?
   - help with planning?
   - technical assistance?
   - good management practices?
   - when and how to issue boil-water notices?

     ☐ **Yes**—Good. But if you don't have all that information in one place, check out the lists of contacts under "Getting Outside Help" in Chapter 5 on "Planning Ahead" and in Chapter 6, "For More Help."

     ☐ **No**—Look through the contacts listed in Chapters 5 and 6. One or more of these sources can give you the information you need.

Chapter 1
Emergencies and Boil-Water Notices

Low Pressure and Water Outages

When do you need to issue a boil-water notice?

There are two common situations resulting from drought or other water supply problems that may require public water systems to issue boil-water notices:

- low distribution pressure resulting, for example, from a pump failure or line break; and
- water outage, a complete loss of water supply due to equipment failure or depletion of the water source.

A flowchart in Appendix A shows the kind of immediate response that is required by a water supplier when either of these emergencies exists. See this flowchart to help you determine if you need to issue a boil-water notice. This flowchart also appears in the rules in 30 TAC, Section 290.47, Appendix H.

Other conditions when you may have to issue a boil-water notice

You should consider the need for issuing a boil-water notice in the following conditions, although they are not related to drought or the flow chart (call the TNRCC for guidance):

- when microbiological samples from the system are found to contain *E. coli* or fecal coliform organisms;
- when you have inadequate disinfection levels;
- when you have elevated finished water turbidity levels; and
- when the system is flooded.

How do you issue a boil-water notice?

- You must issue all your customers a boil-water notice within 24 hours using the required boil-water language. A sample in English appears in Appendix B of this publication. It is found in 30 TAC, Section 290.47, Appendix E.
- You can mail the notice, and/or deliver the notice to each customer, and/or put it on television and/or radio.
- You should issue bilingual notification, as necessary. See Appendix C of this publication for the required notice in Spanish.

Who else do you notify?

- Call your TNRCC's drought coordinator at 512/239-6054.
- Send a copy of the notice to:
  TNRCC
  Public Drinking Water Section, MC 155
  PO Box 13087
  Austin TX 78711-3087
- Call the TNRCC regional office nearest you to notify them about the boil-water notice.
- Call your county health department in case they get calls from your customers.

What should a boil-water notice say?

A sample of the required English notice appears in Appendix B of this publication, and a sample of the required Spanish notice, in Appendix C. You can fill in your name and phone number and make copies for your customers. Read through the sample notice so you are familiar with what your customers need to do.

How long must this boil-water notice stay in effect?

A boil-water notice must stay in effect until ***all*** of the following conditions have been met:

- water distribution pressures of at least 35 pounds per square inch (psi) can be maintained consistently;
- a minimum of 0.2 mg/l free chlorine residual or 0.5 chloramine residual (measured as total chlorine) is present throughout the system;
- special water samples collected in the distribution system for microbiological analysis are found negative for coliform organisms; and
- any other situations that might compromise the potability of the drinking water.

Do customers need to be notified when the boil-water notice is lifted?

Customers must be notified when the boil-water notice has been lifted, and it is safe to drink the water. The notice may be hand-delivered or communicated by the local media—newspapers, radio, or television.

How can you keep good communication with your customers?

Good customer relations are an important factor during a drought or water shortage. Make sure you do the following:

- Involve the public.

- Make your customers part of the process and your plans.
- Give your customers the correct information as soon as possible through meetings, newspapers and newsletters, local radio, and television.
- ***Keep it honest, keep it simple, and keep it consistent.***
- Keep a list of phone contacts who can provide information or service to your customers in the event of a major water system failure.
- Decide who will be your contact with the media, and make sure they have the latest information.
- Make sure your employees know to direct inquiries to your media contact.

Emergency Sources and Approval Requirements

A public water supply "emergency" exists when the loss of supply will result in normal operating conditions of less than 35 psi throughout the entire distribution system (for example, your well goes dry). This is the minimum standard for a public water supply.

When emergencies occur as a result of drought, flooding, or equipment failure, it is sometimes necessary to connect to an alternate source of water on a temporary basis.

Before an emergency occurs you should:

- Evaluate the existing system and determine what improvements can be made to alleviate potential emergency outages.
- Evaluate alternate sources of water that may be needed in an emergency—for example, interconnects, unused public water supply wells, or raw water sources.
- Enter into TNRCC-approved, written agreements for emergency interconnection with neighboring systems.
- Review the steps necessary to activate the alternate source.
- See Chapter 5, "Planning Ahead," for more ideas.

Before connecting to an alternate water source you must:

Obtain TNRCC approval. The TNRCC will only consider approving an alternate water source when you have implemented water-use restrictions. For more information, contact the TNRCC's Utilities & Districts Section, 512/239-6960.

All temporary and permanent piping must be acceptable to the TNRCC. However, normal installation requirements can be waived for temporary use. Contact a TNRCC regional office (see Chapter 6, "For More Help") or the TNRCC's Public Drinking Water Section, 512/239-6020.

Sources of water that may be used on a temporary, emergency basis include:

- An adjacent public water system.
- A public water supply well that is not currently in use by the system.
- A nonpublic water supply well (normally restricted to domestic, irrigation, or industrial uses) with approval. **Note:** Wells can be approved for temporary, emergency use without all standard equipment (for example, a 6-foot slab, sampling tap, 18-inch casing, or well meter).

Alternate water sources are approved in the following order of preference:

- **First preference**—source meets *all* drinking water standards. They include *primary standards,* which are health-related; and *secondary standards,* which are aesthetic in nature and change the taste, color, and odor.
- **Second preference**—source meets all primary standards, but has secondary violations.
- **Third preference**—source has primary violations, in which case additional notification and provision of bottled water may be required.

Note: The TNRCC will accept private laboratory or historical chemical results when reviewing emergency source proposals. Water quality sampling and acceptance will be coordinated by the nearest TNRCC regional office and the Drinking Water Monitoring Team in the Public Drinking Water Section, 512/239-6020.

In certain cases, the TNRCC can, on an emergency basis, order a neighboring system to interconnect for up to 90 days. For more information, contact the Utilities and Districts Section, 512/239-6960.

Steps to activate a well that is an unused public water supply or a nonpublic water supply:

1. Introduce a free chlorine residual of at least 50 mg/l into the well casing and allow it to stand for at least 12 hours.
2. Pump the well "to waste" until no free chlorine residual is detected.
3. Obtain three successive daily raw water samples free of coliform organisms.
4. Contact the TNRCC's Public Drinking Water Section at 512/239-6020 for approval before using.

Steps to activate alternate raw water sources for surface water treatment:

1. Evaluate potential sources of contamination.
2. Evaluate temporary intake location.
3. Contact the TNRCC's Public Drinking Water Section at 512/239-6020 for approval before using.

Chapter 2
Drought Contingency Plans

What Is a Drought Contingency Plan?

The drought contingency plan (DCP) is defined as "a strategy or combination of strategies for *temporary* supply management and demand management responses to *temporary* and potentially recurring water supply shortages and other water supply emergencies." Unlike *water conservation,* which focuses on the *ongoing* maintenance and efficiency of the water supply system and customers' water-use habits, drought contingency is triggered by cases of **extreme drought, periods of abnormally high usage, supply contamination, or extended reduction in ability to supply water due to equipment failure.**

The rules and requirements for DCPs come from Title 30 of the Texas Administrative Code, Chapter 288, Subchapter B.

Who Must Have a Drought Contingency Plan?

If your water system charges its customers for water service, then you must have a DCP. The following table presents some basic points about your DCP, depending on the ownership of your water system.

If you are a	To officially adopt a DCP, you must	To set special drought rates, you must	In your DCP, user fines are
city, town, or other municipality	adopt an ordinance	adopt an ordinance	allowed
district	pass a resolution	pass a resolution	not allowed
water supply corporation (WSC)	amend your tariff (requires board approval)	amend your tariff (requires board approval)	not allowed
investor-owned utility (IOU)	amend your tariff (requires TNRCC approval)	amend your tariff (requires TNRCC approval)	not allowed
county	pass a commissioners court order	pass a commissioners court order	allowed

How can I tell if my system is an investor-owned utility?

Some investor-owned utilities call themselves a "district" or a "water supply corporation." Regardless of the name, the water system is an investor-owned utility (IOU) if its owner is one of the following:

- an individual,
- a for-profit corporation,
- a partnership, or
- a nonprofit homeowners'or property owners' association.

In other words, *unless* your water system is operated by a city, a district established under state law, a county, or a nonprofit water supply corporation organized under Chapter 67 of the Texas Water Code, it is almost certainly a private investor-owned utility. You can find the rules pertaining to IOUs in 30 TAC, Chapter 291.

It is important to know if you are an IOU because your DCP—as well as your rates, fees, and service policies—must be incorporated into your tariff and approved by the TNRCC. To find out more about your options during a drought or other water crisis, see "Rate changes for IOUs" in Chapter 3, "Using a Rate Change as a Drought Strategy."

How do I get my DCP approved?

Once you have completed your DCP, you must get it approved by your governing body.

- City, town, or other municipally-owned water supplier—approved by the city council as an ordinance.
- District water system—approved by your board of directors as a resolution.
- Water supply corporation (WSC)—approved by your board of directors and included in your tariff.
- Investor-owned utility (IOU)—approved by the owner or board and by the TNRCC and included in your approved tariff.
- County-owned water supplier—approved in a commissioners court order.

IOUs must incorporate DCP into tariff

Investor-owned utilities must incorporate their approved DCPs into their tariffs, according to 30 TAC Chapter 288, Subchapter B, and Chapter 291, Subchapters B and F.

Because your DCP is considered a minor amendment to your tariff, you can incorporate it by sending a written request to:

TNRCC
Water Rights Permitting & Availability Section, MC 160
PO Box 13087
Austin TX 78711-3087

IOUs located within a city must have a minor tariff amendment approved by the city.

What if I don't charge for water?

There are some water systems in Texas that do not charge their customers for water service—for example, some military institutions, colleges, universities, businesses that have their own water systems, prisons, truck stops that are far from any other water system, or even some mobile home parks.

If you operate or manage one of these systems, you are encouraged to develop a DCP, even though state law does not require it. This guide will help you understand how to prepare for the next drought.

What Steps Does a Drought Contingency Plan Include?

A DCP covers four phases of preparing for and coping with a drought:

1. preparing for droughts before they occur,
2. taking action as a drought begins to put a strain on your system or supply,
3. enforcing water-use restrictions during the drought, and
4. ending water-use restrictions when appropriate.

Each of these stages is addressed through two or more components of the DCP called for in the TNRCC rules.

Step 1: Preparing for Droughts

Preparing for a drought begins with the required components of public involvement and public education. You should also cover coordination with nearby water systems in this phase of your DCP. Another required component involves identifying your system's drought triggers. Conducting a thorough analysis of your system to identify these triggers is a critical exercise that can make or break the success of your DCP.

Getting the public involved

You must involve your customers in preparing your DCP. The reason for this is simple: if your customers have a voice in preparing the DCP, then

they will be more likely to use water wisely and comply with water-use restrictions when the plan gets implemented.

The success of your DCP depends upon how well your customers react to the message you give them when facing a potential water supply problem. The goal for any public water supplier should be to achieve the necessary water-use reduction through voluntary water-use restrictions. The buy-in that is necessary to successfully reduce water can only take place through customer involvement in both preparing and refining the DCP.

Common ways to involve the public include:

- providing public notice that a drought plan is being prepared;
- forming a citizen's advisory committee or task force;
- holding public meetings;
- conducting customer surveys;
- seeking input directly from large-volume water customers and other groups most likely to be directly impacted during implementation (for example, landscape maintenance contractors, owners of car washes, golf course operators); and
- distributing the draft plan for public review and comment prior to adoption.

Educating the public

An educated, well-informed customer is more likely to comply with voluntary and mandatory water-use restrictions. If your customers understand what they are asked to do, when they are supposed to do it, and why, they will have a better chance of actually changing their water-use patterns to help the system.

Ongoing public education should inform customers of the conditions that would trigger water-use restrictions. Let your customers know what it takes to get water to their faucets, what the system limitations are, and what they can do to help.

The information provided should include a description of the conditions that will trigger implementation of the plan and a description of what can be expected once the DCP is in effect, including the response and enforcement measures that must be taken. This information can also be coupled with water conservation tips for ongoing water savings inside and outside of the home.

Providing practical consumer information will help customers comply with the plan. For example, you might send out tips on proper lawn-watering practices with information about restrictions on lawn watering.

Coordinating with nearby water systems

As you think about public involvement in the drought planning process, consider coordinating with nearby water systems within your region. If your water system relies on the same water supply source as another system, you could be affected by a drought in similar ways. Having similar response stages (watering schedules) might enhance your ability to communicate with the public through a regional news media. You should still be on guard for confusion that can arise when there are differing requirements among local jurisdictions within the same area.

You and your neighboring water systems will have separate DCPs with different drought triggers. You should still coordinate on specific water-use restrictions to reduce customer confusion. For example, you might each adopt a twice-a-week watering schedule in which residences with street addresses ending in even numbers are allowed to water on Sundays and Thursdays and those with addresses ending in odd numbers are allowed to water on Saturdays and Wednesdays.

This would also be a good time to explore your options for entering into a written emergency interconnection agreement with a neighboring system to get more water in the event of an emergency (see Chapter 1, "Emergencies and Boil-Water Notices").

How to identify your system's drought triggers

Unlike other types of weather-related natural disasters, droughts develop slowly over the course of months and years. Because of the almost imperceptible development of drought, public water suppliers need to identify drought triggers that may indicate potential water supply problems before they actually happen.

Because your DCP is required to include measures for dealing with both supply and demand problems, your triggers should be defined in the same way. *Supply-side triggers* are associated with *getting* the water—the water supply system's management of the available source of water, such as a well or a lake. *Demand-side triggers* are associated with *delivering* the water—the public's use of it. In Texas, as the water supplies dwindle, we also usually see an increase in demand because of outside watering and swimming pools.

The triggers you identify in your DCP should be easy for you to monitor and measure. They should be stated in a way that can be understood by the public. This will help you establish the stages that require action. Such a gradual approach will help you avoid over- or under-reacting as you gear up for drought conditions and later as you scale back, based on the level of

available water (see Appendix D, Example of Drought Response Stages with Supply- and Demand-Side Triggers).

It is important to develop triggers that best suit the unique climate, geology, and stream-flow conditions in your area. Historical records will help you determine the *drought of record*—the period of time when the amount of water in the supply source is at its lowest levels. TNRCC rules require you to estimate the quantity of water that can be provided from a given supply source by comparing it to a repeat of the drought of record for your area, and to plan for a situation that compares to the lowest historical amount of water in that supply (see also "Supply-side triggers" below).

What are response-stage triggers?

Listed below are examples of the *triggers*, or *weak links*, in your water system that might be identified as a signal for initiating a drought response. They are broken out in supply and demand categories. Also see Appendix D for an example of how supply- and demand-side triggers can be defined in a five-stage DCP.

Supply-side triggers

- **Well level**. The most common source of water for systems. Declining water levels in the well define triggers for initiating a drought response.
- **Storage tank recovery**. Reflects the ability of your pumps to keep up with your customers' demand.
- **Reservoir storage**. How much water is in a lake or pond. While lake levels are easy to see, looks can be deceiving. Due to evaporation, silting, and the actual shape of the reservoir, you may have less water than you think you do.
- **Streamflow**. The amount of water flowing down the river or into your reservoir might be a good way to predict a potential supply limitation.
- **Wholesale supplier's drought stage**. If you are a wholesale customer, your triggers could be affected by water availability in your wholesale supplier's area.
- **Contamination**. *A required trigger.* Results from biological or chemical contamination (see Chapter 1 "Emergencies and Boil-Water Notices").

Demand-side triggers

- **Treatment rate as a percentage of plant capacity**. How much water you can treat on a given day. Can change from one day to the next.

- **Total daily demand as a percentage of storage capacity.** Associated with storage and delivery to the public.
- **Total daily demand as a percentage of production capacity.** How much water you can pump from the supply source.
- **Pump hours per day.** Related to production capacity. A good way to measure how hard your system is working to provide water. Continuous pumping can cause stress on the system and lead to mechanical failure.
- **Mechanical problems.** *A required trigger.* A catchall category for such problems as line breaks, leaks, pump failures, and clogged intakes.
- **Outage.** *A required trigger.* A systemwide outage due to depletion of water supply (for example, your well is dry) or equipment failure (for example, pump failure).

Step 2: Taking Action as Drought Begins

When you recognize that one or more triggers have occurred, you must respond appropriately. To be ready to respond, you will need to develop three more required components of your DCP—the response stages, notifying customers, and notifying the TNRCC.

What are response stages?

The response stages in your DCP should spell out two kinds of action that must be taken in response to the specific triggers you have identified:

- what action your water system will take to manage the water supply—the way you operate your system, such as leak detection and repair, adjusting the pressure, or acquiring alternative water supplies; and
- what action the system will ask or tell its customers to take to use less water—*water-use restrictions.*

How do you begin water-use restrictions?

Water-use restrictions should gradually curtail nonessential water uses as you progress through stages—from mild to moderate, severe, and critical, and finally to emergency conditions.

Implement in stages

A relatively simple DCP has four or five stages. An example of drought response stages with supply- and demand-side triggers and responses appears in Appendix D.

Water-use restrictions are all demand-side measures because they involve actions taken by the public. Because they must be monitored, they are

almost always visible, like outdoor water use—watering lawns and washing cars.

Make sure that the restrictions you initiate don't actually cause customers to *increase* water consumption. This has been shown to be the case with alternate-day and odd-even watering schedules. People tend to panic. They feel compelled to water on their assigned day, even when they don't need to. This is when customer education becomes very important.

A better alternative is a twice-a-week watering schedule based on customer addresses. This approach, coupled with "anytime watering" with a hand-held hose, is consistent with horticultural recommendations for maintaining landscapes, even in drought.

Consult your DCP

Before you start restricting water use, make sure you have met all the requirements outlined in your drought contingency plan, including notice. If those procedures do not match your needs, your DCP may need to be updated. When you have determined that water-use restrictions are necessary, start with a voluntary watering schedule and tips for how to use less water.

If the water demands on the system remain high or continue to increase, there will come a point when the welfare and integrity of your system and pumps may be jeopardized. At this point you may have to implement mandatory water-use restrictions, or in a critical condition, prohibit all outside watering.

Your goal should be to provide your customers with a continuous and adequate supply of water for reasonable uses. *Remember, mandatory restrictions can only be implemented under the specific conditions listed in your drought continency plan.*

Notifying your customers

The means by which you notify your customer of a drought stage may be similar to the method used for the public involvement and public education. It is important to understand that notifying your customers when they are in a drought stage is not the same thing as "public education." If little or no public education has been done prior to the implementation of the DCP, then you may not be able to reduce your customers' water use effectively.

You should develop written procedures for notifying the public about the initiation and determination of drought response stages. Some procedures to notify the public include:

- announcements to local media—television, radio, and newspapers;
- door-to-door notification during water supply emergencies;
- signs along major roadways or marquees at businesses or churches; and
- dissemination of information through churches, schools, and civic groups.

Notifying the TNRCC

If you are a public water system, you are required to notify the TNRCC of any mandatory water-use restrictions imposed on your customers. This notice, which is required by TNRCC rules, must be provided within five working days of the day the mandate was issued. You should call the TNRCC drought coordinator at 512/239-6054.

Also be sure to notify the drought coordinator when water-use restrictions are lifted. Information on water-use restrictions is posted on the TNRCC Web site for public access.

Step 3: Enforcing Water-Use Restrictions

When implementing mandatory water-use restrictions, it is essential to have and use enforcement measures for customers who violate the restrictions, depending on your type of water system. The enforcement measures can vary from fines and water-use surcharges to flow restrictors and, ultimately, termination of water service.

A little visible enforcement can go a long way. Most water systems count on voluntary compliance and monitoring by utility staff and the public. Municipal water systems may also use their police force to help enforce compliance. Political subdivisions have the power to levy fines. IOUs have the option of terminating water use.

Deciding how to deal with a customer who won't cooperate with water-use restrictions can be troublesome. The specific steps should be listed in your drought contingency plan. Any enforcement must be consistent and nondiscriminatory.

IOU enforcement

It is important to note that privately-owned utilities (IOUs) are limited to these enforcement measures that are included in an approved tariff:

- issuing written warnings;

- installing flow restrictors; and
- cutting off service for 7 days or until the end of the month, whichever comes first.

Establishing procedures for variances

Your DCP must also address the issue of variances. If a customer cannot comply with water-use restrictions, then your DCP must allow them to apply, in writing, for a variance to the restrictions. For example, some allowance might be provided for more frequent watering of newly installed landscapes.

Variances should be granted only for a specific time frame and use. Variances should expire when the restrictions are lifted.

Step 4: Pulling out of the Drought

Your system should emerge from a drought in the same measured stages that you established to initiate action. Your plan for ending water-use restrictions is defined by your drought triggers—once conditions improve to the point that the triggering conditions no longer exist, you can scale back to a less severe response stage.

Telling your customers when to reduce or lift restrictions is just as important as telling them when you implement restrictions. If the public understands and accepts these measures, they will be more likely to comply. If there is confusion, then compliance will probably be low.

Be sure that your DCP clearly states how customers are to be notified that water-use restrictions have ended.

You are required to review and update your DCP

Every drought is an opportunity to learn how well your DCP works. But even if the lesson is that you prepared for this drought well, will the situation be the same when the next drought arrives? Things change over time—your customer base might grow, new industries might come to your town, or the amount of water available to your system might change.

And even if there is no drought to learn from, remember that TNRCC rules require you to review and update your DCP **at least every five years**.

Coordinating with regional water planning groups

You should also pay attention to developments concerning regional water planning groups in your area. Senate Bill 1, the state's 1997 water

planning law, created 16 working groups around the state to study their areas' water availability and long-term demands. Studies for the 16 designated regions were presented to the Texas Legislature in January 2001. The 77th Legislature continued the regional water planning process that was established in Senate Bill 1.

You should keep up with activities of any regional water planning groups in your area and also provide them a copy of your DCP. You can get information about these groups from the Texas Water Development Board Web site, **www.twdb.state.tx.us**.

Requirements for Wholesale Purchases

When there is a contract for wholesale purchase, there are special requirements for both the buyer (customer) and the seller (supplier).

Wholesale customers

Wholesale customers must consult with their wholesale suppliers in preparing their DCPs. The DCP must include provisions for responding to reductions in the wholesale water supply. This applies to your system, even if only part of your water supply is obtained from another supplier.

Wholesale suppliers

If your water system supplies water to another system that sells water to the public, then you are a *wholesale public water supplier*. Wholesale drought contingency plans must be submitted to the TNRCC for review. For further information on drought contingency plans for wholesale public water suppliers, please call 512/239-4730 and ask for the Water Conservation & Drought Management Team.

Chapter 3
Using a Rate Change As a Drought Strategy

If you need to limit water use, consider using a rate change as part of your defense strategy in a drought or water supply crisis. Adjusting your rates can help you reduce demand on your system, generate revenues for capital improvements to increase supply, and recover some of the revenues lost due to water restriction.

Metered rates and rate changes can make a real difference in your system's performance because customers pay for the water they use.

Before You Begin, Ask Yourself ...

1. What do I really need? Gather and organize your records.
2. Am I making money or not? Are your revenues covering your expenses?
3. What can I do? I'm not making enough money from rates to cover my expenses.
4. Am I making enough money? I'm covering my expenses, but I need more to make repairs or improvements.
5. Do I have enough water? I'm making enough money, but I'm concerned about the demand on my supply.
6. If you need assistance, contact the TNRCC's Utilities & Districts Section at 512/239-6960, or other available assistance providers.

Where Do I Begin?

The procedure you use for implementing a rate change depends on your organization and ownership.

Rate changes for cities, districts, counties, and WSCs

If your water system is owned by a city, a district established under state law, a county, or a water supply corporation (WSC), you can change your rates with the approval of your governing body. The table at the beginning of Chapter 2 on DCPs shows how special drought rates must be approved for each type of public water system. Of course, you should follow all the appropriate procedures that are required in legal documents authorizing your organization. Pay particular attention to notice requirements for customers.

What about water rate surcharges?

An effective way to reduce demand is a water rate surcharge. It can take the form of higher charges for water use in excess of some base amount, or a temporary increase for a specific use. Water rate surcharges can be used to generate additional revenue to offset losses associated with reduced water sales.

What about rates to encourage conservation?

Your water system may want to consider a rate structure that discourages water use and promotes conservation. One choice is increasing block rates. With this rate structure, the customers who use more water also pay more per unit. The wear and tear on the system is paid for by those who cause it. For example, rates will be higher for customers who water their lawns during peak-demand summer months.

Your system should explore all the rate options that are available to help control water use. But you need to plan ahead to be sure these strategies are in place by the time you need them. This is one way to prepare your customers for the shortages you know you will have in the coming months.

Rate changes for IOUs

If you are an IOU and you want to change your rates, you must first get approval from the TNRCC and then include the rate change in your tariff. However, if you are an IOU operating in a city, its governing body must approve your rate change. You must also provide notice and an opportunity for a hearing. This can take some time, so you must plan ahead to make sure your rates are in effect when a drought occurs.

IOU rates and tariffs that are allowed under TNRCC rules are listed below. Some of these rates may not appear to be related to drought planning strategy. However, you should consider all the options that might be available. For example, a water rate increase to recover the costs for a required sampling, inspection fees, or other governmental requirements would allow you to recoup some losses during a drought, when other revenues are down.

There are two types of IOU rate changes—major and minor tariff changes. Call the TNRCC's Utilities & Districts Section at 512/239-6960 for advice and assistance on your options.

Major IOU rate and tariff changes

Major IOU rate and tariff changes require TNRCC review, customer notice, opportunity for public comment, and a hearing, if applicable. Several of these rates, which are indicated with an asterisk, must be activated at the appropriate time, and only with TNRCC approval.

- Increasing block rates—the more customers use, the more they pay per unit. This rate discourages high water use.
- Conservation rate—rates that charge more than the cost of service at higher usage amounts.
- Phased rate*—a rate that goes into effect in stages to avoid rate shock.
- Single issue rate—allows recovery of costs for a single item, like a new well, but requires a complete rate case to be submitted within 24 months of the single-issue rate application.
- Temporary water rate*—allows utilities to recover losses resulting from orders to reduce pumping issued by courts and regulatory authorities.
- Purchased-water or water-use fee pass-through*—allows utilities to recover costs for water purchases, and for fees paid to withdraw water from an aquifer or lake.
- Surcharge—specific amount over and above the usual cost of service to be collected from customers for a specific use, for example the cost of installing a new storage tank.
- Extension policy—allows utility to control and plan its service territory when there are concerns about the ability to provide water and at what cost.

Minor IOU rate and tariff changes

Minor rate and tariff changes allow IOU's to take fairly quick action by filing a written request with the TNRCC for approval. The rates listed below with asterisks are all intended as follow-up action to one of the major rate changes listed above:

- Sampling cost surcharge—a flow-through to customers for costs a utility incurs for sampling and other regulatory requirements.
- Phased rate adjustment*
- Purchased-water and water-use fee pass-through implementation*
- Temporary water rate adjustment*
- Service rule and customer fee change—utility operation policies for disconnection, customer service inspection, meter testing and replacement, and payment options.

Chapter 4
Reducing Water Loss: Leak Detection and Preventive Maintenance

Water Loss

Your cheapest source of water is the water you do not lose. To combat water loss, you need to develop methods to detect, locate, and repair leaks. You will discover that the savings in water you do not lose far outweigh the cost of leak detection and repair.

What is water loss?

Water loss is the difference between:

- the amount of water produced, and
- the amount of water billed.

How does water loss occur?

Water loss occurs when:

- lines leak or break due to age, corrosion, or poor construction;
- valves are not maintained;
- water meters have stopped working or have lost accuracy;
- water use is not metered (such as at parks, fire departments, or other public uses); and
- theft from fire hydrants and flush valves.

When is action required?

All water systems experience some percentage of water loss. Generally, a water loss of 15 percent or less is acceptable. Water loss over 15 percent requires immediate attention and corrective action.

Why should you manage your water loss?

The increasing costs of pumping, treatment, and operation make it important to limit water loss all year, but especially during a drought. You should manage your water loss to:

- prevent significant loss of revenue,
- prevent higher-than-normal operating expenses, and
- conserve water.

How can you manage water loss?

You should:

- repair leaks quickly,
- replace customer meters on a scheduled basis to ensure accuracy,
- look for leaks,
- participate in a leak-detection program, and
- encourage your customers to report leaks.

How do you calculate water loss?

Use this procedure to calculate water loss monthly:

1. Figure out your system's *total* water loss.

Look at your records and fill in these blanks:
A. Total gallons pumped for the month: _____
B. Total gallons billed to customers for the month: _____

And then subtract B from A:
A - B = C (your system's total water loss in gallons): _____

2. Figure out your system's *percentage* loss.

(C ÷ A) x 100 = % water loss

(water loss ÷ water pumped) x 100 = % water loss

Example:

30,000 gallons pumped - 27,000 gallons billed = 3,000 gallons water loss

(3,000 gallons loss ÷ 30,000 gallons pumped) x 100 = 10% water loss

Leak Detection

While there are many sources of unaccounted-for water loss, the primary cause of excessive loss is usually leaks.

Who needs a leak-detection program?

Everybody. Preventive maintenance for all water distribution systems should include an active leak-detection and repair program.

What are the benefits of leak detection?

If done properly and regularly, a leak-detection program can save you money and water. A leak-detection program can:

- reduce water loss;
- reduce water demand during peak seasonal usage;
- reduce the strain to different parts of the water system components;
- reduce the risk of contamination;
- reduce property damage, legal liability, and insurance because of fewer main breaks;
- prevent emergency repairs;
- delay capacity expansion;
- increase revenue;
- increase your knowledge about the distribution system, which will help you respond to emergencies and set priorities;
- increase firefighting capability;
- improve relations with both the public and utility employees; and
- provide a highly visible example of water conservation to your customers, who will be encouraged to think about reducing their own water use before they are asked to take action.

How should you conduct a leak-detection program?

There are several methods for detecting leaks in your distribution system. You can use *sonic leak-detection equipment*, which identifies the sound of water escaping a pipe. Sonic equipment includes pinpoint listening devices for valves and hydrants and geophones for the ground. Or you can use *correlator leak-detection equipment* that pinpoints the exact location by listening at two points.

Small leaks make more noise than large leaks, and so they are easier to detect with *hydrophones*. They tend to cause more water loss on the long run because large leaks are usually found quickly and repaired.

A leak-detection program can be conducted by properly trained water system personnel or by water industry professionals.

Where should you focus on leak detection?

You should focus your leak-detection efforts where you expect the most problems:

- areas with a high rate of leaks and breaks,
- areas where leaks can cause the highest property damage,
- areas where system pressure is high,
- areas near stream crossings, and
- areas where pipes have not been designed to carry the loads.

Preventive Maintenance

Preventive maintenance is an important way to prevent water loss and to save water resources and money. But to institute a preventive maintenance program, you need to plan ahead to ensure that appropriate maintenance and system upgrades are completed in time to meet the demands of spring and summer high usage. Part of your planning should be to keep an adequate inventory of commonly used repair parts.

Timing is important

It is important to schedule maintenance and upgrades that require pumping and storage units to be out of service for times when water usage is lowest. Properly scheduled preventive maintenance completed during low-usage periods will also lessen the impact of the next drought or emergency situation.

Winter maintenance

For extended projects the winter months are usually the times of lowest usage, so this is the best time for the following kinds of work:

- repairing a well,
- repainting a storage tank,
- extending and upgrading water lines,
- any work that requires pumping and storage units to be out of service,
- upgrading distribution maps,
- checking and exercising valves to determine operational status,
- checking the production on wells and system pumps to get an accurate determination of gallons-per-minute produced,
- planning for future maintenance and upgrades, and
- organizing information for budget planning.

Late-night maintenance

For short-term projects, late night is a good time for maintenance. Such projects include:

- valving, and
- electrical repairs.

Chapter 5
Planning Ahead

When a water system first starts to notice a water shortage, it is often too late to increase the supply. There are long lead times involved in drilling a new well, adding plant capacity, or desilting a reservoir. Customers who are told to cut back on usage will wonder why the water system did not anticipate the shortage and take steps to avoid it by planning ahead.

There are a number of tools you can use to develop a planning process in your water system: a written master plan, a conservation plan, and a capital improvements program. You should also give some thought to consolidation and getting some outside help with your planning efforts.

Developing a Master Plan

A written master plan helps to keep a big-picture and forward-looking perspective. In Appendix E of this publication, you will find a handy master plan data sheet to help you get started and get your ideas on paper.

A person can find many reasons for not preparing a written plan—none of them are good. The most frequent reason is, "Why should I take the time to plan on doing something when I could just be doing it?" Another argument heard in small water system offices is, "Of course I have a plan. It's all in my head."

How do you benefit from a master plan?

Here are some of the reasons why you should take the time to prepare a *written* master plan:

- The process of preparing a master plan helps you and the people you work with to anticipate and prepare for future droughts and emergencies.
- The process of preparing a master plan is an opportunity for community involvement and education about the water system.
- The master plan helps to introduce new ideas. This helps to get out of the rut of "doing it this way because its always been done this way."
- The process of thinking through the various strategies and ideas allows for mistakes to be made on paper, rather than in the real world.
- By putting the master plan in writing, you can help your water system avoid working in a crisis-of-the-day mode.
- A plan will help keep your water system on track, which is particularly helpful when there are changes in staff, boards, and councils.

- When it's in writing, your master plan can be used to communicate needs.
- The master plan helps determine actions that should be taken *now* to respond to the future.

What should your master plan include?

Your water system's master plan must be a dynamic document. The format should be developed so that it can be changed easily and the date of the changes can be noted. As conditions change or as lessons are learned, you should update the master plan, so that your system's operators and managers can provide for guidance on a regular basis. Set aside time to formally review and change your master plan every one to three years.

A good master plan should provide a description of the water system as it is now and goals for how it will serve customers in the future. Since you probably don't have a crystal ball, you might want to include different scenarios. These could include:

- status quo—if nothing changes;
- dramatic changes in demand for water (up *or* down);
- discussions and developments arising from regional water planning or formation of regional water systems in your area; and
- changes in regulations that call for changes in the way you treat water and operate your system.

Your master plan should include quantitative data that reflect the unique conditions and circumstances of your system. To get you started, a master plan data sheet has been included in this publication as Appendix E. Your master plan should answer these key questions:

- **Who are your primary customers?** What are their water-use habits? The plan could include estimated median age, estimated income levels, employment status, major employers, predominant activities that affect water supply (for example, keeping livestock, gardening), average water usage, peak demand periods, projected population growth, and other changes in water demand.

- **How does your water system look now?** List the facilities owned by your system, including wells, plants, and extent of distribution lines; capacities of the system; vehicles and equipment owned by the system; any reoccurring violations of drinking water standards; any major changes or challenges in treating or delivering water in the future; age of the system; and any physical deficiencies in the system, such as inadequate production capacity or significant amounts of unaccounted-for water.

- **Where do you get your water now?** Identify groundwater sources or surface water sources, nature of watershed area (agricultural, residential), quality of water source in terms of drinking water standards, adequacy of water supply based on projected demand, trends or threats to the water supply, location of alternate sources, and use of interconnects.

- **Who runs the system, and how?** The written plan could include the organizational structure, including staffing levels and qualifications, and consultants or contractors engaged; the existence of operating procedures or other reference manuals, along with general responsibilities of personnel at all levels; and the existence of documents concerning emergency response plans, drought contingency plans and water conservation plans, major policies, bylaw provisions of the governing board, customer service policies, and cross-connection control programs.

- **What is your current financial status?** List major creditors, debt service requirements, and reserve fund requirements. State the procedures for adopting the budget. Discuss the adequacy of current rates or projected changes in rates. State the audit or financial reporting procedures, depreciation policy, if any, insurance coverages, growth potential, and major financial challenges in the future.

Getting community input

While preparing your master plan, you can ask for input from the local civic organizations, the chamber of commerce, the community economic development commission, and other organizations, in addition to your consultants, engineers, and financial advisors.

You can also appoint a selected blue ribbon committee of customers. Getting the input of others in the community will help them to become more informed about the water system and more confident that you are working toward the same goals they are. The advisory committee may be an excellent way to recruit and test out new candidates for the governing board or corporate officer, if you have one.

Developing a Conservation Plan

Planning ahead for a drought is not just a question of increasing your water supply or capacity. Your system can avoid the need for new facilities by reducing the normal demand for water all year. A water conservation plan will help your system determine how much water your customers can save,

what you can do to help the customers save water, and what educational efforts are needed to encourage conservation.

For forms and guidance on developing a conservation plan, go to **www.tnrcc.state.tx.us**, click on "Index," and choose "Water Conservation." You can also call 512/239-4730 and ask to speak to a member of the Water Conservation & Drought Management Team. Also, many water organizations have standard educational materials for programs that can be customized for your system.

Developing a Capital Improvements Program

If the master plan is the road map, then the capital improvements program tells you what car to buy, how much it will cost, and where the money is coming from. The master plan should point to the system's needs to achieve and maintain compliance in the long run. The annual budget incorporates the system improvements that can be financed from revenues in the current year. The link between the two is the capital improvements program. It takes the strategies identified in the master plan one step farther toward implementation.

The capital improvements program should identify the major improvements needed for the system to provide reliable service in the next 10 to15 years. It should also identify financial resources that can be used toward those improvements and other unfunded needs. The priority of projects should be based on stated criteria. This plan helps to provide stability in the water system, even though the management of the system or elected officials running the system may change.

For larger projects that require outside financing, the capital improvement program should not be too specific about the best technical solution. Those issues will be decided after a preliminary engineering report identifies the alternatives and the pros and cons of each alternative. Also, the water system should be open to regional solutions that may not be apparent to the individual system.

What about Money?

Too many systems shy away from long-term planning because they know that doing *anything* will require money. But that is why a water system needs to evaluate its situation in the first place! Having a plan can help attract capital, because the financial and physical needs of the system are identified in advance of a crisis. Planning ahead will give you a chance to build a reserve fund, to increase rates, to sell bonds, or to apply for loans and grants before they are critically needed.

For more information on private and governmental funding organizations, see the TNRCC publication, *Funding Sources for Utilities*, RG-220. To get a copy, go to **www.tnrcc.state.tx.us**, and click on "Publications."

Considering Consolidation

If the plans for your system show too many needs and too few resources, perhaps the answer lies in joining forces with one or more nearby water systems. If you have questions about consolidation assistance, call the TNRCC's Utilities & Districts Section at 512/239-6960.

Consider the following consolidation options:

- one owner and one large system serving several different communities or subdivisions (consolidation or mergers and acquisitions);
- one owner and several isolated systems, each providing service to different communities or subdivisions (consolidation, satellite ownership, or mergers and acquisitions);
- several public owners, each with individual systems operated through a central coordinated board or authority (consolidation or public merger);
- several owners, each with an isolated system, all served by a central wholesale provider;
- several owners, each with an isolated system, all using the same management and/or operating company (satellite management or contract operations); and
- several owners or one private owner, all using the same private management and/or operating company (privatization or contract operations).

Getting Outside Help

Depending on your system's size and complexity, you might want to consider hiring a consultant to help you in your planning. Consulting engineers work with many large and small systems with a variety of problems and resources. They can offer new ideas and technologies, as well as experience with what has actually worked or not worked. Many consulting engineers will work with the system to review funding options. Or you might want to engage a financial advisor for this purpose.

Regional councils of government, commonly called COGs, may also be able to help you with planning and grants. There are 24 regional COGs in Texas. They are comprised of local governments—cities, counties, special districts (like water or conservation districts), school districts—working together on issues that tend to cross their boundaries. They provide a variety of programs and services designed to meet regional needs.

For more information about COGs and the one nearest you, check the Web site of their association, the Texas Association of Regional Councils (TARC), at **www.txregionalcouncil.org**. You can also contact TARC as follows: phone, 512/478-4715; fax, 512/478-1049; 1305 San Antonio, Austin, TX 78701.

Neighboring water systems can be another good resource. It is important to keep the lines of communication open with other systems that may have succeeded at overcoming challenges similar to the ones you are facing.

In addition to the TNRCC and the TWDB, you can also get technical assistance, classes, or training from the following groups:

- **Texas Rural Water Association, www.trwa.org**; phone, 512/472-8591; fax, 512/472-5186;1616 Rio Grande, Austin, TX 78701.
- **Texas Water Utilities Association, www.twua.org**; phone, 888-FOR-TWUA or 512/459-3124; fax, 512/459-7124; 1106 Clayton Lane, Ste 101 East, Austin, TX 78723-1093.
- **Texas Engineering Extension Service, www.teexweb.tamu.edu**; Engineering Utilities & Public Works Training Institute; phone, 800/824-7303; John B. Connally Bldg., 301 Tarrow, Ste 119, College Station, TX 77840-7896.
- **Community Resource Group, www.crg.org**; phone, 512/454-1033; fax, 512/371-1051; 7701 N. Lamar, Ste 503, Austin, TX 78752.

Chapter 6
For More Help

TNRCC Assistance on Drought

At the Austin Office

On the Web: Go to **www.tnrcc.state.tx.us**, click on "Index" and choose "D" and "Drought Information." Also see "Rules" and "Publications."

E-mail: Questions can be sent to TNRCC staff in the Water Permits and Resource Management Division at **watermon@tnrcc.state.tx.us**.

By mail: TNRCC
Section Name, Mail Code
PO Box 13087
Austin, TX 78711-3087

Public Drinking Water Section **512/239-6020**
Mail Code 155

- boil-water notices
- cross-connection control program
- disinfection
- Drinking Water Monitoring Team
- drought coordinator
- interruptions of service (systemwide) outages
- plumbing fixtures
- pressure problems
- reporting outdoor watering restrictions
- Surveillance & Technical Assistance Team
- system operations issues
- treatment of drinking water
- water quality
- water-use restriction notices

Utilities & Districts Section **512/239-6960**
Mail Code 153

- assistance visits
- certificates of convenience and necessity (CCNs)
- emergency rate increases (investor-owned utilities only)
- funding
- Utility Certification & Rate Analysis Team
- Utility Creation & Plan Review Team
- utility service areas
- water tariffs for IOUs
- water-use restriction notices for IOUs

Water Rights Permitting & Availability Section **512/239-4730**
Mail Code 160

- Conservation & Drought Management Team
- developing drought contingency plans
- developing water conservation goals
- developing water conservation plans
- implementing drought contingency plans
- quantifying water savings for drought planning purposes
- water rights

Water Information & Assistance Section, Consumer Hot Line **512/239-6100**
Mail Code 141

- customer questions about rates and services
- customers of IOUs
- disconnection of service

TNRCC Regional Offices

Region 1 **Amarillo** 806/353-9251	Region 5 Tyler 903/535-5100	Region 9 **Waco** 254/751-0335	Region 13 **San Antonio** 210/490-3096
Region 2 **Lubbock** 806/796-7092	Region 6 **El Paso** 915/834-4949	Region 10 **Beaumont** 409/898-3838	Region 14 **Corpus Christi** 361/825-3100
Region 3 **Abilene** 915/698-9674	Region 7 **Midland** 915/570-1359	Region 11 **Austin** 512/339-2929	Region 15 **Harlingen** 956/425-6010
Region 4 **Arlington** 817/588-5800	Region 8 **San Angelo** 915/655-9479	Region 12 **Houston** 713/767-3500	Region 16 **Laredo** 956/791-6611

Texas Water Development Board Assistance on Drought

The Texas Water Development Board (TWDB) is the state agency charged with planning for statewide water resources. The TWDB also plans and administers low-cost financial assistance programs for projects dealing with the planning, design, and construction of water supply, wastewater treatment, flood control, and agricultural water conservation.

The TWDB has a variety of programs and services to assist communities in developing and implementing local responses to drought-induced water supply problems. These include:

- Drought-related information—how drought is measured, monitored, and mitigated; current reports by region on drought status, water condition, and stream flow; Web links to many state and national sites.
- Technical assistance—regional and state water planning and water conservation practices.
- Financial assistance—infrastructure construction, research and regional facilities planning, and flood mitigation.
- Information on regional water planning groups—the 16 regional water plans, maps, meeting minutes, and updates.

Contacting the TWDB

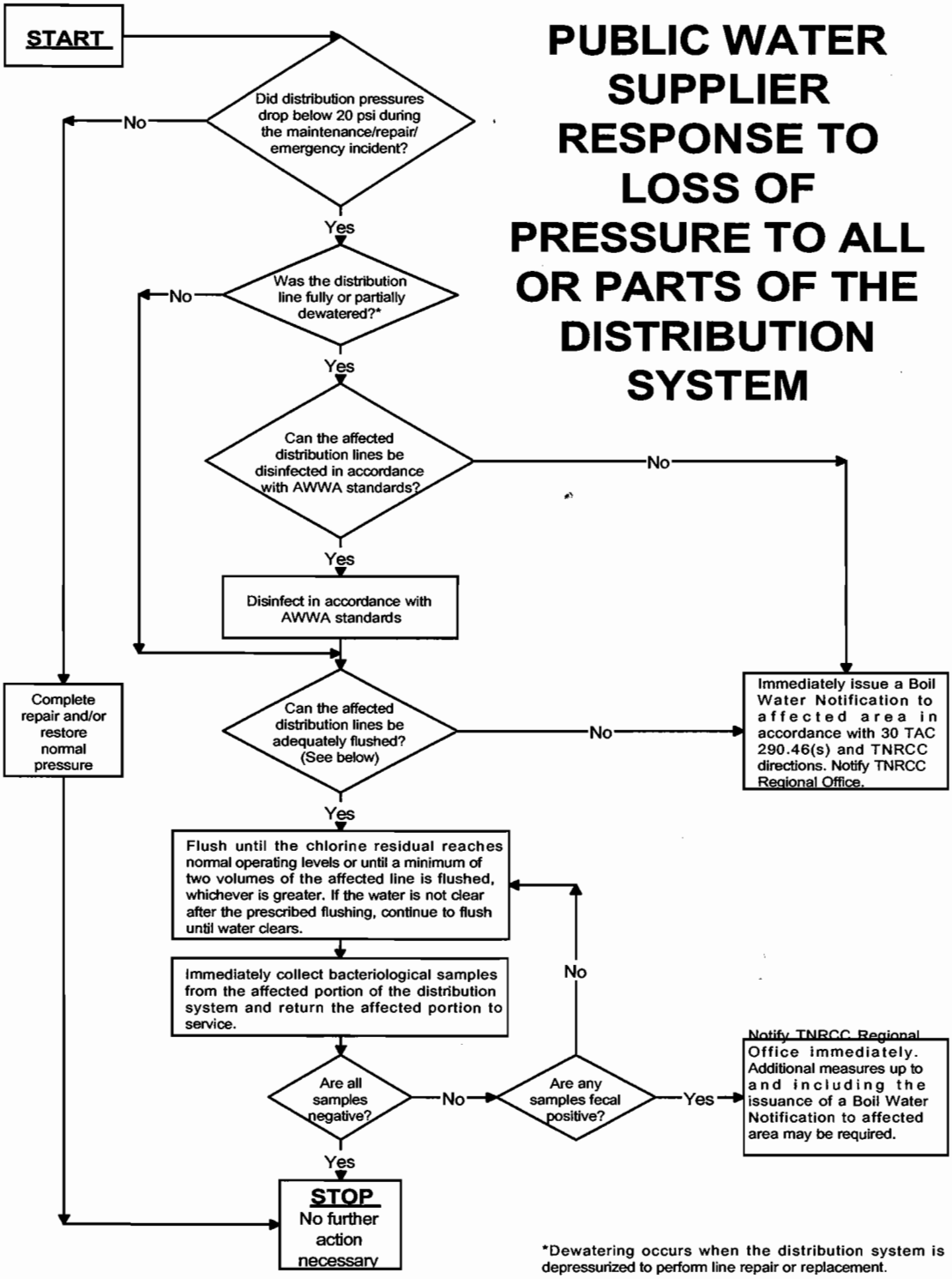
On the Web: Go to **www.twdb.state.tx.us** and look for the link on "Drought Status and Information" link.

By Mail: Texas Water Development Board
P.O. Box 13231
Austin, TX 78711-3231

TWDB Phone Contacts

Drought Indices & Water Resources Data	512/936-0877
Municipal & Industrial Drought Management & Conservation	512/463-7988
Agricultural Drought Management & Conservation	512/463-7940
Water Audit & Leak Detection	512/463-8048
Water Conservation Public Information (English *and* Spanish)	512/463-7955
Water Supply Data & Special Investigations	512/936-2420
Financial Assistance for Water Supply Improvements	
Border Areas	512/463-7509
Other Areas	512/463-7857

Appendix A: Low-Pressure Flowchart



Appendix B: Boil-Water Notice (English)

BOIL-WATER NOTIFICATION
[INSERT NAME OF SYSTEM]

Due to conditions which have occurred recently in the water system, the Texas Natural Resource Conservation Commission has required the system to notify all customers to boil their water prior to consumption.

To ensure destruction of all harmful bacteria and other microbes, water for drinking, cooking, and ice making should be boiled and cooled prior to consumption. The water should be brought to a vigorous rolling boil and then boiled for two minutes. In lieu of boiling, you may purchase bottled water or obtain water from some other suitable source. When it is no longer necessary to boil the water, water system officials will notify you.

If you have questions regarding this matter you may contact:

(list utility officials) at: *(list phone numbers)*

_____ _____
_____ _____
_____ _____

Instructions:

- List more than one utility official and phone number. ***Do not list the TNRCC as the primary contact.***
- If a customer wishes to call the TNRCC, please have them call 512/239-6020.

Appendix C: Boil-Water Notice (Spanish)

AVISO DE HERVIR AGUA
[INSERT NAME OF SYSTEM]

Debido a condiciones urgidos recientemente en el sistema de agua potable, la Comisión de Texas para la Conservación de los Recursos Naturales (Texas Natural Resource Conservation Commission, o TNRCC) exige a usuarios que hiervan el agua antes de consumo.

Para estar seguro de que toda la bacteria y los microbios hayan sido eliminados, el agua que va a ser utilizada para beber, cocinar, y hacer hielo debe ser hervido y después dejarlo enfriar antes de consumirlo. El agua debe llegar a un punto vigoroso de ebullición y debe hervirse por dos minutos. En vez de hervir el agua, puede comprar agua embotellada u obtener agua de otra fuente. Las autoridades del sistema de agua le avisarán cuando ya no sea necesario hervir el agua.

Preguntas sobre éste aviso pueden ser dirigidas a:

Oficiales de Servicios de Agua		**Números de Teléfono**
_____	a:	_____
_____		_____
_____		_____

Instructions:

- List more than one utility official (under "Oficiales de Servicios de Agua") and phone number (under "Números de Teléfono"). ***Do not list the TNRCC as the primary contact.***
- If a customer wishes to call the TNRCC, please have them call 512/239-6020.

Appendix D: Sample Drought Triggers

Example of Drought Response Stages with Supply- and Demand-Side Triggers*

Drought Response	Supply-Side Triggers	Demand-Side Triggers	Response Measures
Stage 1 Mild conditions	Reservoir levels at 50% of capacity	Demand exceeds 60% of storage capacity for 3 days	Raise public awareness of the supply situation and request voluntary reductions in non-essential water use
Stage 2 Moderate conditions	Reservoir levels at 40% of capacity	Demand exceeds 70% of storage capacity for 3 days	Implement mandatory restrictions on certain nonessential water uses
Stage 3 Severe conditions	Reservoir levels at 30% of capacity	Demand exceeds 80% of storage capacity for 3 days	Implement ban on certain non-essential water uses and water rate surcharge for excessive use
Stage 4 Critical conditions	Reservoir levels at 15% of capacity	Demand exceeds 90% of storage capacity for 3 days	Continue ban on nonessential water uses, increase water rate surcharge, activate backup wells
Stage 5 Emergency conditions	System outage due to depletion of water supply or equipment failure	Demand exceeds 100% of storage capacity for 3 days	Initiate emergency response procedures

* These triggers are examples. You should adopt triggers that match the unique needs of your public water system.

Appendix E: Master Plan Data Sheet

Public Water System: _____ PWS I.D. No.: _____

Date: _____ Your name: _____

Who are your primary water customers?

Number of retail connections	
Number of wholesale connections	
Major employers	
Predominant activities that affect water supply (livestock, gardening, carwashes, pools)	
Average water usage	
Peak demand periods	
Projected population growth	
Other considerations	

How does your water system look now?

List wells	
List other supply sources	
List plants	
Age of major components of the system	
Describe facilities (tanks, distribution system, treatment)	

List other equipment owned by the system	
Any reoccurring violations of drinking water standards?	
Any physical deficiencies? If yes, what are they (leaks, not enough capacity)?	
Any major changes or challenges in treating or delivering water system in the future?	
Active leak detection program?	
Active cross-connection program?	

Where do you get your water from now?

List groundwater sources	
List surface water sources	
Nature of the watershed (agricultural, residential)	
Quality of water in terms of drinking water standards?	
Adequacy of current water supply, given projected demand	
Trends or threats to your water supply	
Location of alternate supplies	
Location of current interconnects	
Location of possible future interconnects	

Who runs the water system, and how?

Describe organizational structure	
Staff and qualifications	
List current consultants or contractors	
Do you have written operating procedures? Where are they located?	
Do you have reference manuals? Where are they located?	
List general responsibilities of personnel at all levels	
Do you have emergency response plans? Where are they located?	
Do you have a conservation plan? Where is it located?	
Do you have a drought contingency plan? Where is it located?	
If you are governed by a board or council, do you have written policies and bylaws? Where are they located?	
Do you have written customer service policies? Where are they located?	
Do you have preventive maintenance schedules and where are they located?	

What is your current financial status?

What are your current rates?	
Do your rates encourage conservation, or give big users a break?	
If you purchase water, what rates do you pay?	
When did you last increase your rates?	
Do you have a current audit?	
What are your financial reporting procedures?	
List your major creditors	
What are your debt service requirements?	
What are your reserve fund requirements?	
Describe your procedure for adopting a budget?	
What kind of insurance coverage do you have?	
What is the system's growth potential?	
How much "emergency" money can you access?	

7-1-91

AGREEMENT

THIS AGREEMENT is made by and between **Consoer, Townsend & Associates, Inc.** hereinafter called "**UNDERSIGNED**", and the ~~**CITY OF FARMERS BRANCH, TEXAS**~~, North Dallas County Water Supply Corporation (NDCWSC) hereinafter called "**OWNER**".

WHEREAS, **OWNER** desires **UNDERSIGNED** to perform Engineering Design and Services During Construction for the Sanitary Intercepter Tunnel serving portions of Farmers Branch and the city of Addison, as set forth herein and in Scope of Services, marked Exhibit "A" and "B", and attached hereto and incorporated herein; and

WHEREAS, the **UNDERSIGNED** has agreed to perform such work and services,

NOW, THEREFORE, all parties agree as follows:

SECTION 1 - GENERAL

UNDERSIGNED shall furnish and pay for all labor, tools, materials, equipment, supplies, transportation and management necessary to perform Engineering Design and Services During Construction for the Farmers Branch/Addison Sanitary Interceptor Tunnel as set forth in "Section 2." hereof for the **OWNER** in accordance with the terms, conditions and provisions of the Scope of Services, marked Exhibits "A" and "B" attached hereto and incorporated herein for all purposes. **OWNER** may, at any time, stop any services by the **UNDERSIGNED** upon giving **UNDERSIGNED** written notice. **UNDERSIGNED** shall be bound to **OWNER** by the terms, conditions and responsibilities toward the **OWNER** for **UNDERSIGNED's** services set forth in this Agreement.

SECTION 2 - SERVICES

a. The Engineering Design Services, when authorized in writing by a Notice to Proceed, shall be performed by the **UNDERSIGNED** in accordance with the **OWNER'S** requirements; as set forth in Exhibit A and summarized as follows:

Prepare construction plans, and specifications including surveying and geotechnical services for a Sanitary Intercepter Tunnel ranging in size from 60 to 72 inches in diameter for a distance of approximately 22,200 lineal feet from the Trinity River Authority intercepter, easterly crossing I-35 generally following an alignment along Valley View Lane and Marsh Lane in the city of Farmers Branch, Texas.

b. The following Services During Construction, when authorized in writing by a Notice to Proceed shall be performed by the undersigned in accordance with the **OWNER'S** requirements; as set forth in Exhibit B and summarized below:

Provide Construction Management Services for the construction of the Sanitary Interceptor Tunnel referred to in paragraph a. above including Detailed full time observation of construction, including inspection, reporting and recommendations to owner for conformance with plans and specifications, shop drawing review, recommendations for pay estimate approvals, utility and traffic control coordination, daily approval of all Contract pay items, and coordination of all restoration, daily clean up and citizens complaints, and monitor contractors schedules.

c. **UNDERSIGNED** shall be responsible for the professional quality, technical accuracy, and the coordination of all designs, drawings, specifications, plans and other services furnished by **UNDERSIGNED** under this Agreement. **UNDERSIGNED** shall, without additional compensation, correct or revise any errors or deficiencies in the design, drawings, specifications, plans and other services.

d. Neither **OWNER'S** review, approval or acceptance of, nor payment for any of the services required under this Agreement, shall be construed to operate as a waiver of any rights under this Agreement or of any cause of action arising out of the performance of this Agreement, and **UNDERSIGNED** shall be and remain liable to **OWNER** in accordance with applicable law for all damages to **OWNER** caused by **UNDERSIGNED's** negligent performance of any of the services furnished under this Agreement.

e. The rights and remedies of **OWNER** under this Agreement are as provided by law and equity and shall include but shall not be limited to the right to seek specific performance of the terms hereof and to strictly enforce all terms and provisions..

SECTION 3 PAYMENT

a. **OWNER** shall pay **UNDERSIGNED** for all Engineering Design services authorized in writing and properly performed by **UNDERSIGNED** on the basis herein described, subject to additions or deletions for changes or extras agreed upon in writing.

b. Partial payment for Engineering Design Services will be as stipulated in Exhibits "C" and "D" attached hereto and incorporated herein. Invoices shall be submitted monthly.

c. Upon completion of Design Services and prior to notice to proceed with Services During Construction, the **OWNER** will negotiate with the **UNDERSIGNED** the billing rates and fee schedules for Services During Construction. **OWNER** shall pay undersigned for all Services During Construction authorized in writing and properly performed by **UNDERSIGNED** on the basis herein described, subject to additions or deletions for changes or extras agreed upon in writing.

d. Partial payment for Services During Construction, will be stipulated in Exhibits E and F which will be negotiated and upon execution thereof attached to this agreement and incorporated herein. Invoices shall be submitted monthly.

e. Upon complete performance of this Agreement by **UNDERSIGNED** and final approval and acceptance of **UNDERSIGNED's** service by **OWNER, OWNER** will make final payment to **UNDERSIGNED** of the balance due under this Agreement within thirty (30) days of the following month after final payment for Design and Services During Construction services has been billed by **UNDERSIGNED.**

f. **OWNER** may deduct from any amounts due or to become due to **UNDERSIGNED** any sum or sums owing by undersigned to **OWNER.** In the event of any breach by **UNDERSIGNED** of any provision or obligation of this Agreement, or in the event of the assertion by other parties of any claim or lien against **OWNER,** or the **OWNER'S** premises, arising out of **UNDERSIGNED's** performance of this Agreement, **OWNER** shall have the right to retain out of any payments due or to become due to **UNDERSIGNED** an amount sufficient to completely protect the **OWNER** from any and all loss, damage or expense therefrom, until the breach, claim or lien has been satisfactorily remedied or adjusted by the **UNDERSIGNED.**

SECTION 4 - TIME FOR PERFORMANCE

a. **UNDERSIGNED** shall perform all services as provided for under this Agreement in a proper, efficient and professional manner in accordance with the **OWNER's** requirements. As time is of the essence in this Agreement, Services for Design Services excluding bidding and recommendation of award shall be completed within 340 calendar days, from the date of written notice to proceed from Owner to **UNDERSIGNED,** exclusive of **OWNER** and other governmental review time. Review submittals to **OWNER** during progress of the Design shall be at 50 percent, 90 percent and 100 percent completion stages at 225, 300 and 340 calendar days respectively from notice to proceed exclusive of **OWNER** and other governmental review time.

b. In the event **UNDERSIGNED's** performance of this Agreement is delayed or interfered with by acts of the **OWNER** or others, **UNDERSIGNED** may request an extension of time for the performance of same as hereinafter provided, but shall not be entitled to any increase in fee or price, or to damages or additional compensation as a consequence of such delays, not to exceed one year.

c. No allowance of any extension of time, for any cause whatever, shall be claimed or made to the **UNDERSIGNED**, unless **UNDERSIGNED** shall have made written request upon **OWNER** for such extension within forty-eight (48) hours after the cause for such extension occurred, and unless **OWNER** and **UNDERSIGNED** have agreed in writing upon the allowance of additional time to be made.

SECTION 5 - DOCUMENTS

a. All instruments of service (including plans, specifications, drawings, reports, designs, computations, computer programs, estimates, surveys other data or work items, etc.) prepared under this Agreement shall be submitted for approval of the **OWNER.** All instruments of service shall be professionally sealed as may be required by law or by **OWNER.**

b. Such instruments of service, together with necessary supporting documents, shall be delivered to **OWNER**, and **OWNER** shall have unlimited rights, for the benefit of **OWNER**, in all instruments of service, including the right to use same on any other work of **OWNER** without additional cost to **OWNER.** If, in the event **OWNER** uses such instruments of service on any work of **OWNER** other than that specified in the Scope of Services, attached as Exhibits "A" and "B", provided **UNDERSIGNED** completes this Agreement, under those circumstances **OWNER** hereby agrees to protect, defend, indemnify and hold harmless the **UNDERSIGNED**, their officers, agents, servants and employees (hereinafter individually and collectively referred to as "Indemnities"), from and against suits, actions, claims, losses, liability or damage of any character, and from and against costs and expenses, including, in part, attorney fees incidental to the defense of such suits, actions, claims, losses, damages or liability on account of injury, disease, sickness, including death, to any person or damage to property including, in part, the loss of use resulting therefrom, arising from any inaccuracy, such use of such instruments of service with respect to such other work except where **UNDERSIGNED** participates in such other work.

c. **UNDERSIGNED** agrees to and does hereby grant to **OWNER** a royalty-free license to all such instruments of service which **UNDERSIGNED** may cover by copyright and to all designs as to which **UNDERSIGNED** may assert any rights or establish any claim under the design patent or copyright laws. **UNDERSIGNED**, after completion of the project, agrees to furnish the originals of all such instruments of service to the **OWNER.**

SECTION 6 - TERMINATION

a. **OWNER** may suspend or terminate this Agreement for cause or without cause at any time by giving written notice to the **UNDERSIGNED**. In the event suspension or termination is without cause, payment to **UNDERSIGNED**, in accordance with the terms of this Agreement, will be made on the basis of services reasonably determined by **OWNER** to be satisfactorily performed to date of suspension or termination. Such payment will be due upon delivery of all instruments of service to **OWNER**.

b. Should the **OWNER** require a modification of this contract with **UNDERSIGNED**, and in the event **OWNER** and **UNDERSIGNED** fail to agree upon a modification to this Agreement, **OWNER** or **UNDERSIGNED** shall have the option of terminating this Agreement and the **UNDERSIGNED's** services hereunder at no additional cost other than the payment to **UNDERSIGNED**, in accordance with the terms of this Agreement, for the services reasonably determined by **OWNER** to be properly performed by the **UNDERSIGNED** prior to such termination date.

SECTION 7 - INSURANCE

a. **UNDERSIGNED** shall provide and maintain Workers Compensation and Employer's Liability Insurance for the protection of **UNDERSIGNED's** employees, as required by law of any employer. **UNDERSIGNED** shall also provide and maintain in full force and effect during the time of this Agreement, insurance (including, but not limited to, insurance covering the operation of automobiles, trucks and other vehicles) protecting **UNDERSIGNED** and **OWNER** against liability from damages because of injuries, death, suffered by any person or persons other than employees of **UNDERSIGNED**, and liability for damages to property, arising from or growing out of **UNDERSIGNED's** operations in connection with the performance of this Agreement.

b. Such insurance covering personal and bodily injuries or death shall be in the sum of not less than Two Hundred Fifty Thousand Dollars ($250,000.00) for one (1) person, and not less than Three Hundred Thousand Dollars ($300,000.00) for any one (1) occurrence. Insurance covering damages to property shall be in the sum of not less than Three Hundred Thousand Dollars ($300,000.00) for any one (1) occurrence, and Three Hundred Thousand Dollars ($300,000.00) aggregate.

c. A signed Certificate of Insurance, satisfactory to **OWNER**, showing compliance with the requirements of this Section shall be furnished to **OWNER** before any services are performed under this Agreement, and shall further indicate that each and every policy for liability insurance coverage as required herein includes a

"Contractual Liability Coverage" endorsement covering the Agreement under "Section 8." hereof. Such Certificate of Insurance shall provide for ten (10) days written notice to **OWNER** prior to the cancellation or modification of any insurance referred to therein.

SECTION 8 - INDEMNIFICATION FOR INJURY AND PERFORMANCE

UNDERSIGNED further specifically obligates itself to **OWNER** in the following respects, to-wit:

The **UNDERSIGNED** hereby agrees to protect, defend, indemnify and hold harmless the **OWNER**, their officers, agents, servants and employees (hereinafter individually and collectively referred to as "Indemnities"), from and against suits, actions, claims, losses, liability or damage of any character, and from and against costs and expenses, including, in part, attorney fees incidental to the defense of such suits, actions, claims, losses, damages or liability on account of injury, disease, sickness, including death, to any person or damage to property arising from any act, error, omission or neglect of the **UNDERSIGNED**, its officers, employees, servants, agents or subcontractors, or anyone else under the **UNDERSIGNED's** direction and control, and arising out of, occurring in connection with, resulting from or caused by the performance or failure of performance of any work or services called for by this Agreement, or from conditions created by the performance or non-performance of said work or services. In the event one or more of the Indemnities is determined by a court of law to be jointly or derivatively negligent or liable for such damage or injury, the **UNDERSIGNED** shall be obligated to indemnify **OWNER** as provided herein on a proportionate basis in accordance with the final judgement, after all appeals are exhausted, determining such joint or derivative negligence or liability.

The **UNDERSIGNED** is not responsible for the actions of the **OWNER's** contractor to perform the construction of the improvements covered under this Agreement. Acceptance and approval of the final plans by the **OWNER** shall not constitute nor be deemed a release of this responsibility and liability of **UNDERSIGNED**, its employees, associates, agents and Engineers for the accuracy or competency of their designs, working drawings and specifications, or other documents and work; nor shall such approval be deemed to be an assumption of such responsibility by the **OWNER** for any defect in the designs, working drawings and specifications, or other documents prepared by **UNDERSIGNED**, its employees, contractor, agents and Engineers.

SECTION 9 - INDEMNIFICATION FOR UNEMPLOYMENT COMPENSATION

UNDERSIGNED agrees that it is an independent contractor and not an agent of the **OWNER**, and that **UNDERSIGNED** is subject, as an employer, to all applicable Unemployment Compensation Statutes, so as to relieve **OWNER** of any responsibility or liability from treating **UNDERSIGNED's** employees as employees of **OWNER** for the purpose of keeping records, making reports or payments of Unemployment Compensation taxes or contributions. **UNDERSIGNED** further agrees to indemnify and hold **OWNER** harmless and reimburse it for any expenses or liability incurred under said Statutes in connection with employees of **UNDERSIGNED**.

SECTION 10 - INDEMNIFICATION FOR PERFORMANCE

UNDERSIGNED shall defend and indemnify **OWNER** against and hold **OWNER** and the premises harmless from any and all claims, suits or liens based upon or alleged to be based upon the non-payment of labor, tools, materials, equipment, supplies, transportation and management costs incurred by **UNDERSIGNED** in performing this Agreement.

SECTION 11 - ASSIGNMENT

UNDERSIGNED shall not assign or sublet this Agreement, or any part thereof, without the written consent of **OWNER**.

SECTION 12 - APPLICABLE LAWS

UNDERSIGNED shall comply with all Federal, State, County and Municipal laws, ordinances, regulations, safety orders, resolutions and building codes relating or applicable to services to be performed under this Agreement.

This Agreement is entered into subject to the Charter and Ordinances of the **CITY OF FARMERS BRANCH** and the laws of the State of Texas.

SECTION 13 - DEFAULT OF UNDERSIGNED

IN THE EVENT **UNDERSIGNED** fails to comply or becomes disabled and unable to comply with the provisions of this Agreement as to the quality or character of the service or time of performance, and the failure is not corrected within ten (10) days after written notice by **OWNER** to **UNDERSIGNED, OWNER** may, at its sole discretion without prejudice to any other right or remedy:

a. Terminate this Agreement and be relieved of the payment of any further consideration to **UNDERSIGNED** except for all work determined by **OWNER** to be satisfactorily completed prior to termination. Payment for work satisfactorily completed shall be for actual costs, including reasonable salaries and travel expenses of **UNDERSIGNED** to and from meetings called by **OWNER**, at which the **UNDERSIGNED** is required to attend, but shall not include any loss of profit of **UNDERSIGNED**. In the event, of such termination, **OWNER** may proceed to complete the services in any manner deemed proper by **OWNER**, either by the use of its own forces or by resubletting to others. In either event, the **UNDERSIGNED** shall be liable for all costs in excess of the total contract price under this Agreement incurred to complete the services herein provided for and the costs so incurred may be deducted and paid by the **OWNER** out of such monies as may be due or that may thereafter become due to **UNDERSIGNED** under and by virtue of this Agreement.

b. **OWNER** may, without terminating this Agreement or taking over the services, furnish the necessary materials, equipment, supplies and/or help necessary to remedy the situation, at the expense of the **UNDERSIGNED**.

SECTION 14 - ADJUSTMENTS IN SERVICES

No claims for extra services, additional services or changes in the services will be made by **UNDERSIGNED** without a written agreement with **OWNER** prior to the performance of such services.

SECTION 15 - EXECUTION BECOMES EFFECTIVE

This Agreement will be effective upon execution of the contract by and between **UNDERSIGNED** and **OWNER**.

SECTION 16 - AGREEMENT AMENDMENTS

This Agreement together with Exhibit A, Exhibit B, Exhibit C and Exhibit D attached hereto contains the entire understanding of the parties with respect to the subject matter thereof and there are no oral understandings, statements or stipulations bearing upon the meaning or effect of this Agreement which have not been incorporated herein.

Exhibit E and Exhibit F, summary of cost and Billing rates for Services During Construction, will be included as Amendments to the Contract upon negotiation of the cost of these services upon completion of Design Services and when executed and attached hereto. This Agreement may only be modified, amended, supplemented or waived by a written instrument execute by the parties except as may be otherwise provided therein.

SECTION 17 - WRITTEN NOTICES

All notices, demands and communications hereunder shall be in writing and may be serviced or delivered personally upon the party for whom intended, or mailed to the party for whom intended at the address set forth on the signature page of this Agreement. The address of a party may be changed by notice given pursuant to this Section.

SECTION 18 - GENDER AND NUMBER

The use of any gender in this Agreement shall be applicable to all genders, and the use of singular number shall include the plural and conversely.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on this the _____ day of _____, 19 _____.

OWNER:

City of Farmers Branch, Texas

By: _____
Richard L. Escalante
City Manager
P.O. Box 819010
Farmers Branch, Texas
75381-9010

Witness:

_____
City Secretary

Approved as to Form:

_____
City Attorney

UNDERSIGNED:

By: _____

_____
_____
_____

Witness:

_____

EXHIBIT "A"

SCOPE OF SERVICES FOR ENGINEERING DESIGN

This is an Exhibit to and incorporated into the Agreement (the "Agreement") entered into by and between the **CITY OF FARMERS BRANCH, TEXAS**, a municipal corporation, hereinafter referred to as "City", and **CONSOER TOWNSEND & ASSOCIATES, INC.**, hereinafter referred to as "Engineer", on _____, 19__ and sets forth certain terms, conditions and provisions of the Agreement. Final design includes Special Services which are included in Exhibit "A" as Section B-1 thru B-4.

A. FINAL DESIGN

1. Upon notice to proceed meeting with owner to review Preliminary Report and establish a schedule for review and monthly progress meetings.

2. Establish the route and parameters of the detailed topographic survey and complete surveys using Datum and Bench Marks established in Preliminary Report. The detailed scope of the topographic surveys is set forth in Special Services.

3. Conduct field land surveys necessary to prepare plats and legal descriptions of all permanent and temporary easements along the route of the proposed interceptor. The detailed scope of the land surveys is set forth in Special Services.

4. Prepare final design geotechnical report supplementing the soil report completed during the preliminary design phase. Also pumping tests and an Environmental water quality assessment will be completed in connection with the Geotechnical Report. The detailed scope of final geotechnical report is set forth in Special Services.

5. Plans will be prepared on 24-inch by 36-inch plan and profile, sheets of a scale of 1" = 20' in plan view and 1" = 5' in the profile vertical scale. Plans will be prepared using CADD method.

6. Plans will include a cover sheet, a location sheet, traffic control sheets, plan and profile sheets, detail sheets, construction notes and legend sheets and standard detail sheets. All sheets will be designed and sealed by a engineer registered in the state of Texas.

7. Prepare contract documents including notice to bidders, proposal, special instructions to bidders, contract conditions, special provisions, and project specifications using the CSI standard specifications, and City of Farmers Branch Standard Documents.

8. Prepare the documents required to obtain approval of all governmental authorities having jurisdiction over the design and/or operation of the Project and all public and private utilities including license agreements to cross railroad property and pipeline transmission companies affected by the Project. Submit plans or agreements for signatures of representatives of such governmental authorities and public utilities; and City officials.

9. Design the Project in compliance with the requirements of all applicable local, state and federal laws, codes and regulations, make all revisions to the plans, specifications and other contract documents necessary to provide clarifications or to correct discrepancies. The plans and specifications shall conform to all applicable federal and state regulations.

10. Deliver to the Cities five copies of preliminary plans at the 50% completion stage for their review and at the 90% and 100% completion stages of Final Design a detailed cost estimate and five (5) copies of all the reports, recommendations, analyses, specifications, plans and drawings (including working drawings) or as may be modified by Exhibit "A", Scope of Services.

11. Assist the Cities in securing bids for the construction of the Project based upon the construction documents; attend prebid conferences; assist the Cities in evaluating the bid proposals; prepare tabulations of bids received; and furnish the City 20 copies of the bid tabulation and a written recommendation for the award of a construction contract for the project; and 30 sets of plans and specifications for bidding purposes.

12. Issue all required addenda to revise the plans, specifications and other contract documents in order to (i) provide clarifications; (ii) correct discrepancies; (iii) correct errors and/or omissions; or (iv) reflect changes in design requirements and/or field conditions.

B. SPECIAL SERVICES

1. Surveying

Perform field surveys and provide office support relative to surveying required to obtain horizontal and vertical data along the proposed interceptor sewer line, prepare temporary and permanent easements, and to prepare a working plan layout on CADD. Specific tasks are as follows:

a. Horizontal Control - Establish a baseline as approved by Cities on a location near the centerline of the proposed interceptor sewer. A representative from CT&A will assist Lichliter, Jameson & Associates in identification of the shaft locations (PI's) on the baseline. The baseline will be staked at 100' station intervals. PI's will be referenced with points outside the construction area for re-establishment during construction using Aerial and Field Surveys.

b. Topography - Obtain complete planimetric topography with ties to streets, buildings, trees, utilities, etc. Where sewer is in public R.O.W. the topography will be obtained from right of way to right of way plus an additional 35 feet or the distance necessary to locate the nearest dwelling units which ever is smaller. Where sewer is in public or private property the topography will be obtained 75 feet on each side of the centerline of proposed sewer. This topo

will be obtained from ROW to ROW or for a width of 150' (75' each side of the baseline) when on new location. Invert elevations of underground utilities will be obtained where accessible. Elevations will be obtained along utilities at locations probed or uncovered by utility companies. All survey data will be digitized on discs for CADD Drafting.

c. Profiles and Cross Sections - Obtain elevations along the baseline at 100' station intervals. At creek, street, railroad, and highway crossings, obtain additional cross sections as appropriate to represent the surface. At shaft locations, establish a 20' grid for a width of approximately 60' x 80' and obtain elevations on the grid points.

d. ROW/Easements - Research property information (plats, right of way plans, metes & bounds descriptions). Tie property corners, fences, etc. to define the existing street right of way. Prepare a working sketch of existing street right of way and properties which are crossed by the interceptor sewer line. Perform boundary analysis and computations to define the permanent easements as required for the line and temporary easements at shaft locations. Prepare individual plats and metes and bounds descriptions for each easement. Stake the limits of the easements in a semi-permanent manner as required by the cities.

2. Geotechnical Investigations

Perform final geotechnical services to provide soil borings, tests and reports in accordance with the following specific tasks:

a. Test borings will be drilled at approximately 500-feet intervals along the recommended alignment to depths below the proposed sewer invert.

b. A total of 37 borings to total depths of 25 to 100 feet are proposed as summarized in Table 1. Boring logs and related information from the preliminary geotechnical report will be used to fill in the information base along the alignment.

c. Cohesive soils will be sampled with thin-walled tube samplers. Standard penetrations tests will be performed on very sandy or cohesionless soils. The sampling intervals will be at each change in material or a maximum of five feet. The unweathered Eagle Ford Shale will be continuously cored with double-tube core barrels and appropriate bits. All samples will be extruded in the field and packaged to protect them from disturbance and preserve their in-situ moisture content.

d. Field permeability tests by the pressure packer method will be performed at selected locations in the shale bedrock to evaluate in-situ permeability. Small-diameter (2-inch PVC) groundwater observations wells will be installed at selected locations, primarily in the overburden soils, for long-term groundwater level measurements. Field permeability tests by the bailing and recovery method will be performed in these observation wells to evaluate in-situ permeability.

e. All borings will be grouted following completion of drilling.

f. An experienced field geologist will be assigned to each drilling rig to log the borings, perform field tests, assist in access and utility clearances at boring sites, and perform related duties.

g. Ground surface elevations and locations will be provided for each of the test borings (final and preliminary).

h. Laboratory tests will be performed on representative samples to establish the pertinent engineering properties of the various soil and rock strata.

For soil samples, the following tests are anticipated:

Natural moisture content
Dry unit weight
Atterberg limits and linear shrinkage
Grain-size analysis

Unconfined compression
Triaxial shear
Direct shear
Absorption swell

For rock core samples, the following tests are anticipated:

Natural moisture content
Dry unit weight
Unconfined compression
Triaxial compression
Absorption swell
Atterberg limits

These tests will be performed in general accordance with ASTM and IRSM methods. It is also proposed to perform a limited program of special tests to further evaluate the rock durability, hardness, and mineralogy. Additional types of tests for both soil and rock samples may be performed depending on conditions encountered.

i. The results of all field and laboratory studies will be compiled into an engineering report with Southwestern Laboratories (SwL) comments and recommendations on various appropriate design parameters.

These will include, as a minimum, the following:

- o Test boring logs and discussion of soil and rock stratigraphy
- o Interpretive subsurface profile along the alignment
- o Discussion of geologic and hydrogeologic conditions including groundwater levels
- o Laboratory test results and discussion of engineering properties of soil and rock materials.
- o Geotechnical engineering comments and recommendations, including

- dewatering (open cut, shafts, and tunnel)
- soil bearing and settlement in cut and cover segment
- pipe bedding and backfill
- design parameters for excavation support
- cut and cover excavation slopes
- estimated ground movements
- monitoring and instrumentation

j. Field pumping tests will be performed to provide more in-depth measurements of the in-situ permeability characteristics of the overburden soils, at three locations. At each location, this will require installation of a 4-inch diameter PVC pumping well and two nearby 2-inch diarneter PVC observation wells or piezometers. The larger well will be pumped for a period of 12-hours with observations of drawdown levels in the pumping well, and the drawdown wells before, during, and following the pumping period. The pumping flow rate will also be monitored. The test results would then be analyzed to obtain coefficients of permeability, transmissivity, and related geohydrologic information at each of the test sites.

k. Preliminary Environmental and Water Quality Assessment will be prepared to assess the potential for environmental liabilities associated with past or current practices along the alignment, and include the following tasks:

(1) Determine Existing Conditions Along Alignment

A site visit will be conducted to observe surficial evidence of environmental impairment. The SwL staff will inspect the alignment and adjacent properties for the presence of the underground storage tanks, chemical stains, stressed vegetation, land scars, or obvious evidence of improper use or disposal of toxic or hazardous materials. Right of entry will be provided by the Cities.

(2) Review History

The history of the alignment will be reviewed by utilizing data such as aerial photographs, inquiries of persons familiar with adjacent sites, and possibly, property chain-of-title. The surface conditions and surrounding land-use will be examined for previous activities that may have affected the environmental conditions.

(3) Regulatory Agency Inquiry

Inquiries will be made to local, state, and federal regulatory agencies to determine whether or not noncompliance citations or violations have been issued in the past. Examples of regulatory agencies include, the Texas Water Commission (TWC), city or county health departments, air quality and water quality departments, and the Environmental Protection Agency (EPA).

(4) Groundwater Sampling and Tests

Based on these findings, sites will be selected for installation of 4-inch diameter groundwater monitor wells at three locations judged to have the highest potential for the presence of hazardous substances. These wells will be installed using appropriate decontamination procedures for the drilling equipment and well materials. Groundwater samples will then be obtained using appropriate sampling methods for water quality analysis. Parameters anticipated for such analyses include general groundwater characterization (pH, total dissolved solids, specific conductance, etc.), total organic carbon, total petroleum hydrocarbons, total volatile hydrocarbons, purgeable aromatics, general pesticides and herbicides, and other substances as may be indicated by the findings of the previous tests.

(5) Data Evaluation and Final Report

All pertinent data and observations will be organized and presented in the final report. The report will include an opinion by SwL with regard to the potential for environmental concerns and liabilities, including the

presence of hazardous and toxic substances. Should the results of this study reveal evidence for the potential for environmental concerns, a recommendation will be made for additional investigation activities, which commonly include additional soil borings, monitor wells, soil/waste sampling and laboratory testing, not included within the scope of this preliminary study.

3. Analytical Laboratory Testing

A minimum of three analytical laboratory tests will be performed on the sanitary sewage which will be conveyed in the new sanitary interceptor tunnel. The test will include the following analysis:

PH, sulfates, sulfides, cyanide, volatile organics, semi-volatile organics, chlorides and methane.

These tests will be conducted for use in analyzing corrosion protection necessary for the tunnel and appurtenances.

4. Flow Monitoring

A maximum of two portable velocity flow monitors will be installed for a maximum six week period to determine dry and wet weather flows tributary to the terminus of the new sanitary interceptor tunnel.

EXHIBIT "B"

SCOPE OF SERVICES FOR SERVICES DURING CONSTRUCTION

This is an Exhibit to and incorporated into the Agreement (the "Agreement") entered into by and between the **CITY OF FARMERS BRANCH, TEXAS**, a municipal corporation, hereinafter referred to as "City", and **CONSOER TOWNSEND & ASSOCIATES, INC.**, hereinafter referred to as "Engineer", on _____, 19__ and sets forth certain terms, conditions and provisions of the Agreement.

The Engineer shall provide professional services during construction to assist in obtaining a complete Project in accordance with the purpose and intent of the contract documents. Services During Construction shall include, but not be limited to, the following:

1. Participate in pre-construction conferences and assist with the execution of a contract between the City and the successful bidder;

2. Provide a full time on site resident engineer and assistant field engineers as required to administer construction contracts and prepare monthly progress reports, minutes of meetings, daily diaries, review and monitor contractor's CPM schedule adherence and project progress, and check and recommend approval of contractors pay estimates, and provide daily on site construction inspection for conformance with plans and specifications, including reporting and recommendations to Owner. However, neither Consoer, Townsend & Associates or Jay Dee Contractors are responsible for the means or methods employed by the Contractor in the process of his work, or have the authority to stop the Contractor's work.

3. Jay Dee Contractors Inc. will assist Consoer Townsend & Associates during construction Phase Services and will provide at least one full time representative as part of the onsite personnel referred to in Paragraph 2 above.

Both Consoer Townsend and Jay Dee Contractors will assign a project manager to interface between the contractor, the cities and resident engineers and attend monthly progress meetings and any other meetings as required.

4. Review, prepare, make recommendations, execute, and administer contract changes including field change orders and engineering design changes.

5. Review and recommend approval of contractor's submittals and schedules including shop drawings and coordinate during construction to minimize the impact of traffic disruption or dust conditions to the local populace.

6. Arrange for, and coordinate as required, all independent testing or laboratory services necessary for the project and review and administer, as needed, in accordance with the test results.

7. Coordinate with contractor, utility companies and Owners Public Works Department to minimize disruption of utilities caused by or required by construction operations.

8. Conduct a final inspection and prepare final punch list to be approved by Owner prior to approval of final pay estimate. Conduct a final inspection with Owner after completion of punch list.

9. Provide two sets of reproducible record prints of drawings, which shall become the property of the cities corrected to show significant changes made in the work during the construction of the Project. Such corrections shall be based upon " as-built" prints, drawings, field sketches and other data furnished to the Engineer by the City and the contractor, upon change orders issued during construction, and upon on-site observations of the Engineer.

10. No less than 30 days and no more than 45 days before the expiration of the guarantee period established by the construction contract documents, the Engineer, in company with the cities, shall inspect the construction site. Within fourteen days after such inspection the Engineer shall furnish the cities with a written report enumerating items which require repair or replacement as provided under the guarantee and warranty provisions of the contract documents;

EXHIBIT "C"

PAYMENT AND BILLING RATES

This is an Exhibit to and incorporated into the Agreement (the "Agreement") entered into by and between the **CITY OF FARMERS BRANCH, TEXAS**, a municipal corporation, hereinafter referred to as "City", and **CONSOER, TOWNSEND & ASSOCIATES, INC.**, hereinafter referred to as "Engineer", on _____, 19___.

I. PAYMENT

Payment will be based on base salary of staff members involved in productive work on the project times a multiplier of 3.10 with maximum fees set forth in Exhibit "D".

II. BILLING RATES

Average billing rates for Consoer, Townsend & Associates, Inc. and the subcontractor's Lichliter Jameson for surveying services; Southwestern Laboratories for geotechnical work and Jay Dee Contractors for design services are as follows:

A. CONSOER TOWNSEND

Classification	Average Billing Rate Per Hour
Senior Advisor	$ 110.00
Project Manager	110.00
Project Engineer	84.00
Sr. Civil Engineer	78.00
Civil Engineer	65.00
Structural Engineer	81.00
CAD Technician	56.00
Technician	50.00

(Exhibit "C" Continued)

B. JAY DEE CONTRACTORS

Classification	Average Billing Rate Per Hour
Sr. Design Engineer	$ 107.00
Sr. Estimator	60.00
Staff Estimator	45.00

C. SOUTHWESTERN LABORATORIES
(See Following Pages)

D. LICHLITER/JAMESON & ASSOCIATES, INC.
(See Following Pages)

EXHIBIT "C"

Lichliter Jameson & Associates, Inc.

AVERAGE RATE SCHEDULE

Classification	Base Salary Per Hour	Average Billing Rate Per Hour
Project Manager	$ 26.50	$79.50
Engineer	18.30	54.90
Registered Public Surveyor	19.00	57.00
Survey Technician	15.00	45.00
Survey Crew (3 man)	-----	70.00
CADD Operator	15.00	45.00
Clerical	11.50	34.50
CADD Equipment	-----	25.00

SCHEDULE OF SERVICES AND FEES

NORTH TEXAS GEOTECHNICAL ENGINEERING DIVISION
JANUARY 1991

HOURLY FEES FOR PERSONNEL

ENGINEERS

Staff Engineer	(Grade I and II)	$ 60.00
Project Engineer	(Grade III and IV)	$ 75.00
Senior Engineer	(Grade V and VI)	$ 95.00
Principal Engineer	(Grade VII and VIII)	$105.00
Expert Witness	(4 hour minimum)	$160.00

GEOLOGIST

Staff Geologist	$ 45.00
Project Geologist	$ 55.00
Senior Geologist	$ 85.00

DRAFTSMAN

$ 35.00

TECHNICIANS

Technician in Training	$ 25.00
Engineering Technician	$ 35.00

WORD PROCESSING

$ 30.00

Direct Costs at cost plus 15 percent

EXHIBIT "C"

SCHEDULE OF SERVICES AND FEES

NORTH TEXAS GEOTECHNICAL ENGINEERING DIVISION
LABORATORY TESTING
JANUARY 1991

IDENTIFICATION AND CLASSIFICATION TESTS	UNIT PRICES
1. Liquid and Plastic Limits	$ 39.50
2. Hydrometer Analyses, including Sieve	$ 75.00
3. Sieve Analyses through No. 200 Sieve	$ 26.00
4. Percent Passing No. 200 Sieve	$ 15.50
PHYSICAL TESTS	
5. Moisture Content	$ 3.00
6. Density and Moisture Content	$ 15.50
7. Maximum and Minimum Density	$ 185.00
8. Specific Gravity	$ 46.75
9. Permeability Fixed Wall	$ 75.00
Permeability Flex Wall	$ 175.00
10 Organic Content	$ 10.00
STRENGTH AND COMPRESSIBILITY TESTS	
11. Unconfined compression-maximum stress	
Soil (with Moisture-density)	$ 27.50
Rock	$ 27.50
12. Triaxial Shear 2 inch and 3 inch diameter specimens	
Unconsolidated - undrained	
Per specimen	$ 40.00
Multiple Stage	$ 100.00
Consolidated-Undrained with Pore Pressure	
Per specimen	$ 140.00
Multiple Stage (3-points)	$ 340.00
Stress-Strain curves for above tests	
Per specimen	$ 30.00
13. Direct Shear - Per specimen	
Unconsolidated - Undrained	$ 45.00
Consolidated - Undrained	$ 85.00
Consolidated - Drained	$ 135.00
Residual strength determination in conjunction with above tests - Add	$ 115.00

SCHEDULE OF SERVICES AND FEES

NORTH TEXAS GEOTECHNICAL ENGINEERING DIVISION
FIELD STUDIES
JANUARY 1991

MOBILIZATION AND DEMOBILIZATION

1. Truck mounted drill rig, water truck and crew——— $ 2.65/mi.
   ($175.00 Minimum)
2. Pickup and 3-man crew (travel to/from site and office when equipment left at location on out-of-town projects) $ 1.25/mi.
3. Subsistence per crew member——— $ 60.00/day
4. Minimum drilling fee——— $500.00

FIELD INVESTIGATION

5. Soil samples (Shelby Tube samples in cohesive soils, 2-inch split spoon samples in cohesive soils)
   a. Intermittent 2 or 3-inch diameter
      0-50 (sampled at 5'intervals——— $ 9.15/ft
      50-100 (sampled at 5'intervals)——— $ 11.60/ft.
      100-200 (sampled at 10'intervals)——— $ 16.80/ft.
      200-300 (sampled at 20'intervals)——— $ 21.00/ft.
   b. Continuous 2 or 3-inch diameter
      0-50 feet——— $ 16.80/ft.
      50-100 feet——— $ 21.00/ft.
   c. Larger diameters———Quoted on request
6. Wash or auger borings without samples——— $ 5.00/ft.
7. Undisturbed or split-spoon samples in wash or auger borings——— $ 31.50/ea.
8. Casing of boring through overburden for soil sampling or rock coring——— $ 5.00/ft.

FIELD STUDIES

9. Rock coring (NX-size), continuous coring, plus bit costs

   a. Carbide——— $14.95

   b. Diamond——— $21.00

10. Equipment rental plus bit costs

   a. Two men, Mobil B-53——— $136.50/hr.

   b. Three men, Failing 1250 (air), GD1000 (air) Mobil B-57——— $150.00/hr.

   c. Three men, CME 75 air combination——— $160.00/hr.

11. Stand-by of crew and equipment, including move time in excess of 30 minute per boring

   a. Three men, drilling equipment——— $130.00/hr.

12. Rental equipment necessary to gain access——— Cost +15%

13. Instrumentation (slope indicators, piezometers, etc.)

   a. Installation——— Rig rental rate

   b. Materials (screen, pipe, instruments)——— Cost +15%

   c. Geologist or Engineer at rate listed in Schedule of Hourly fees for personnel

   d. Standard 2-inch standpipe observation wells——— $ 6.00/ft.

14. Drilling tools, casing and bits lost in hole——— Cost +15%

15. Pressure testing——— Rig rental rate

16. Resistivity Surveys———Quoted on request

17. Borehole Grouting

   a. Equipment——— Rig rental rate

   b. Materials——— Cost +15%

18. Rock Core Wooden Boxes——— Cost +15%

LABORATORY TESTING

STRENGTH AND COMPRESSIBILITY - Continued	UNIT PRICE
14. Consolidation	$ 180.00
15. Absorption Swell Test	$ 60.00
Controlled Pressure Swell	$ 80.00
16. Preparation of remolded or compacted specimen for items above	$ 20.00
17. Optimum Moisture - Density Relation	
Standard	$ 135.00
Modified	$ 150.00
18. California Bearing Ratio (3 specimens)	$ 415.00
19. Lime Stabilization	
Lime/Atterberg Series	$ 160.00
Lime/pH Series	$ 80.00
Optimum Moisture - Density/Lime Stabilized Soil	
4-inch Mold	$ 150.00
6-inch Mold	$ 150.00
Optimum Moisture Density with strength tests - three lime contents	$ 450.00
20. Dispersion	
Pinhole	$ 115.00
Crumb	$ 21.00
Double Hydrometer	$ 115.00
21. Laboratory Resistivity	$ 35.00

EXHIBIT "C"

ANALYTICAL TESTING
SANITARY INTERCEPTOR SEWER
FARMERS BRANCH/ADDISON, TEXAS

pH	$ 5.00 ea.
Sulfates	$ 20.00 ea.
Sulfides	$ 25.00 ea.
Cyanide	$ 25.00 ea.
Volatile Organics	$225.00 ea.
Semi-Volatile Organics	$575.00 ea.
Chlorides	$ 20.00 ea.
Methane	$ 50.00 ea.
Total	$945.00/sample

Above series on five or more samples $875.00/sample.

Sampling Charge $45.00/hr. For three sampling times estimate maximum of 8 hours.

April 17, 1991

CONSOER, TOWNSEND & ASSOCIATES, INC.

INDIRECT COST RATE SCHEDULE
FOR PERIOD 10/1/90 - 02/28/91

INDIRECT COSTS

Vacation	$231,500
Holiday	175,880
Sick Leave	83,396
Courtesy	27,672
Severance	5,490
FICA	282,231
FUI	12,539
SUI	23,577
Workmen's Compensation	36,367
Medical/Dental	132,624
Life/ACC/Disability/Vision	32,365
Employee Morale	10,309
ESOP	377,000
Benefit Plans Administration	25,364
Pension	62,500
Bonus	125,000
Tuition	7,773
General and Administrative Salaries	482,501
Corporate Development Salaries	517,455
Corporate Development Expenses	378,995
Professional Services	117,028
Auto Expense	49,939
Travel and Meals	14,177
Reproduction	28,378
Telecommunication	64,275
Postage	21,390
Computer	56,731
Relocation	43,566
Professional Development	19,029
Rent & Utilities	510,115
Equipment	23,004
Office Supplies	69,611
Subscriptions & Dues	38,454
Insurance	108,778
Miscellaneous Taxes	16,350
Recruitment	9,445
Office Temps	14,055
Building Maintenance	1,859
Miscellaneous	5,475
Depreciation	73,023
AECOM Allocation (Home Office G&A)	180,000

TOTAL INDIRECT COST POOL	(A)	$4,495,260
DIRECT SALARIES	(B)	2,563,607
INDIRECT COST RATE (A÷B)		175.35%

Footnote: The above listed expenses are audited annually in accordance with the applicable sections of the Standards for Audit of Government Organizations, Programs, Activities and Functions published by the Comptroller General of the United States and generally accepted auditing standards. Cost allowability is based upon Subpart 31 of the Federal Acquisition Regulations.

EXHIBIT "D"

SUMMARY OF COSTS

This is an exhibit to and incorporated into the Agreement (the "Agreement") entered into by and between the **CITY OF FARMERS BRANCH, TEXAS**, a municipal corporation, hereinafter referred to as "City" and **CONSOER, TOWNSEND & ASSOCIATES, INC.**, hereinafter referred to as "Engineer", on _____, 1991.

MAXIMUM FINAL DESIGN BASIC SERVICES COST

A.	BASIC FINAL DESIGN SERVICES	$607,984 ?
B.	OTHER DIRECT COSTS:	
1.	Printing plans specifications @ commercial invoice costs	
a.	5 sets for 50, 90 & 100 percent review	
b.	30 sets for bidding purposes	
c.	20 sets for regulatory & utility agencies	
d.	Total costs	$5,500
2.	Travel cost @ commercial invoice cost @ 26 round trips	$4,000
3.	CAD use costs @ $10.00 per hour @ 1,384 hours =	$13,840
	Total other direct costs	$23,340 ?
	TOTAL MAXIMUM FINAL DESIGN BASIC SERVICES	$631,324

MAXIMUM SPECIAL SERVICES COST SUMMARY

A.	Surveying	$92,896

B.	Easement legal descriptions and plat preparation	$49,408
C.	Geotechnical investigations	$183,500
D.	Sanitary sewage analytical testing	$3,195
E.	Flow metering	$4,500
	TOTAL MAXIMUM SPECIAL SERVICES	$333,499
	TOTAL MAXIMUM COST FINAL DESIGN AND SPECIAL SERVICES COST	$964,823

EXHIBIT "E"
PAYMENT AND BILLING RATES FOR
SERVICES DURING CONSTRUCTION

This is an exhibit to and incorporated into the Agreement (the "Agreement") entered into by and between the **CITY OF FARMERS BRANCH, TEXAS**, a municipal corporation, hereinafter referred to as "City" and **CONSOER, TOWNSEND & ASSOCIATES, INC.**, hereinafter referred to as "Engineer", on _____, 1991.

I. PAYMENT

Payment will be based on actual salary of staff members involved in productive work on the project based on a salary multiplier to be negotiated with the owner upon the completion of Final Design.

II. BILLING RATES

Billing rates will be based on the personnel assigned to the project upon the completion of Final Design and will also be based upon the salary multiplier negotiated in Paragraph I - Payment - above.

EXHIBIT "F"
SUMMARY OF MAXIMUM COST FOR
SERVICES DURING CONSTRUCTION

This is an exhibit to and incorporated into the Agreement (the "Agreement") entered into by and between the **CITY OF FARMERS BRANCH, TEXAS**, a municipal corporation, hereinafter referred to as "City" and **CONSOER, TOWNSEND & ASSOCIATES, INC.**, hereinafter referred to as "Engineer", on _____, 1991.

The Maximum Costs for Services During Construction will be negotiated with the owner upon completion of Final Design.

SANITARY SEWER FLOW MONITORING FINAL REPORT

Farmers Branch Creek Drainage Basin

City of Farmers Branch

Engineering Department

P.O. 65043
Resolution #90-102

September 1990

ADS SERVICES, INC.

SANITARY SEWER FLOW MONITORING FINAL REPORT

Farmers Branch Creek Drainage Basin

City of Farmers Branch

Engineering Department

P.O. 65043
Resolution #90-102

September 1990

ADS SERVICES, INC.

TABLE OF CONTENTS

I. Executive Summary

A. Overview

The primary purpose of the Farmers Branch Creek flow monitoring study was to establish available interceptor sewer capacity east of Marsh Lane. This information is required for the on-going interceptor sewer project. A total of 3 flow monitoring sites were selected and continuous recording flow meters were installed. Data collection spanned approximately 30 days from July to August 1990. Rainfall data was recorded to obtain a correlation between dry and wet weather flows.

B. Summary of Findings

The three monitoring sites showed no significant increases in flow during the rainfall events monitored. Dry weather capacity is adequate at sites 1 and 3 with 60% and 55% of total peak capacity used during dry weather. During the rainfall events recorded, peak wet weather capacity utilized increased at these two sites to 61% and 58% respectively.

Monitoring site 2; however, was found to be at 100% capacity during dry weather and surcharges during peak dry weather periods.

C. Conclusions and Recommendations

Analysis of data obtained during the flow monitoring study combined with observations and discussions have resulted in the following conclusions and recommendations.

<u>Conclusions</u>

- Wet weather inflow only marginally impacted the collection system capacity. High intensity storm events may create a system response that (due to dry soil conditions in this study) was not observed.
- The 21 inch interceptor east of Marsh Lane utilizes 60% of its dry weather capacity. Silt was noted in the pipeline which if removed would increase capacity slightly.
- The 15 inch pipeline east of Midway Street utilizes 55% of its dry weather capacity. Weekend flows are approximately half those of weekdays.
- The 8 inch pipeline west of Alpha Road occasionally exceeds its dry weather capacity during normal dry weather conditions.

Recommendations

- Evaluate future flows to determine loadings on the interceptors and adequacy based on land use and ultimate development.
- Annually inspect and clean interceptors that are silting to restore capacity.
- Evaluate all new sewer design to ensure adequate velocities are present to prevent silting.
- Initiate plans to provide relief capacity to the 8 inch (RH02 Monitoring Site) pipeline.
- Initiate plans to address future hydraulic loadings on the Farmers Branch interceptor east of Marsh Lane due to current dry weather flows utilizing approximately 60% of the interceptor capacity.

II. Flow Monitoring

A. Background

1. Purpose of Study

The primary purpose for the sanitary sewer flow monitoring investigation survey was to establish sewage flows and line capacity being utilized. These findings and recommendations will be instrumental in subsequent sanitary sewer system improvements made by the City of Farmers Branch.

2. Study Area

a. Drainage Basin Delineation

The Farmers Branch sanitary sewer system investigated during this study consists primarily of the eastern Farmers Branch Creek interceptor. This study was limited in scope and does not include the entire Farmers Branch collection system.

b. Meter Locations

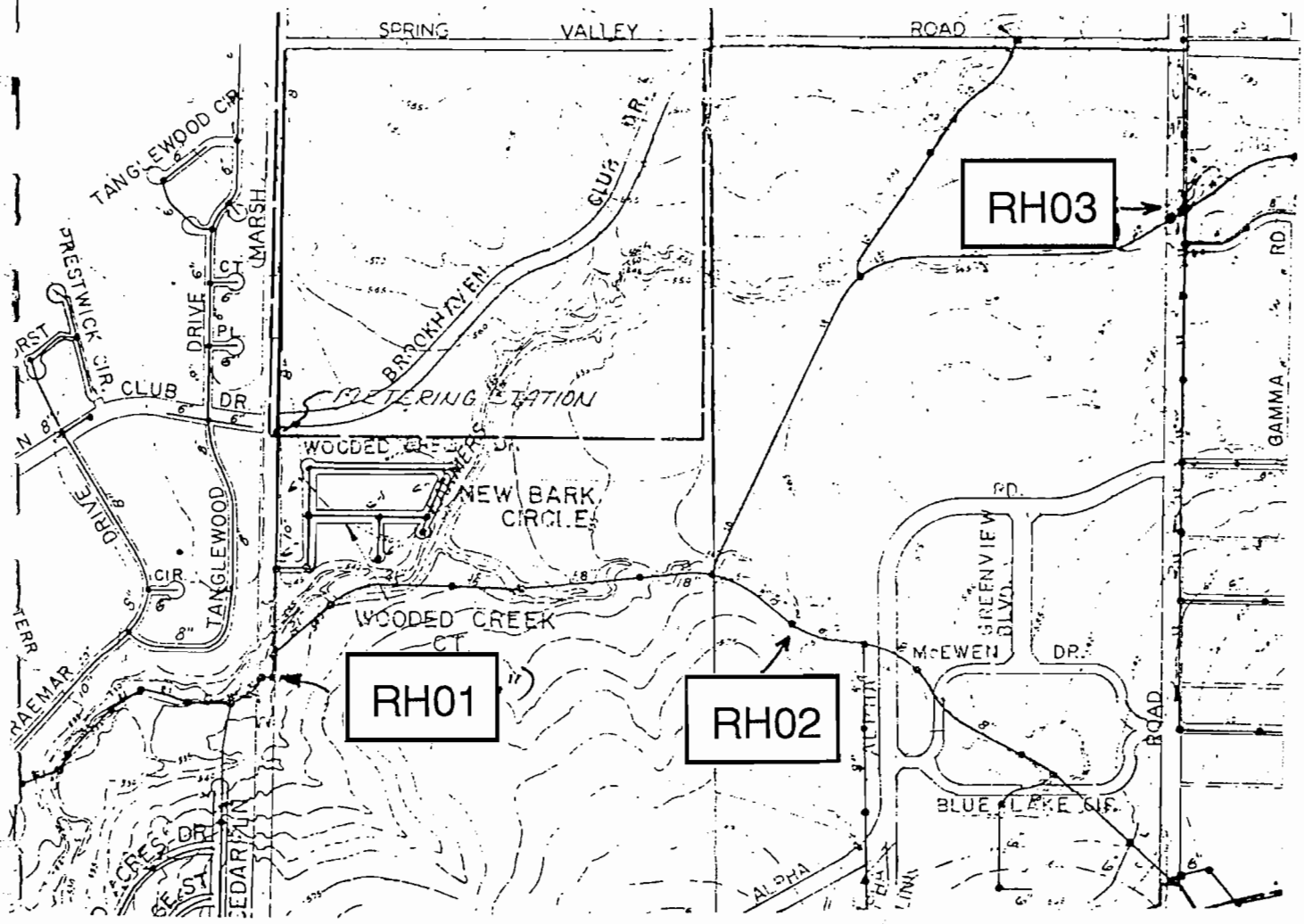
The Farmers Branch Engineering Department made the preliminary selection of meter locations for this study. The ADS Services, Inc. field crew examined each location and determined its adequacy from a hydraulic and flow data collection standpoint. A total of 3 flow meter locations were defined (see Figure 1). Supplemental daily rainfall data was supplied by a rain gauge that recorded rainfall events intensity and duration.

c. Statistical Rainfall Variation

Mean annual precipitation for the study area as defined by the U.S. Department of Agriculture Soil Conservation Service is approximately 35 inches. Annual average precipitation recorded by NOAA is provided in Figure 2. There are two peak rainfall periods occurring annually in May and September with the former being dominant. Figure 3 shows the percent probability for the study area receiving a rainfall of given return period with a six hour duration for any month. Rainfall data collected from the study area over the recording period showed, as would be expected, that high intensity short term rainfall (local thunderstorms) was more probable than that of low intensity long term (regional) rainfall. This type of weather pattern will result in rapid runoff of storm water with the potential for relatively high peak inflow rates.

Figure 1

Monitoring Site Locations



MONITORING SITE	LOCATION	INTERCEPTOR SIZE	LINE SLOPE %
RH01	Marsh Lane at Farmers Branch Creek	21"	0.23%
RH02	Creek Easement West of Alpha Road	8"	1.30%
RH03	Dooley at Farmers Branch Creek	15"	0.50%

Figure 2

ANNUAL PRECIPITATION DATA

FARMERS BRANCH
35 inches per year

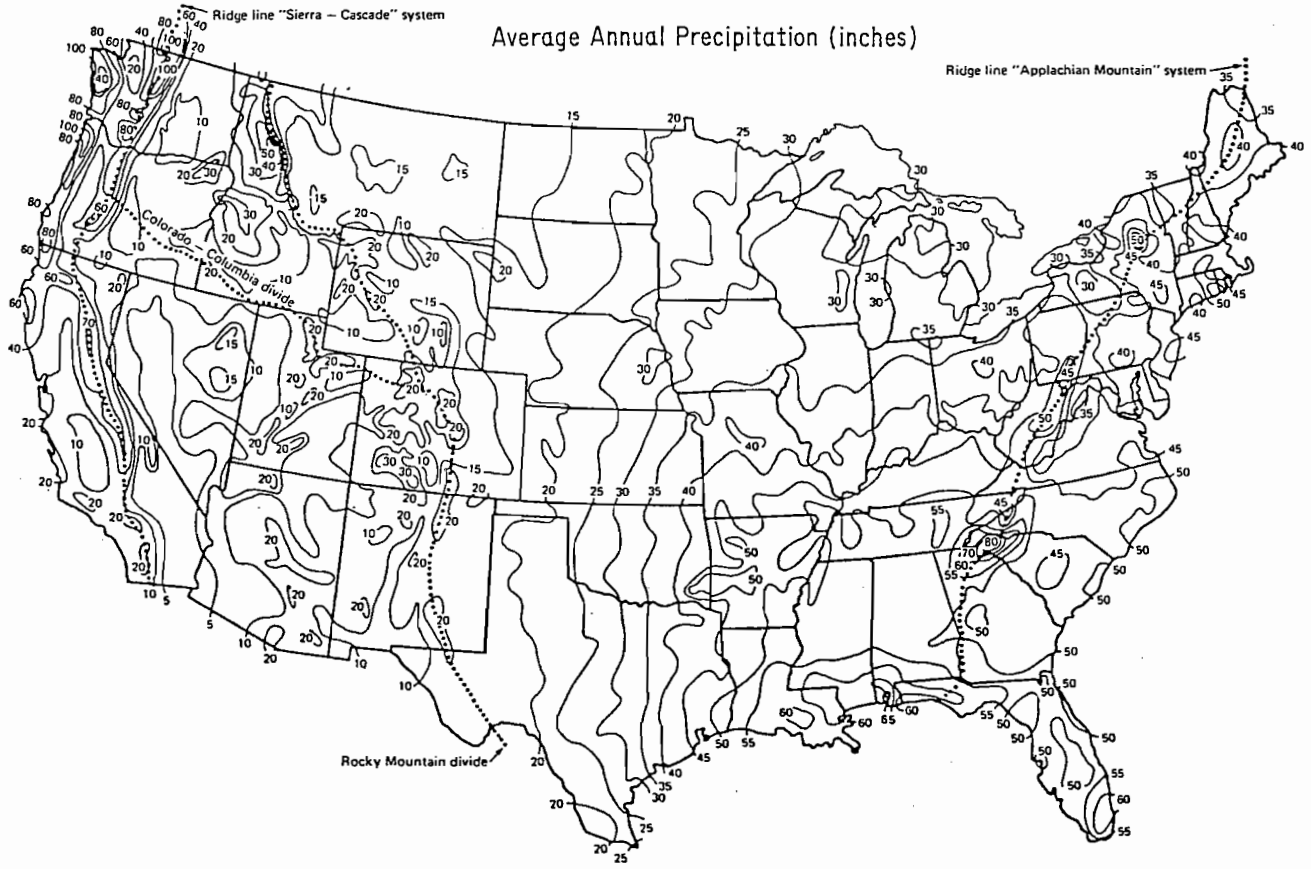
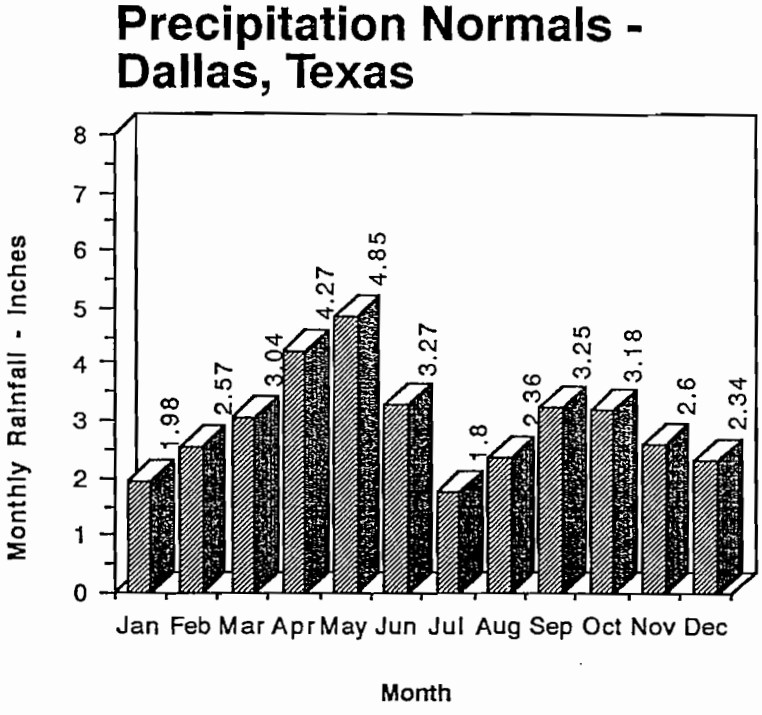
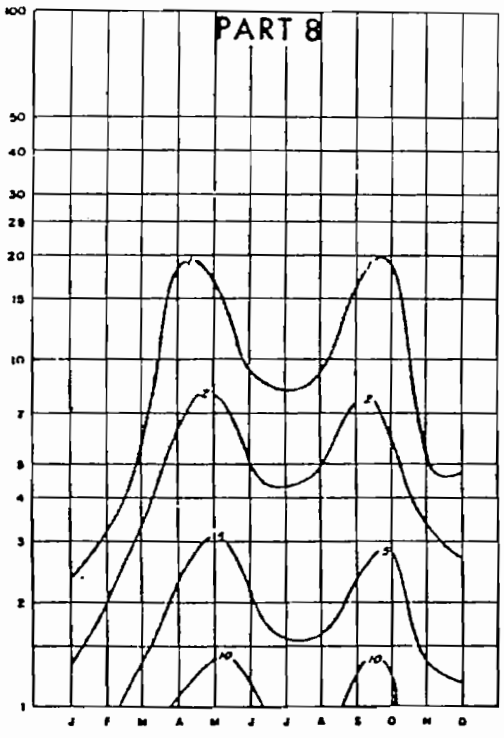


FIGURE 3

SEASONAL PROBABILITY OF INTENSE RAINFALL AND MONTHLY PRECIPITATION NORMALS





3. Instrumentation/Methodology

a. Description

The Quadrascan 1500 flow monitor manufactured by ADS Services, Inc. was used to measure open channel flow in this project. The monitoring unit has three basic components: (1) sensors that measure depth of flow and velocity; (2) a microprocessor; (3) computer memory chips that store the data; and a crystal clock to synchronize sensor recordings.

Each monitor stores depth of flow and velocity readings at user-defined intervals, typically every 5 or 15 minutes. A portable lap-top computer was used for the purpose of retrieving data from the monitor.

b. Pre-Installation Calibration

Calibration of all equipment was performed before installations. The purpose of the calibration was to assure sensor accuracy. The sensors were placed in a hydraulic testing tank and the output signals were compared to the actual readings of known depths.

c. Installation

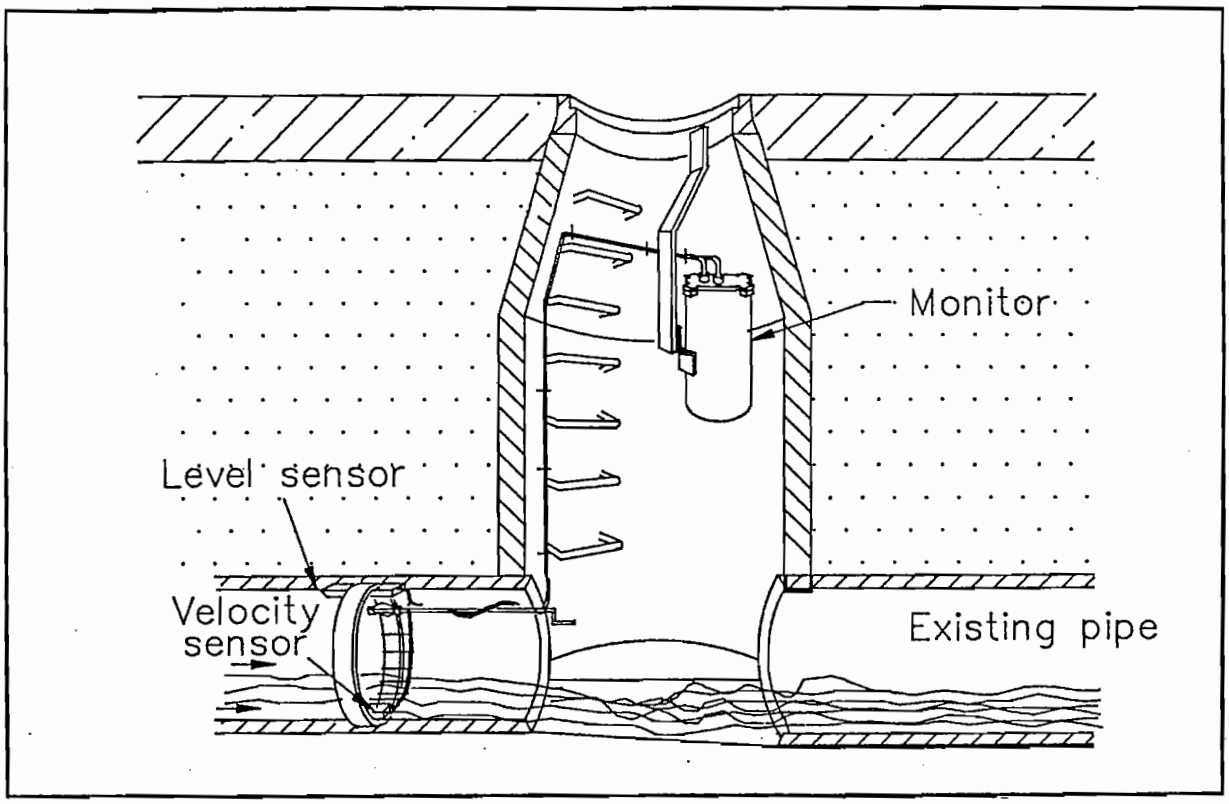
After the site investigations and monitor calibrations were completed, monitoring equipment was installed. The depth and velocity sensors were mounted on an expandable aluminum ring and installed approximately one to two pipe diameters upstream of the manhole invert in the incoming sewer pipe. Figure 4 presents a typical installation.

After the installation was completed the field crew test fired the sensors to ensure that the monitor was working properly and verified that the monitor clock was synchronized with the project master clock.

Three meters were installed in the Farmers Branch sanitary sewer system during the period of July 4 through August 6, 1990.

FIGURE 4

TYPICAL FLOW METER INSTALLATION



d. Monitoring

During the monitoring period, field crews visited the metering location approximately once a week to upload the data and document the field conditions. The following steps were taken to assure the integrity of the data collected at each metering location:

Quality Assurance - The quality of the field data was analyzed throughout the project. Regular field visits to each Flow Monitor include the following tests:

- Measure Power Supply: Power levels are recorded and power supplies replaced, if necessary. The monitor is powered by a dry cell battery pack. A lithium battery on the Processor Board provides back-up power to the memory, which allows the primary battery to be replaced without the loss of data.

- Verify Depth of Flow and Velocity: During the site visit, a field crew member descended the manhole to measure the depth and velocity of flow at the sensor. The independent manual readings were compared to the monitor readings to confirm monitor accuracy.

- Measure Silt Level: The field crew member measured and recorded the depth of the silt at the sensor.

- Perform Hydraulic Calibration: Flows were quantified by velocity and/or weir test.

- Upload Raw Data: Raw data was uploaded and reviewed for comparison with previous data.

- Confirm Monitor Synchronization: The field crew checked the flow monitor's timing against the project master clock to ensure that all readings were taken simultaneously. Thus, a "hydraulic snapshot" of the flows in the system was obtained.

- Review Raw Data: After the data was collected, it was reviewed on-site by the field crew to verify its integrity. All readings were reviewed for consistency and screened for deviations in the flow patterns which would indicate system anomalies or equipment failure.

e. Data Format

As described earlier, the ADS 1500 velocity/depth recorder samples the velocity and depth every 15 minutes. Flow values for each meter location for each day's recording are presented in Appendix A. Also included are the daily maximum, minimum and average flow values. The tabulated flow data was used to prepare hourly wastewater flow hydrographs.

Rainfall data is presented in Table 1. It is worthy to note how some storm events were quite localized in the study area. Such localized storm events have limited value during the analysis of the collection system. In addition, dry soil conditions may have prevented activation of inflow sources.

f. Infiltration/Inflow Impact on Treatment Facilities

Normal dry weather wastewater flows are currently transported and treated without bypass or overflows. The effect of storm events on the collection and treatment system are directly related to the storm occurrence intensity and duration. High intensity rainfall will create elevated peak hydraulic loads on the interceptor while low intensity rainfall, with long duration, will generally have less impact. The volume of inflow to be transported and ultimately treated will be a function of the storm intensity-duration and the types of defects contributing to the extraneous flows.

B. Flow Data Analysis

A summary of flow monitoring data is presented in Table 2. Data is presented for each of the flow monitoring sites within the Study Area. A summary of flow data is presented in the Appendix along with wastewater flow hydrographs.

1. Average Daily Flow

The average daily flow was determined for each monitoring site utilizing dry weather recorded data. Those days influenced by rainfall were omitted from the determination. Dry weather days used during this analysis were July 4-11, 21, 27, 28, 31, and August 1, 1990.

2. Peak Flow - Wet Weather

Peak wet weather flow rates were obtained from analysis of rainfall data. Data presented in Figure 2 indicates little increase in flows due to rainfall; however, due to the dry soil conditions during the monitoring period, the full impact of wet weather induced inflow may not have been fully evaluated.

TABLE 1
Recorded Rainfall Data

DATE	TOTAL RAINFALL (Inches)	Maximum 15 Minute Intensity (Inches)
7-12	.69	.38
7-16	.19	.14
7-17	.08	.02
7-18	1.01	.45
7-22	.13	.10
7-23	.16	.11
7-24	.14	.11
7-25	.03	.03
7-29	.68	.33
8-02	.15	.05
8-03	.58	.57
8-04	.53	.12
8-05	.38	.09

TABLE 2

FLOW MONITORING DATA SUMMARY

City of Farmers Branch

DESCRIPTION	FLOW MONITORING SITE		
	RH01	RH02	RH03
1. AVERAGE DAILY FLOW (mgd)	1.962	0.457	1.016
2. PEAK FLOW-WET (mgd)	3.197	0.634	1.819
3. CAPACITY USED-WET (%)	61%	70-100%	58%
4. PEAKING FACTOR-WET	1.6	1.4	1.8
5. DRY WEATHER PEAK FLOW (mgd)	3.137	0.632	1.728
6. CAPACITY USED-DRY (%)	60%	66%	55%
7. PEAKING FACTOR-DRY	1.6	1.4	1.7
8. PIPELINE CAPACITY (mgd)	5.227	0.947	3.156
9. LINE SIZE (inches)	21	8	15
10. INTERCEPTOR SLOPE	0.23%	1.30%	0.50%

ADS SERVICES, INC.

Dry Days - July 4-11,21,27,28,31, August 1, 1990

3. Capacity Used - Wet Weather

A comparison of the pipeline peak capacity and the peak flow rate observed establishes the percentage of line capacity utilized during the rainfall events recorded during the monitoring. These values are based on the interceptor line sizes.

4. Wet Weather Peaking Factor

The wet weather peaking factor, found in Table 2, is the quotient of the peak hourly flow during a rainfall event divided by the average dry weather flow at the same hour. This parameter is not necessarily determined at the maximum total flow since maximum inflow could occur at a time of low base flow (2:00-4:00 a.m.) but still be less than the total flow (7:00-10:00 a.m.) when base flow is maximum. A comparison of wet weather peaking factors and dry weather peaking factors provide insight into the degree of wet weather inflow. Pumping stations, long interceptors, and industrial discharges can each affect the peaking factor.

5. Dry Weather Peak Flow

Peak base line flows in the study area usually occur in late morning. Percentage of industrial contribution and time of the week will have considerable influence on the magnitude and time of peak dry weather flows. Table 2 presents dry weather peak flow which is the highest dry weather flow observed during the study.

6. Capacity Used - Dry Weather

Presented is a summary of the percentage of pipeline capacity used during peak dry weather conditions. This value is the ratio of the peak dry weather flow rate observed and the pipeline maximum capacity.

7. Dry Weather Peaking Factor

The dry weather peaking factors found in Table 2 is the quotient of the dry weather peak flow divided by the average daily flow during dry weather. It is a measure of the ratio between maximum daily flow vs. average daily flow and defines the stability or consistency of flow in a sub-basin. The closer this factor is to 1.0 the less hour to hour flow variation exists. Larger dry weather peaking factors could imply relative high-volume, short-term industrial users or in some instances the influence of pumping stations.

8. Pipeline Capacity

Each interceptor has an estimated theoretical maximum flow capacity as defined by the main collection line. It is a function of line size, slope, and coefficient of roughness. The theoretical capacity is an estimate based on the best available information. The equivalent capacity presented in Table 2 is based on actual flow measurements from velocity/depth recordings at known depth of flow. Using the Manning equation the equivalent line capacity or full pipe flow was determined at each monitored location. Obstructions downstream and/or debris in the line can cause reduced theoretical capacity values. Monitoring site RH01 for example was observed to have 4 inches of silt build up which reduces capacity to the value presented in Table 2.

9. Line Size

Table 1 displays the diameter of the main collection line at the point of monitoring. Line sizes monitored were 8, 24, and 30 inches in diameter. The repetitive interceptor sizes are 8, 15, and 21 inches in diameter. The discrepancy is due to increased pipeline diameter at Sites RH01 and RH03 where the interceptor crosses under major streets. The capacity analysis preferred is based on the interceptor sizes.

10. Interceptor Slope

The slope of the interceptor was obtained from as-built plans and was used to establish the theoretical capacity of the interceptor.

APPENDIX

Flow Monitoring Data and Hydrographs

Site RH01
Flow Monitoring Data
and
Hydrographs

ADS Services, Inc.

1500 Site Report

REWARD IF FOUND - (205) 883-9323

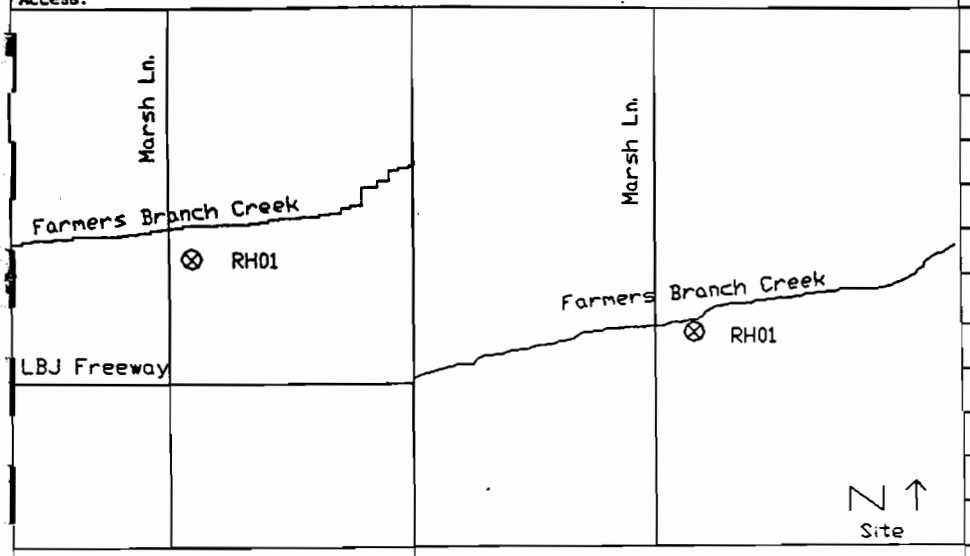
Manhole #	AN	Monitor #
	RH01	8060
V-Sensor #	**Bat Serial #**	**Press. X-ducer #**
2605	048902-A	
Dist. to X-ducer	**Physical Offset**	**Diameter**
		30"

Project/Phase: Farmers Branch, TX Date: Name: BF

Address/Location: On east easement of Marsh Lane @ Farmers Branch Creek

Access:

INSTALLATION Pressure and Velocity



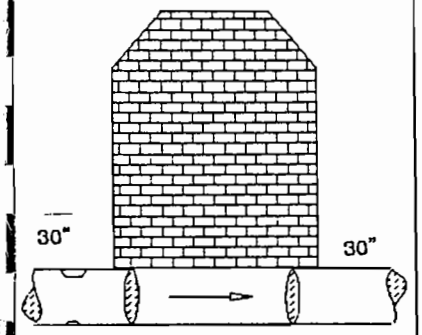
SAFETY

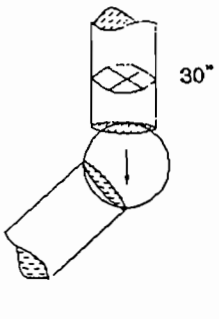
Manhole Depth: 14.4'

Traffic: Park on easement

Gas @ Investigation:

Manhole Condition: Good, brick M/H, No steps





Rain Gauge Zone: RG01

Drop/Fall:

Install QC: Date: Int.:

Comments:

Pipe Type:

BACKUP	Y	N	?	DISTANCE
Trunk		X		
Lift Sta.		X		
STP		X		
Other Input		X		
Ind. U/S		X		
L/S U/S		X		

General Condition, overflows, bypasses, weirs, special information, monitor characteristics, surcharge
* Please make a precise drawing if odd-shaped pipe or special installation

RATING

Hydraulics: Slow velocity, smooth flow. 4" sediment in pipe.

Recommended Analysis Days:

Master List of Recommended Days:

Additional Comments - Final Data Review

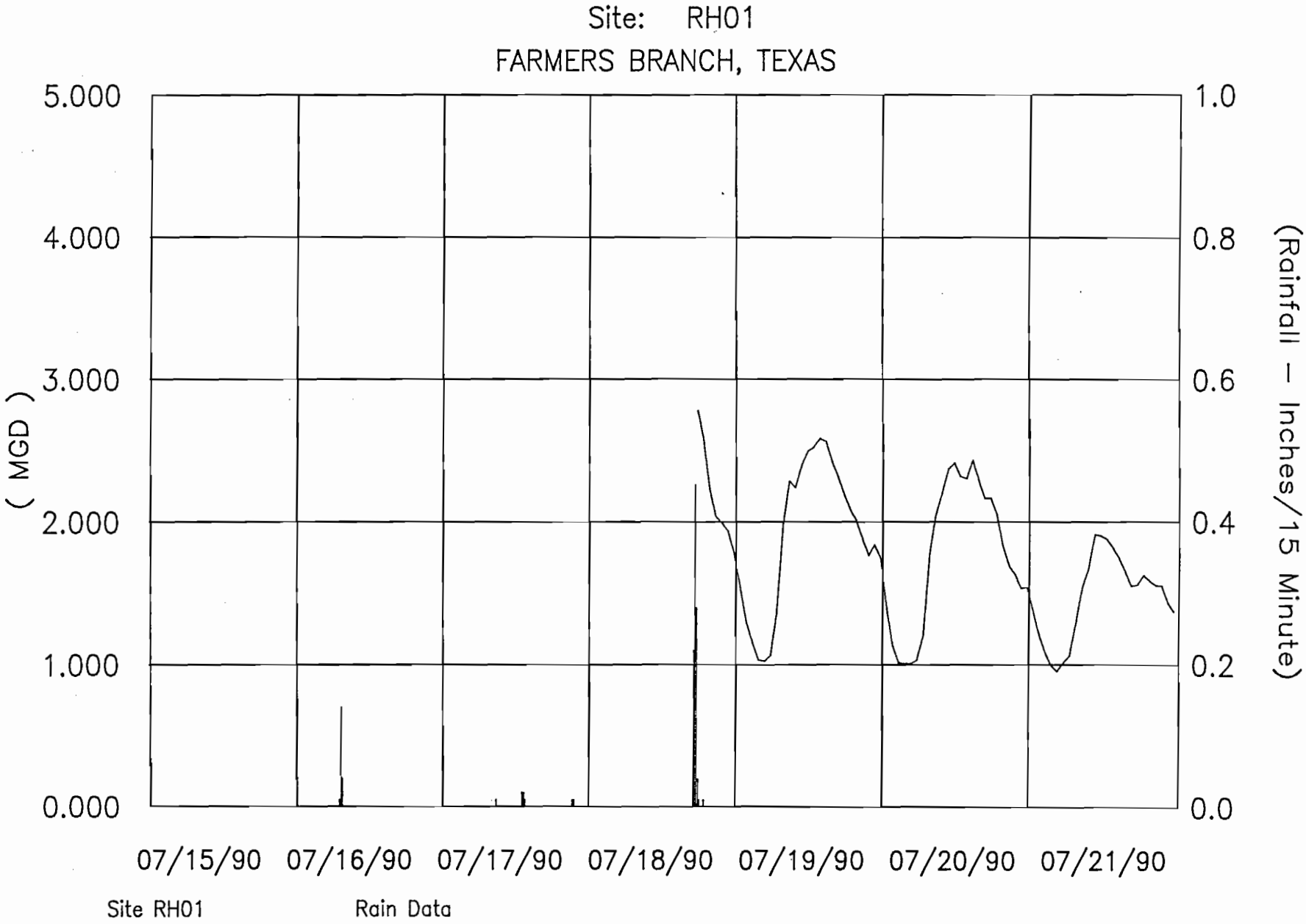
Surcharge: Yes Height: 4'

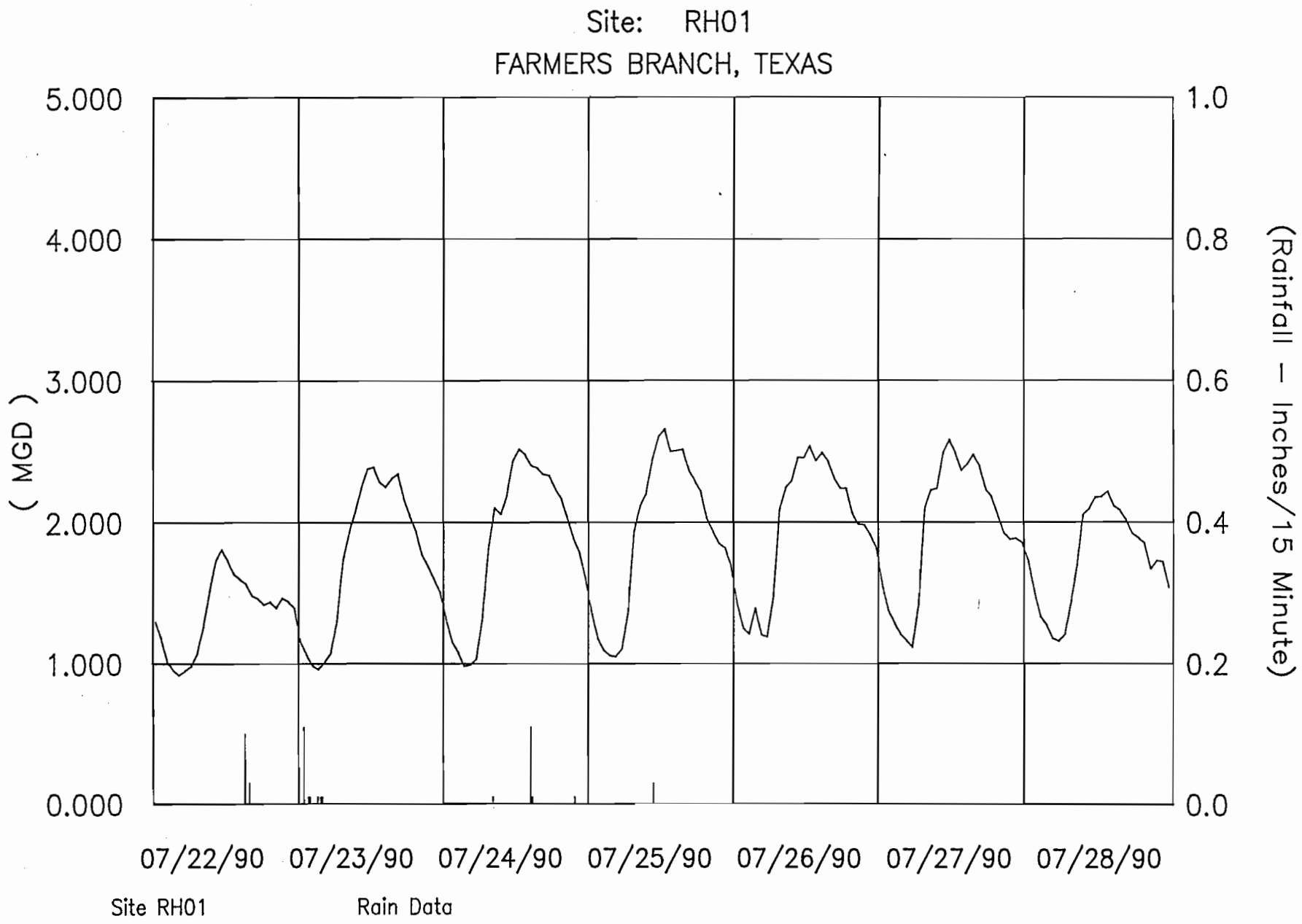
Inv.: DOF: 19" +/- Time: 14:20 Vel: fps Silt: 4"

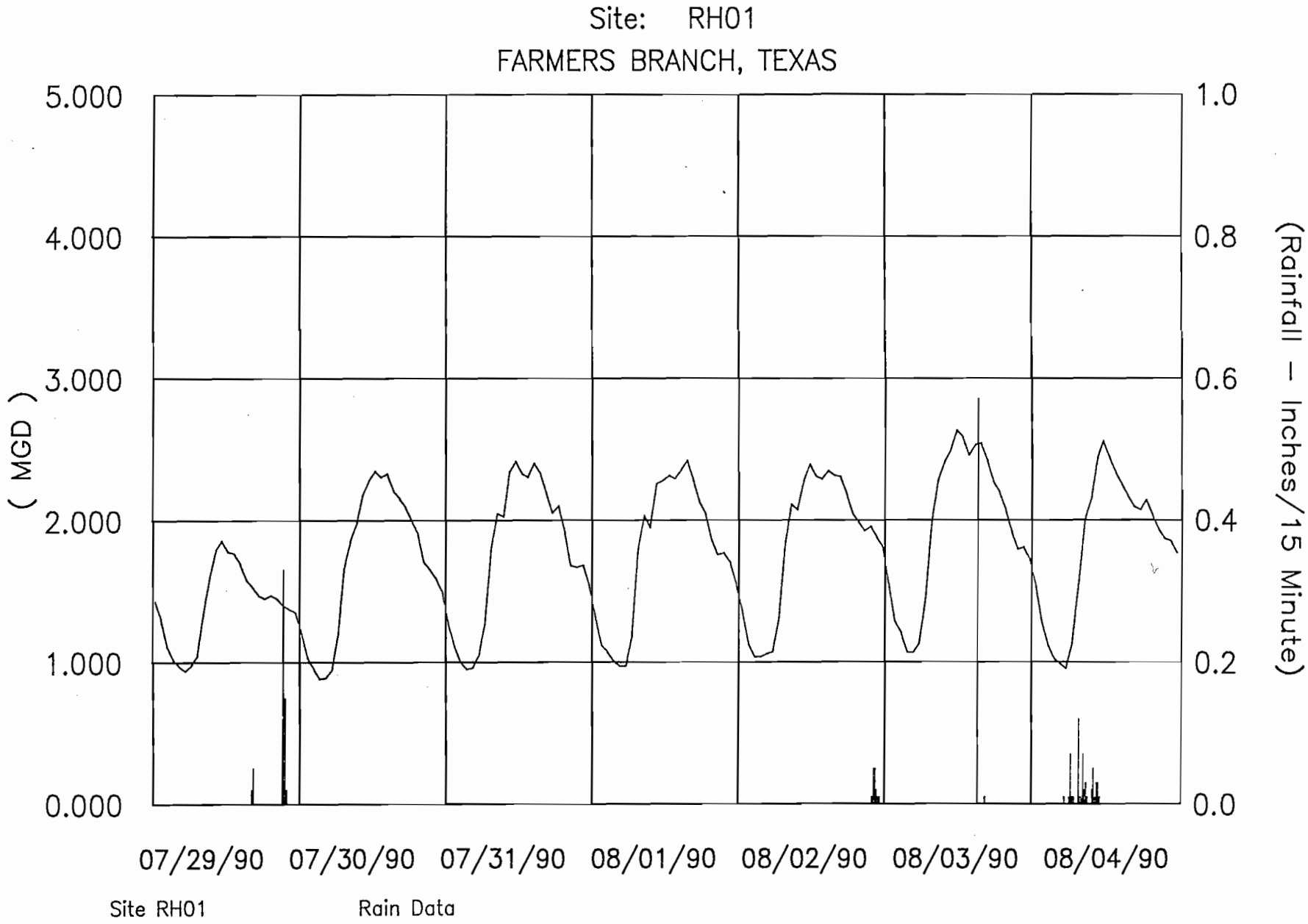
Upstream Manhole Not located

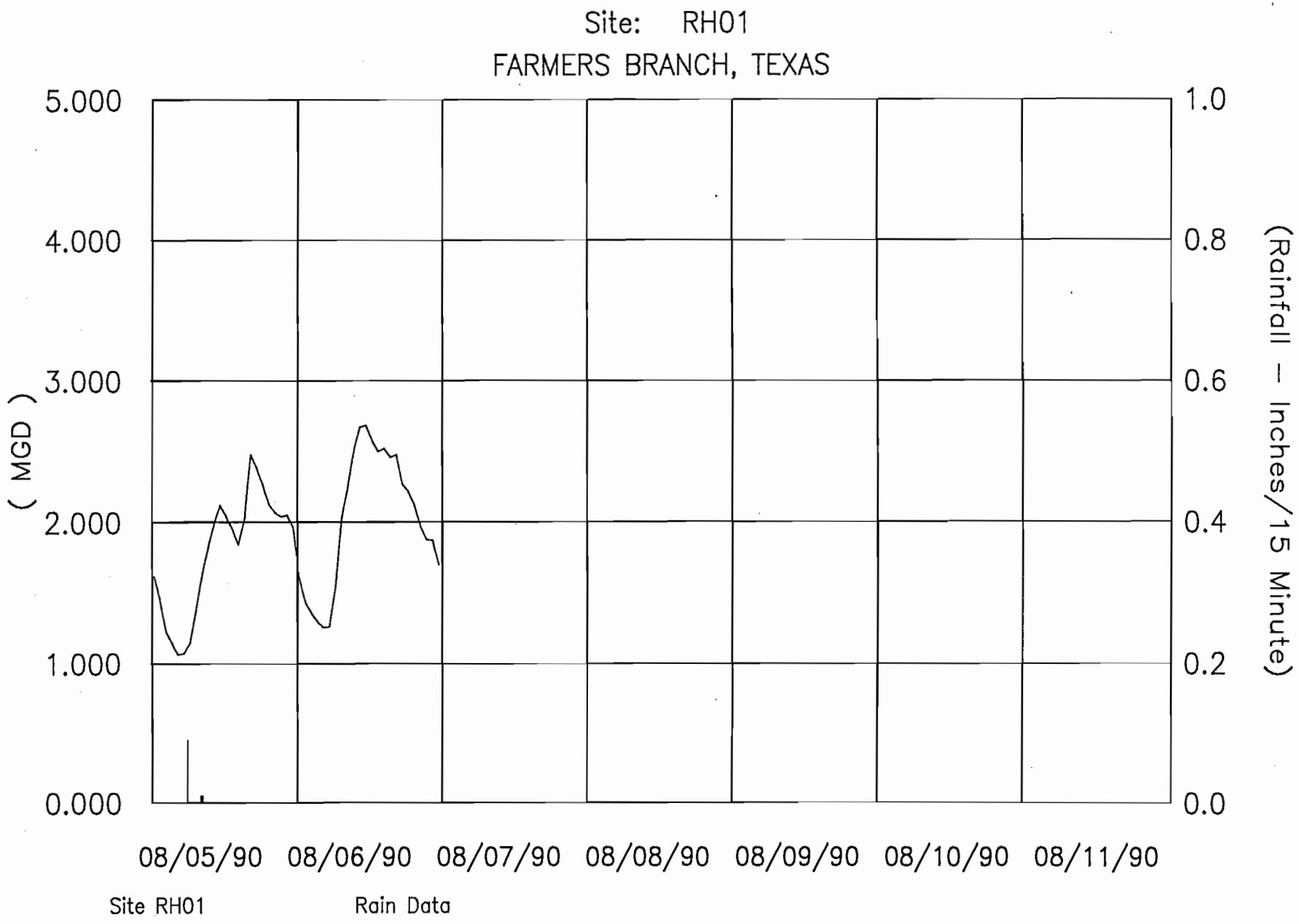
Downstream Manhole Not located

Mini System Character: XX Residential/Commercial/Industrial/Vacant XX


Site: RH01
FARMERS BRANCH, TEXAS
5.000
4.000
3.000
2.000
1.000
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
07/15/90
07/16/90
07/17/90
07/18/90
07/19/90
07/20/90
07/21/90
Site RH01
Rain Data


Site: RH01
FARMERS BRANCH, TEXAS
5.000
4.000
3.000
2.000
1.000
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
07/22/90
07/23/90
07/24/90
07/25/90
07/26/90
07/27/90
07/28/90
Site RH01
Rain Data


Site: RH01
FARMERS BRANCH, TEXAS
5.000
4.000
3.000
2.000
1.000
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
07/29/90
07/30/90
07/31/90
08/01/90
08/02/90
08/03/90
08/04/90
Site RH01
Rain Data


Site: RH01
FARMERS BRANCH, TEXAS
5.000
4.000
3.000
2.000
1.000
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
08/05/90
08/06/90
08/07/90
08/08/90
08/09/90
08/10/90
08/11/90
Site RH01
Rain Data

ID 1: E MARSH LN @ FARMERS BRANCH CR
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 30.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 1.762
MUD: 0.67

PROJECT: FARMBRAN
SITE: RH01
RAIN GAUGE: RG01
PEAK CAPACITY: 6.512

	SUNDAY 7/15/90		MONDAY 7/16/90		TUESDAY 7/17/90		WEDNESDAY 7/18/90		THURSDAY 7/19/90		FRIDAY 7/20/90		SATURDAY 7/21/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
0:00	--		--		--		--		11.9	1.553	11.6	1.398	11.2	1.372
:15	--		--		--		--		12.2		11.3		11.0	
:30	--		--		--		--		11.2		10.9		10.8	
:45	--		--		--		--		11.1		10.2		10.7	
1:00	--		--		--		--		10.8	1.299	10.4	1.143	10.3	1.210
:15	--		--		--		--		10.7		10.0		10.4	
:30	--		--		--		--		10.5		9.9		10.2	
:45	--		--		--		--		10.5		9.5		10.2	
2:00	--		--		--		--		10.0	1.165	9.4	1.016	9.8	1.085
:15	--		--		--		--		10.4		9.4		9.7	
:30	--		--		--		--		9.9		9.2		9.8	
:45	--		--		--		--		9.9		9.5		9.5	
3:00	--		--		--		--		9.6	1.033	9.2	1.007	9.5	0.997
:15	--		--		--		--		9.4		9.4		9.4	
:30	--		--		--		--		9.5		9.5		9.2	
:45	--		--		--		--		9.3		9.2		9.1	
4:00	--		--		--		--		9.4	1.024	9.3	1.009	9.1	0.954
:15	--		--		--		--		9.4		9.4		9.1	
:30	--		--		--		--		9.3		9.3		9.1	
:45	--		--		--		--		9.5		9.4		9.1	
5:00	--		--		--		--		9.2	1.068	9.2	1.033	9.1	1.014
:15	--		--		--		--		9.6		9.4		9.4	
:30	--		--		--		--		9.7		9.8		9.2	
:45	--		--		--		--		10.0		9.4		9.7	
6:00	--		--		--		--		9.9	1.375	9.6	1.213	9.4	1.065
:15	--		--		--		--		10.4		10.1		9.6	
:30	--		0.01	--	--		--		11.3		10.3		9.5	
:45	--		0.14	--	--		--		12.0		11.0		9.9	
7:00	--		0.04	--	--		--		12.5	1.977	11.6	1.774	10.3	1.306
:15	--		--		--		--		12.8		12.4		10.1	
:30	--		--		--		--		13.2		12.8		10.8	
:45	--		--		--		--		14.1		12.9		11.3	
8:00	--		--		--		--		14.3	2.283	12.8	2.038	11.4	1.544
:15	--		--		0.01	--	--		14.1		13.4		11.4	
:30	--		--		--		--		14.3		13.5		11.6	
:45	--		--		--		--		14.1		13.8		11.9	
9:00	--		--		--		--		14.4	2.237	14.1	2.195	11.8	1.686
:15	--		--		--		--		13.7		13.9		11.8	
:30	--		--		--		--		13.7		13.6		12.1	
:45	--		--		--		--		14.4		14.1		12.8	
10:00	--		--		--		--		14.0	2.392	14.0	2.365	12.9	1.912
:15	--		--		--		--		14.8		14.3		12.9	
:30	--		--		--		--		14.8		14.6		12.8	
:45	--		--		--		--		14.5		14.9		13.1	
11:00	--		--		--		--		14.6	2.495	15.0	2.413	13.0	1.904
:15	--		--		--		--		14.9		14.5		13.0	
:30	--		--		--		--		14.9		14.3		12.6	
:45	--		--		--		--		15.1		14.6		13.0	

	SUNDAY 7/15/90		MONDAY 7/16/90		TUESDAY 7/17/90		WEDNESDAY 7/18/90		THURSDAY 7/19/90		FRIDAY 7/20/90		SATURDAY 7/21/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
12:00	--		--		--		--		15.0	2.523	14.8	2.314	12.6	1.879
:15	--		--		--		--		14.8		13.9		12.7	
:30	--		--		0.02	--		--		14.8		14.1		12.6
:45	--		--		0.02	--		--		15.2		14.3		13.3
13:00	--		--		0.01	--		--		14.8	2.585	14.1	2.298	12.9	1.815
:15	--		--			--		--		15.1		14.3		12.4
:30	--		--			--		--		15.7		14.3		12.4
:45	--		--			--		--		15.1		14.3		12.7
14:00	--		--			--		--		15.1	2.563	14.6	2.434	12.4	1.749
:15	--		--			--		--		15.4		14.6		12.1
:30	--		--			--		--		15.0		14.8		12.4
:45	--		--			--		--		14.9		14.8		12.4
15:00	--		--			--		--		15.0	2.425	14.5	2.293	12.0	1.655
:15	--		--			--		--		14.6		14.3		12.0
:30	--		--			--		--		14.8		14.2		12.0
:45	--		--			--		--		14.2		13.9		11.9
16:00	--		--			--		--		14.1	2.313	13.8	2.162	11.7	1.554
:15	--		--			--		--		14.5		13.6		11.6
:30	--		--			--	0.22	--		14.1		13.6		11.9
:45	--		--			--	0.45	--		14.4		14.1		11.4
17:00	--		--			--	0.28	--	2.781	13.8	2.189	13.9	2.162	11.3	1.565
:15	--		--			--	0.04	--		14.1		13.6		11.5
:30	--		--			--	0.01	--		13.9		14.0		12.0
:45	--		--			--		15.8		13.7		13.6		11.9
18:00	--		--			--		15.8	2.554	13.8	2.084	13.2	2.055	11.7	1.632
:15	--		--			--	0.01	15.1		13.7		13.4		11.9
:30	--		--			--		14.8		13.1		13.5		12.1
:45	--		--			--		14.6		13.5		13.6		12.0
19:00	--		--			--		14.5	2.231	13.7	2.012	12.9	1.837	11.5	1.590
:15	--		--			--		14.4		13.2		12.6		11.9
:30	--		--			--		13.9		13.0		12.6		12.0
:45	--		--			--		13.3		13.2		12.6		11.6
20:00	--		--			--		13.6	2.041	12.8	1.887	12.4	1.698	11.5	1.557
:15	--		--			--		13.7		12.6		12.0		11.9
:30	--		--			--		13.1		13.0		11.9		11.6
:45	--		--		0.01	--		13.1		12.9		12.3		11.5
21:00	--		--		0.01	--		13.5	1.995	12.6	1.768	12.2	1.635	11.7	1.554
:15	--		--			--		13.4		12.3		11.7		11.9
:30	--		--			--		13.0		12.4		11.8		11.7
:45	--		--			--		13.0		12.4		12.1		11.3
22:00	--		--			--		13.1	1.932	12.5	1.843	11.5	1.541	11.5	1.441
:15	--		--			--		13.2		12.4		11.3		11.2
:30	--		--			--		13.0		12.8		11.9		11.0
:45	--		--			--		12.7		13.0		11.6		11.1
23:00	--		--			--		12.4	1.788	12.8	1.750	11.4	1.546	11.1	1.371
:15	--		--			--		12.4		12.2		11.5		10.7	
:30	--		--			--		12.8		12.0		11.8		10.9	
:45	--		--			--		12.3		12.3		11.7		10.9	
TOT RAIN:		0.00		0.19		0.08			1.01		0.00		0.00	
TOT FLOW:		--		--		--			2.118		1.910		1.774		1.476
AMMIN FLW:		--		--		--			--		5:00	0.973	3:45	0.973	3:45	0.948
MIN FLOW:		--		--		--		23:45	1.741		5:00	0.973	3:45	0.973	3:45	0.948
MAX FLOW:		--		--		--		17:45	2.781		13:30	2.743	11:00	2.519	12:45	2.009

DEPTH SENSOR USED: Pressure

ID 1: E MARSH LN @ FARMERS BRANCH CR
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 30.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 1.762
MUD: 0.67

PROJECT: FARMBRAN
SITE: RH01
RAIN GAUGE: RG01
PEAK CAPACITY: 6.512

	SUNDAY 7/22/90		MONDAY 7/23/90		TUESDAY 7/24/90		WEDNESDAY 7/25/90		THURSDAY 7/26/90		FRIDAY 7/27/90		SATURDAY 7/28/90	
	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)
0:00		10.6	1.297		10.3	1.165		11.0	1.323		11.1	1.372		11.6	1.434		12.0	1.567		12.6	1.728
:15		11.0			10.0			10.9			11.1			11.2			11.9			12.2	
:30		10.6		0.11	9.9			10.4			10.8			11.0			11.6			12.3	
:45		10.3			10.0			10.6			10.6			10.8			11.3			12.0	
1:00		10.3	1.181		9.8	1.065		10.1	1.158		10.3	1.185		10.6	1.252		11.3	1.386		11.7	1.519
:15		10.2		0.01	9.4			10.3			10.2			10.7			10.9			11.8	
:30		10.2		0.01	9.5			10.0			9.9			10.3			10.9			11.2	
:45		9.8			9.6			9.7			10.1			10.2			10.7			11.3	
2:00		9.5	1.018		9.4	0.986		9.8	1.078		9.8	1.100		10.1	1.212		10.9	1.292		10.9	1.335
:15		9.4			9.3			9.6			9.7			9.8			10.5			10.7	
:30		9.3			9.0			9.6			9.8			10.1			10.4			10.7	
:45		9.3		0.01	9.2			9.5			9.6			10.9			10.6			10.6	
3:00		9.0	0.955		9.1	0.959		9.4	0.984		9.6	1.059		11.4	1.396		10.4	1.210		10.4	1.273
:15		9.3		0.01	9.2			9.1			9.5			11.1			10.2			10.9	
:30		9.0		0.01	9.1			9.3			9.5			10.7			10.2			10.3	
:45		9.0			9.1			9.2			9.7			10.7			10.1			10.4	
4:00		8.9	0.920		9.4	1.009		9.2	0.992		9.6	1.048		10.5	1.206		10.3	1.165		10.2	1.181
:15		8.8			9.3			9.3			9.4			10.2			9.9			10.0	
:30		9.1			9.3			9.2			9.5			10.2			10.0			10.2	
:45		8.9			9.4			9.3			9.6			10.0			10.0			10.0	
5:00		9.0	0.950		9.4	1.076		9.3	1.033		9.6	1.109		10.3	1.190		9.8	1.118		10.1	1.160
:15		9.0			9.6			9.3			9.6			10.1			9.7			10.0	
:30		9.0			9.6			9.6			9.8			10.1			9.8			10.0	
:45		9.3			10.0			9.6			10.1			10.1			9.9			10.0	
6:00		9.1	0.984		10.0	1.305		9.8	1.314		10.1	1.354		10.9	1.480		10.2	1.421		10.2	1.213
:15		9.2			10.1			10.4			10.3			10.9			10.7			10.2	
:30		9.2			11.1			10.6			11.1			11.5			11.1			10.4	
:45		9.4			11.3			11.8			11.8			12.0			12.3			10.3	
7:00		9.4	1.072		11.5	1.725		12.2	1.819		12.1	1.935		12.6	2.087		12.8	2.100		11.0	1.449
:15		9.6			12.1			12.4			12.9			13.2			13.3			10.9	
:30		9.5			12.6			12.8			13.3			13.7			13.8			11.3	
:45		10.1			12.8		0.01	13.0			13.7			14.6			14.4			11.7	
8:00		10.1	1.262		12.9	1.929		13.8	2.104		13.8	2.115		14.5	2.248		14.0	2.230		12.0	1.704
:15		10.2			12.7			13.4			13.5			13.8			14.2			12.1	
:30		10.8			13.1			13.3			13.6			14.0			14.1			12.0	
:45		10.7			13.2			13.9			13.6			14.0			13.8			12.6	
9:00		11.0	1.512		13.6	2.078		13.4	2.058		13.5	2.204		13.6	2.294		13.9	2.242		13.3	2.055
:15		11.1			13.1			13.2			14.1			13.8			14.2			13.5	
:30		11.7			13.7			13.5			13.9			14.7			13.7			13.3	
:45		12.0			13.6			13.6			14.2			14.8			14.3			13.5	
10:00		12.2	1.733		14.0	2.236		13.6	2.186		14.5	2.440		14.5	2.458		14.9	2.489		13.8	2.098
:15		12.1			13.9			13.6		0.03	14.7			14.7			14.8			13.5	
:30		12.4			13.9			14.2			14.6			14.8			14.7			13.4	
:45		12.4			14.4			14.0			15.0			15.0			15.1			13.6	
11:00		12.4	1.809		14.4	2.377		14.3	2.434		15.0	2.603		14.6	2.458		15.6	2.582		13.8	2.180
:15		12.5			14.4			14.6			15.2			14.8			14.9			13.9	
:30		12.6			14.9			14.8			15.4			14.7			15.0			14.0	
:45		12.8			14.3			15.0			15.3			14.8			15.1			13.7	

	SUNDAY 7/22/90			MONDAY 7/23/90			TUESDAY 7/24/90			WEDNESDAY 7/25/90			THURSDAY 7/26/90			FRIDAY 7/27/90			SATURDAY 7/28/90		
	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)
12:00		12.6	1.728		14.6	2.392		15.2	2.520		15.6	2.659		15.2	2.541		15.0	2.492		13.8	2.183
:15		11.9			14.7			15.0			15.5			14.8			15.0			14.1	
:30		12.0			14.6			14.9			15.2			14.9			15.1			13.7	
:45		12.6			14.3			14.8			15.3			15.1			14.4			13.8	
13:00		12.0	1.637		14.1	2.286		15.2	2.480		15.1	2.501		14.6	2.434		14.3	2.364		14.1	2.221
:15		11.7			14.3			14.5			14.7			14.6			14.5			14.3	
:30		12.0			14.1			14.8			14.9			14.8			14.4			14.0	
:45		12.0			14.4			14.8			14.9			14.7			14.7			13.6	
14:00		11.7	1.603		13.8	2.251	0.11	14.3	2.401		14.6	2.508		14.7	2.492		14.4	2.413		13.5	2.118
:15		11.6			14.1		0.01	14.4			15.3			14.9			14.6			13.8	
:30		12.2			14.4			15.1			14.8			14.8			14.6			13.6	
:45	0.10	11.9			14.0			14.4			15.0			15.1			14.8			13.7	
15:00		11.7	1.567		14.0	2.308		14.4	2.383		15.0	2.517		14.6	2.434		15.0	2.480		13.9	2.087
:15		11.7			14.2			14.4			15.0			14.5			14.7			13.7	
:30	0.03	11.8			14.1			14.3			15.2			15.1			14.6			13.2	
:45		11.6			14.9			14.9			14.7			14.5			15.0			13.4	
16:00		10.9	1.484		14.4	2.343		14.5	2.338		14.5	2.374		14.6	2.317		14.9	2.398		13.9	2.019
:15		11.2			14.6			14.4			14.7			14.2			14.4			13.6	
:30		11.8			14.5			14.6			14.2			14.4			14.6			12.9	
:45		11.5			14.1			14.0			14.6			14.1			14.4			12.8	
17:00		11.0	1.463		14.2	2.177		14.5	2.329		14.1	2.296		14.1	2.242		14.3	2.236		13.0	1.921
:15		11.1			13.9			14.6			14.0			14.2			14.1			13.1	
:30		11.6			13.7			14.1			14.5			14.0			13.8			13.1	
:45		11.3			13.5			14.1			14.4			14.0			14.0			12.6	
18:00		11.3	1.418		13.6	2.049		14.1	2.239		14.0	2.218		14.3	2.242		14.3	2.183		12.9	1.893
:15		10.9			13.4			14.3			14.1			14.4			13.7			13.2	
:30		11.0			13.2			13.9			14.2			14.0			13.7			12.8	
:45		11.2			13.4			13.9			13.7			13.6			13.8			12.6	
19:00		11.2	1.438		13.1	1.941		14.0	2.168		13.3	2.034		13.8	2.072		13.6	2.055		12.6	1.854
:15		11.1			12.8			13.8			13.3			13.5			13.5			12.8	
:30		11.1			13.1			13.8			13.5			13.2			13.4			12.9	
:45		11.3			13.0			13.6			13.3			13.4			13.2			12.6	
20:00		11.0	1.396		12.4	1.776		13.3	2.037		13.3	1.941		13.2	1.986		13.1	1.926		12.3	1.669
:15		10.8			12.5			13.3			12.9			13.2			13.0			12.2	
:30		11.0			12.4			13.5			12.8			13.1			12.8			12.0	
:45		11.2			12.6			13.3			13.1			13.2			13.0			11.8	
21:00		11.1	1.468		12.4	1.695		13.0	1.890		12.8	1.851		13.3	1.983		13.0	1.879		12.0	1.730
:15		11.1			12.3		0.01	12.9			12.7			13.2			12.9			12.4	
:30		11.3			11.9			12.7			12.6			13.2			12.4			12.2	
:45		11.5			12.1			12.8			12.8			13.0			12.9			12.4	
22:00		11.1	1.443		12.0	1.606		12.4	1.782		12.6	1.818		13.0	1.915		13.0	1.890		12.3	1.728
:15		11.0			11.9			12.2			12.1			12.8			12.5			12.3	
:30		11.4			11.9			12.6			12.7			13.0			12.8			12.4	
:45		11.3			11.5			12.6			13.0			13.0			13.1			12.0	
23:00		10.9	1.396		11.7	1.508		12.3	1.611		12.4	1.693		13.0	1.823		12.8	1.856		11.5	1.541
:15		11.0			11.6			11.8			12.3			12.6			12.6			11.7	
:30		10.9			11.5			11.6			12.0			12.4			12.7			11.7	
:45		11.2			11.1			11.7			11.9			12.4			12.8			11.5	
TOT RAIN:			0.13			0.16			0.14			0.03			0.00			0.00			0.00
TOT FLOW:			1.364			1.760			1.861			1.914			1.967			1.957			1.744
AMMIN FLW:		4:15	0.892		2:30	0.940		3:15	0.948		4:15	1.024		2:15	1.120		5:15	1.093		5:45	1.147
MIN FLOW:		4:15	0.892		2:30	0.940		3:15	0.948		4:15	1.024		2:15	1.120		5:15	1.093		5:45	1.147
MAX FLOW:		11:45	1.873		11:30	2.507		13:00	2.606		12:00	2.731		12:00	2.606		11:00	2.731		13:15	2.313

DEPTH SENSOR USED: Pressure

ID 1: E MARSH LN @ FARMERS BRANCH CR
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 30.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 1.762
MUD: 0.67

PROJECT: FARMBRAN
SITE: RH01
RAIN GAUGE: RG01
PEAK CAPACITY: 6.512

	SUNDAY 7/29/90		MONDAY 7/30/90		TUESDAY 7/31/90		WEDNESDAY 8/1/90		THURSDAY 8/2/90		FRIDAY 8/3/90		SATURDAY 8/4/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
0:00	11.2	1.431	10.4	1.222	10.9	1.277	11.1	1.324	11.3	1.365	12.1	1.538	12.2	1.537
:15	11.3		10.4		10.7		10.7		11.3		11.7		11.5	
:30	11.3		10.2		10.4		10.6		10.6		11.5		11.4	
:45	10.9		10.2		10.0		10.4		10.4		10.9		11.1	
1:00	10.9	1.307	9.6	1.033	10.0	1.107	10.2	1.121	9.9	1.129	10.9	1.292	10.7	1.294
:15	10.9		9.4		9.7		9.9		10.0		10.5		10.7	
:30	10.4		9.4		10.0		9.7		9.7		10.6		10.4	
:45	10.5		9.3		9.4		9.6		9.9		10.3		10.6	
2:00	9.9	1.111	9.3	0.957	9.5	0.999	9.8	1.072	9.6	1.037	10.6	1.211	10.1	1.125
:15	9.9		9.1		9.3		9.5		9.5		10.2		10.0	
:30	9.7		9.0		9.1		9.7		9.4		10.1		9.8	
:45	9.6		9.1		9.2		9.5		9.4		10.2		9.6	
3:00	9.5	1.020	8.9	0.886	9.1	0.954	9.5	1.007	9.7	1.037	9.8	1.070	9.5	1.026
:15	9.5		8.8		9.1		9.3		9.3		9.5		9.4	
:30	9.3		8.7		9.0		9.4		9.4		9.7		9.4	
:45	9.3		8.7		9.2		9.1		9.4		9.4		9.4	
4:00	9.4	0.973	8.7	0.892	9.1	0.963	9.3	0.973	9.4	1.056	9.6	1.065	9.2	0.990
:15	9.3		8.7		9.1		9.2		9.7		9.7		9.3	
:30	9.0		8.8		9.2		9.2		9.6		9.6		9.4	
:45	9.1		8.9		9.1		9.0		9.5		9.5		9.1	
5:00	9.0	0.940	9.1	0.953	9.6	1.054	9.0	0.973	9.6	1.072	9.8	1.132	9.0	0.954
:15	9.0		9.0		9.4		9.1		9.4		9.6		9.1	
:30	9.1		9.0		9.6		9.1		9.7		10.1		9.0	
:45	9.0		9.3		9.5		9.4		9.8		10.0		9.2	
6:00	9.3	0.980	9.4	1.207	9.8	1.278	9.5	1.182	10.2	1.309	10.4	1.438	9.5	1.139
:15	8.9		10.0		10.6		9.6		10.2		11.0		9.6	
:30	9.4		10.5		10.6		10.3		10.7		11.6		10.1	
:45	9.2		11.0		11.1		10.9		11.5		11.7		10.5	
7:00	9.2	1.046	11.5	1.663	11.5	1.797	11.5	1.793	11.8	1.829	12.5	1.997	10.9	1.567
:15	9.5		11.7		12.4		11.9		12.3		12.9		11.5	
:30	9.6		12.2		13.0		12.9		12.9		13.5		12.0	
:45	9.8		12.7		13.2		13.6		13.5		14.0		12.4	
8:00	10.5	1.347	12.7	1.857	13.4	2.049	13.3	2.035	13.5	2.113	14.1	2.278	12.7	2.007
:15	10.9		13.0		13.5		13.5		13.7		13.9		13.1	
:30	11.0		12.4		13.3		13.4		13.6		14.3		13.7	
:45	10.9		12.8		13.3		13.2		13.6		14.4		13.6	
9:00	11.3	1.598	13.1	1.980	13.0	2.026	12.4	1.949	13.3	2.072	14.8	2.407	13.5	2.154
:15	11.9		12.9		13.4		13.7		13.3		14.8		13.4	
:30	11.9		13.1		13.5		13.7		13.5		14.4		13.9	
:45	12.0		13.5		13.5		12.4		13.8		14.4		14.3	
10:00	12.4	1.796	13.4	2.174	14.3	2.337	14.1	2.257	13.8	2.278	14.6	2.492	14.5	2.437
:15	12.6		13.8		14.6		14.2		13.9		14.9		14.8	
:30	12.5		14.1		14.1		14.1		14.4		15.1		14.5	
:45	12.7		14.1		14.5		13.9		14.6		14.9		15.0	
11:00	12.5	1.859	14.3	2.278	14.6	2.416	13.9	2.281	14.6	2.395	15.3	2.631	15.2	2.554
:15	12.6		13.8		15.0		14.1		14.4		15.9		15.1	
:30	13.0		14.1		14.4		14.5		14.8		15.0		15.1	
:45	12.9		14.5		14.5		14.3		14.5		15.2		14.9	

	SUNDAY 7/29/90			MONDAY 7/30/90			TUESDAY 7/31/90			WEDNESDAY 8/1/90			THURSDAY 8/2/90			FRIDAY 8/3/90			SATURDAY 8/4/90		
	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)
12:00		12.3	1.779		14.2	2.346		14.3	2.328		14.3	2.316		14.6	2.311		15.1	2.585		14.8	2.440
:15		12.3			14.5			14.3			14.6			14.4			15.3			14.6	
:30		12.6			14.6			14.6			14.1			14.1			15.4			14.7	
:45		12.6			14.3			14.3			14.2			14.1			14.9			14.7	
13:00		12.5	1.768		14.6	2.305		14.5	2.304		14.1	2.293		14.2	2.289		14.7	2.455		14.5	2.329
:15		12.1			14.2			14.3			14.1			14.2			14.6			14.6	
:30		12.5			14.0			14.0			14.1			14.1			15.0			14.2	
:45		12.6			14.3			14.3			14.6			14.4			14.6			14.0	
14:00		12.5	1.698		14.1	2.329		14.5	2.404		13.1	2.353		14.3	2.347		14.8	2.529		14.1	2.254
:15		11.9			14.5			14.5			13.6			14.4			14.6			14.2	
:30		12.0			14.7			15.0			15.7			14.8		0.57	15.2			14.1	
:45		12.2			14.1			14.4			15.2			14.2			15.4			14.0	
15:00		12.0	1.582		13.9	2.210		14.3	2.325		14.6	2.422		14.1	2.316		15.2	2.541		13.7	2.171
:15		11.5			14.0			14.1			14.8			14.3			15.4			14.0	
:30		11.7			13.7			14.4			14.6			14.3			14.8			13.9	
:45	0.02	11.8			14.3			14.6			14.6			14.6		0.01	14.8			13.7	
16:00	0.05	11.6	1.529		13.5	2.156		13.9	2.197		14.4	2.286		14.3	2.307		14.9	2.422		13.9	2.095
:15		11.9			13.9			13.9			14.3			14.3			14.4			13.7	
:30		11.3			13.9			14.0			14.1			14.2			14.6			13.4	
:45		11.3			13.7			13.9			14.0			14.3			14.7			13.3	
17:00		11.4	1.471		13.9	2.092		13.6	2.052		14.2	2.131		14.1	2.192		14.0	2.272		13.3	2.072
:15		11.0			13.3			13.1			13.7			13.6			14.1			13.4	
:30		11.2			13.6			13.3			13.3			14.0			14.3			13.6	
:45		11.6			13.4			13.6			13.5			13.9			14.2			13.6	
18:00		11.1	1.448		13.2	2.000		13.8	2.101		13.3	2.046		13.3	2.049		14.1	2.201		13.9	2.145
:15		10.8			13.3			13.6			13.4			13.4			14.3			14.1	
:30		11.3			13.1			13.3			13.3			13.5			13.8			13.6	
:45		11.6			13.3			13.6			13.5			13.4			13.4			13.3	
19:00		11.3	1.470		13.3	1.907		13.6	1.920		13.3	1.865		13.3	1.989		13.5	2.078		13.2	2.037
:15		11.1			12.6			13.2			12.6			13.3			13.5			13.6	
:30		11.4			12.8			12.8			12.5			13.1			13.5			13.4	
:45		11.4			13.0			12.2			12.6			13.1			13.5			13.3	
20:00		11.4	1.448		12.6	1.709		12.0	1.682		12.4	1.757		12.8	1.924		13.3	1.918		13.1	1.935
:15		10.9			12.2			12.2			12.6			13.0			13.0			13.1	
:30		11.1			12.2			12.3			12.2			12.9			12.6			13.1	
:45	0.11	11.5			11.9			12.0			12.2			13.3			13.0			12.7	
21:00	0.33	11.4	1.401		12.1	1.652		11.9	1.672		12.7	1.771		13.3	1.958		12.7	1.796		12.7	1.870
:15	0.15	11.1			12.0			11.9			12.5		0.01	13.1			12.2			12.8	
:30	0.02	10.8			11.9			12.3			12.5		0.05	13.0			12.7			12.9	
:45		10.8			12.0			12.3			12.0		0.05	13.1			12.4			12.8	
22:00		11.1	1.374		11.9	1.587		11.8	1.685		12.3	1.704	0.02	13.1	1.879		12.4	1.810		12.6	1.854
:15		10.9			11.9			12.0			12.3		0.01	12.7			12.4			12.7	
:30		10.7			11.7			12.4			12.3		0.01	12.5			12.4			12.9	
:45		10.9			11.5			12.3			11.9			12.9			13.1			12.7	
23:00		10.9	1.352		12.0	1.492		11.7	1.546		11.7	1.554		13.1	1.811		12.4	1.722		12.6	1.768
:15		11.0			11.4			11.5			11.9			12.7			12.2			12.3	
:30		10.8			11.0			11.8			11.7			12.3			12.2			12.6	
:45		10.6			11.1			11.4			11.2			12.1			12.2			12.3	
TOT RAIN:			0.68			0.00			0.00			0.00			0.15			0.58			0.53	
TOT FLOW:			1.405			1.704			1.770			1.769			1.836			1.953			1.823	
AMMIN FLW:		6:15	0.924		3:30	0.868		3:30	0.932		4:45	0.940		3:15	1.007		3:45	1.033		5:30	0.932
MIN FLOW:		6:15	0.924		3:30	0.868		3:30	0.932		4:45	0.940		3:15	1.007		3:45	1.033		5:30	0.932
MAX FLOW:		11:30	1.929		14:30	2.434		11:15	2.532		14:30	2.756		11:30	2.458		11:15	2.806		11:00	2.581

DEPTH SENSOR USED: Pressure

ID 1: E MARSH LN @ FARMERS BRANCH CR
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 30.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 1.762
MUD: 0.67

PROJECT: FARMBRAN
SITE: RH01
RAIN GAUGE: RG01
PEAK CAPACITY: 6.512

	SUNDAY 8/5/90			MONDAY 8/6/90														
	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)
0:00		12.0	1.619		12.3	1.619															
:15		12.0			11.8																
:30		12.1			12.0																
:45		11.3			11.4																
1:00		11.3	1.455		11.4	1.438															
:15		11.5			11.2																
:30		11.0			11.2																
:45		11.2			10.9																
2:00		10.6	1.234		11.1	1.360															
:15		10.5			10.7																
:30		10.3			11.0																
:45		10.0			10.6																
3:00		10.0	1.147		10.6	1.304															
:15		10.1			10.6																
:30		10.0			10.6																
:45		9.7			10.8																
4:00		9.8	1.063		10.4	1.259															
:15		9.6			10.4																
:30		9.5			10.5																
:45		9.4			10.4																
5:00		9.4	1.072		10.5	1.264															
:15		9.8			10.2																
:30	0.09	9.5			10.6																
:45		9.8			10.6																
6:00		9.6	1.152		11.1	1.554															
:15		9.8			11.1																
:30		10.2			11.9																
:45		10.3			12.3																
7:00		10.7	1.377		12.8	2.019															
:15		10.5			13.0																
:30		11.0			13.4																
:45	0.01	11.4			14.0																
8:00	0.01	11.5	1.633		13.9	2.242															
:15		11.7			13.9																
:30		12.0			14.1																
:45		12.4			14.3																
9:00		12.6	1.829		14.6	2.504															
:15		12.3			14.9																
:30		12.6			14.9																
:45		13.1			15.3																
10:00		13.1	2.000		15.4	2.668															
:15		13.5			15.4																
:30		13.1			15.4																
:45		13.3			15.5																
11:00		13.5	2.118		15.5	2.681															
:15		13.6			15.6																
:30		13.7			15.5																
:45		13.7			15.3																

	SUNDAY 8/5/90			MONDAY 8/6/90																
	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)
12:00		13.5	2.035		15.0	2.572														
:15		13.4			15.3															
:30		13.3			15.4															
:45		13.1			14.8															
13:00		12.9	1.949		14.5	2.495														
:15		12.9			14.8															
:30		13.5			15.1															
:45		13.0			15.2															
14:00		13.1	1.841		15.1	2.517														
:15		12.8			15.1															
:30		12.7			14.8															
:45	0.01	12.1			14.8															
15:00	0.08	12.4	2.027		14.8	2.455														
:15	0.06	12.9			15.0															
:30	0.03	13.7			14.6															
:45	0.03	14.3			14.5															
16:00		14.8	2.474		14.8	2.471														
:15	0.01	14.6			14.6															
:30	0.02	15.0			15.2															
:45	0.02	14.8			14.6															
17:00	0.01	14.6	2.379		14.4	2.269														
:15		14.6			14.4															
:30		14.5			13.8															
:45		14.4			14.0															
18:00		14.1	2.266		14.1	2.212														
:15		14.4			14.0															
:30		14.1			13.7															
:45		13.9			14.0															
19:00		13.7	2.127		14.0	2.113														
:15		13.5			13.4															
:30		13.7			13.5															
:45		13.7			13.6															
20:00		13.6	2.063		13.4	1.972														
:15		13.4			13.2															
:30		13.3			13.1															
:45		13.4			12.9															
21:00		13.3	2.037		13.1	1.876														
:15		13.6			12.9															
:30		13.2			12.6															
:45		13.3			12.6															
22:00		13.4	2.046		12.7	1.871														
:15		13.3			12.9															
:30		13.4			13.0															
:45		13.5			12.6															
23:00		13.5	1.961		12.5	1.704														
:15		13.3			12.3															
:30		12.8			12.2															
:45		12.8			11.8															
TOT RAIN:			0.38			0.00														
TOT FLOW:			1.788			2.018														
AMMIN FLW:		4:45	1.016		5:15	1.201														
MIN FLOW:		4:45	1.016		5:15	1.201														
MAX FLOW:		16:30	2.532		11:15	2.718														

DEPTH SENSOR USED: Pressure

Site RH02
Flow Monitoring Data
and
Hydrographs

ADS Services, Inc.

1500 Site Report

REWARD IF FOUND - (205) 883-9323

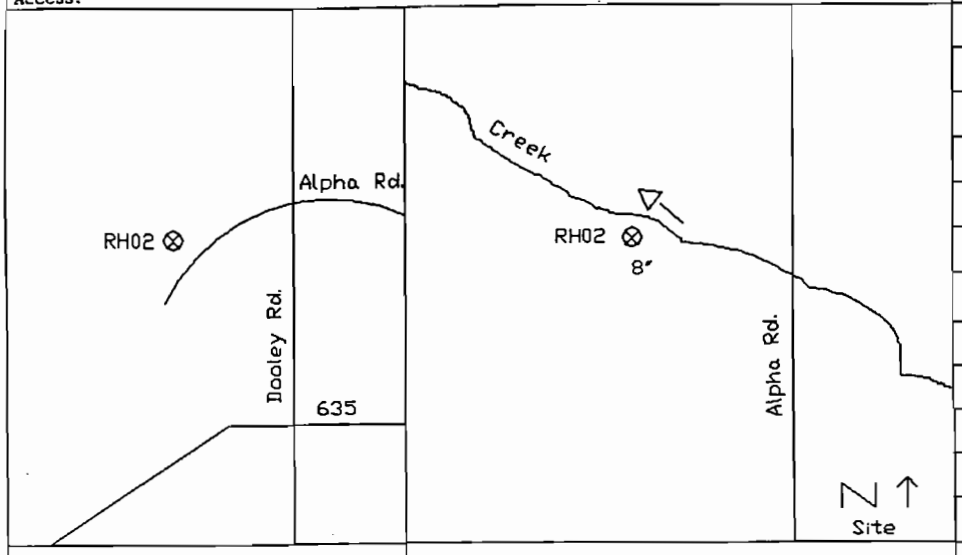
Manhole #	AN	Monitor #
	RH02	8403
V-Sensor #	**Bat Serial #**	**Press. X-ducer #**
Dist. to X-ducer	**Physical Offset**	**Diameter**
6"	1.25"	8"

Project/Phase: Farmers Branch, TX Date: 07/03/90 Name: BF

Address/Location: On creek easement west of Alpha Rd.

Access:

INSTALLATION Ultrasonics



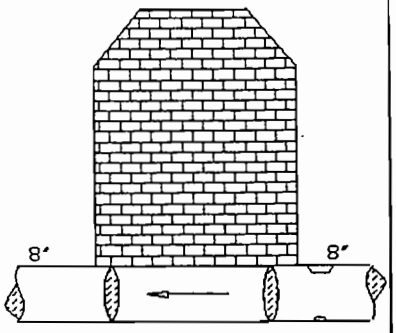
SAFETY

Manhole Depth: 10'

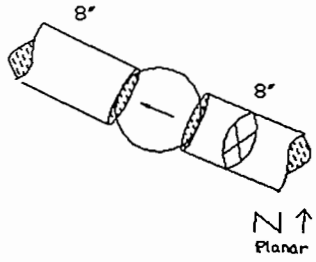
Traffic: None

Gas @ Investigation: None

Manhole Condition: Brick M/H, hood



Cross Section



Rain Gauge Zone: RG01

Drop/Fall:

Install QC: Date: Int.:

Comments:

Pipe Type:

BACKUP	Y	N	?	DISTANCE
Trunk				
Lift Sta.				
STP				
Other Input				
Ind. U/S				
L/S U/S				

General Condition, overflows, bypasses, weirs, special information, monitor characteristics, surcharge
* Please make a precise drawing if odd-shaped pipe or special installation

RATING: B

Hydraulics: Reasonably smooth flow, no sediment in pipe.

Recommended Analysis Days:

Master List of Recommended Days:

Additional Comments – Final Data Review

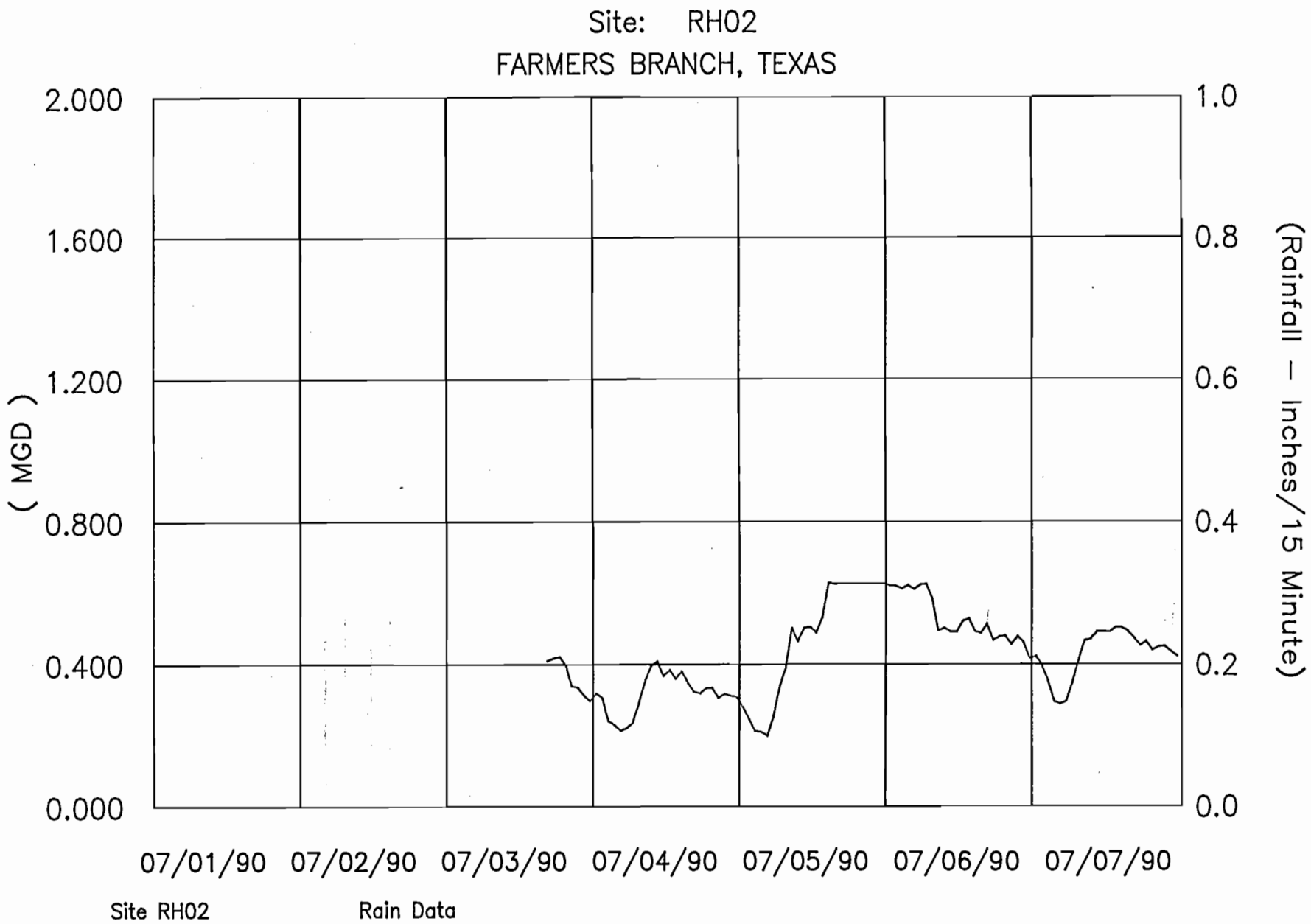
Surcharge: Yes Height: 10'

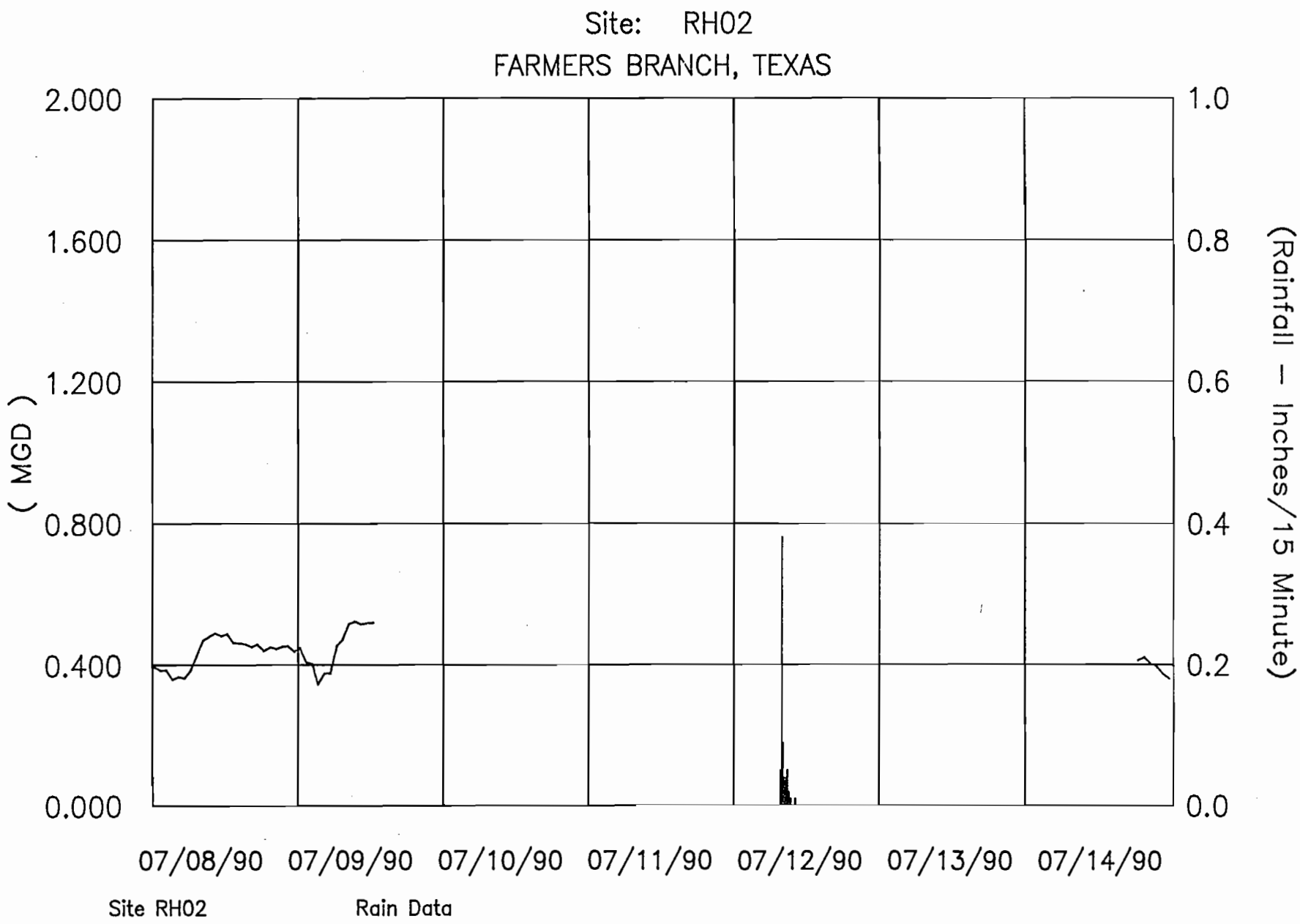
Inv.: DOF: 5" +/- 0 Time: 16:00 Vel: fps Silt:

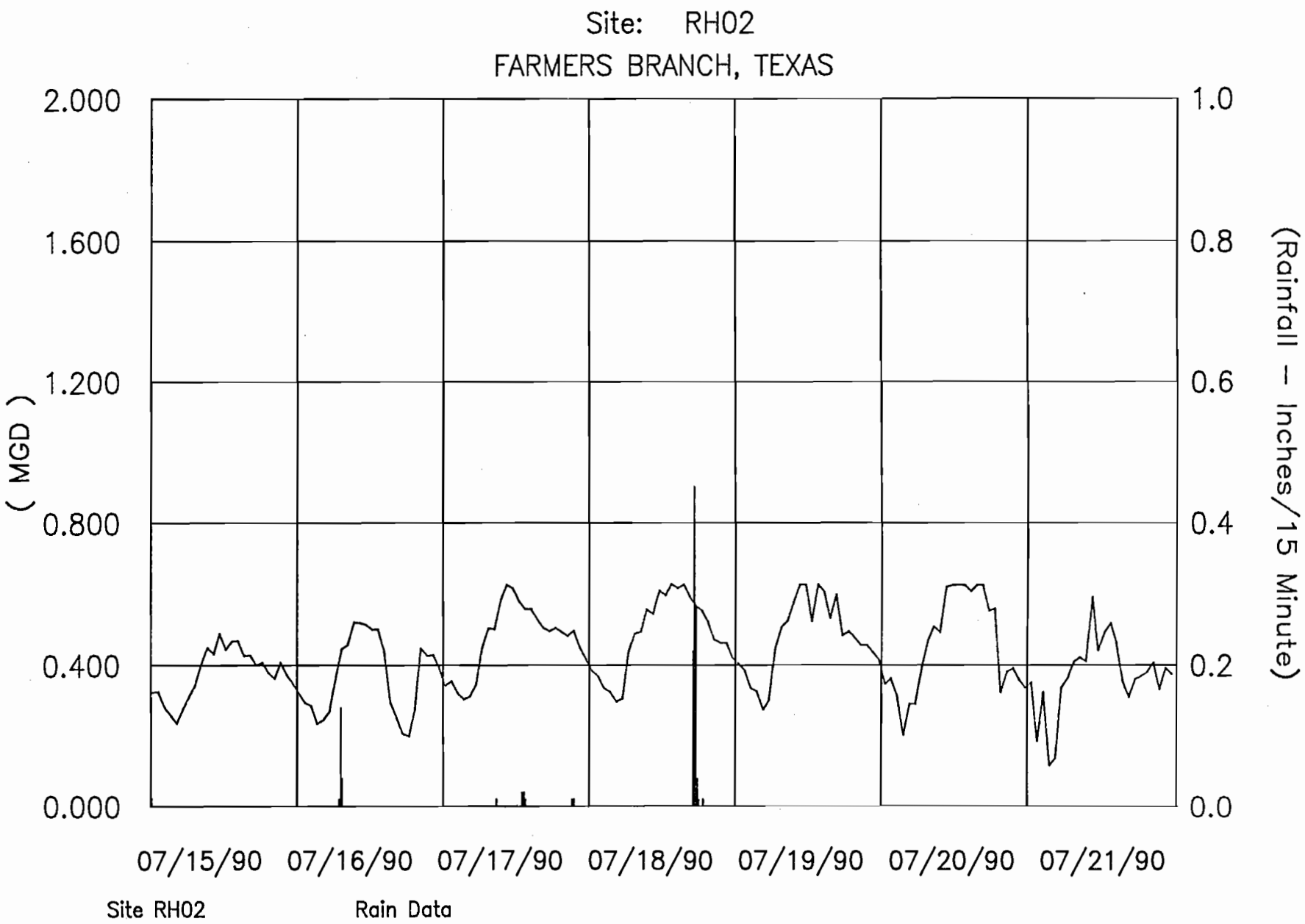
Upstream Manhole Not suitable

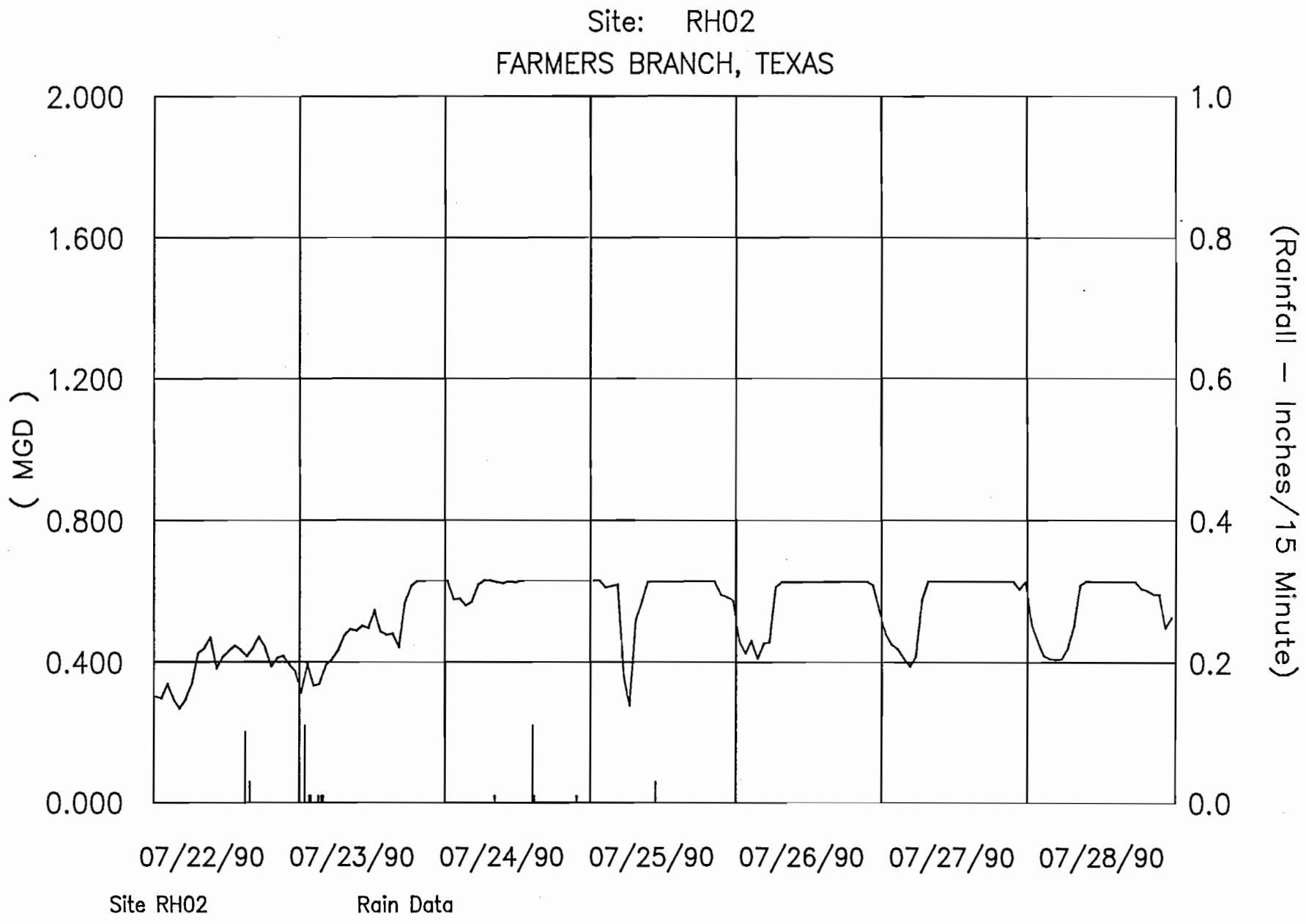
Downstream Manhole Not located

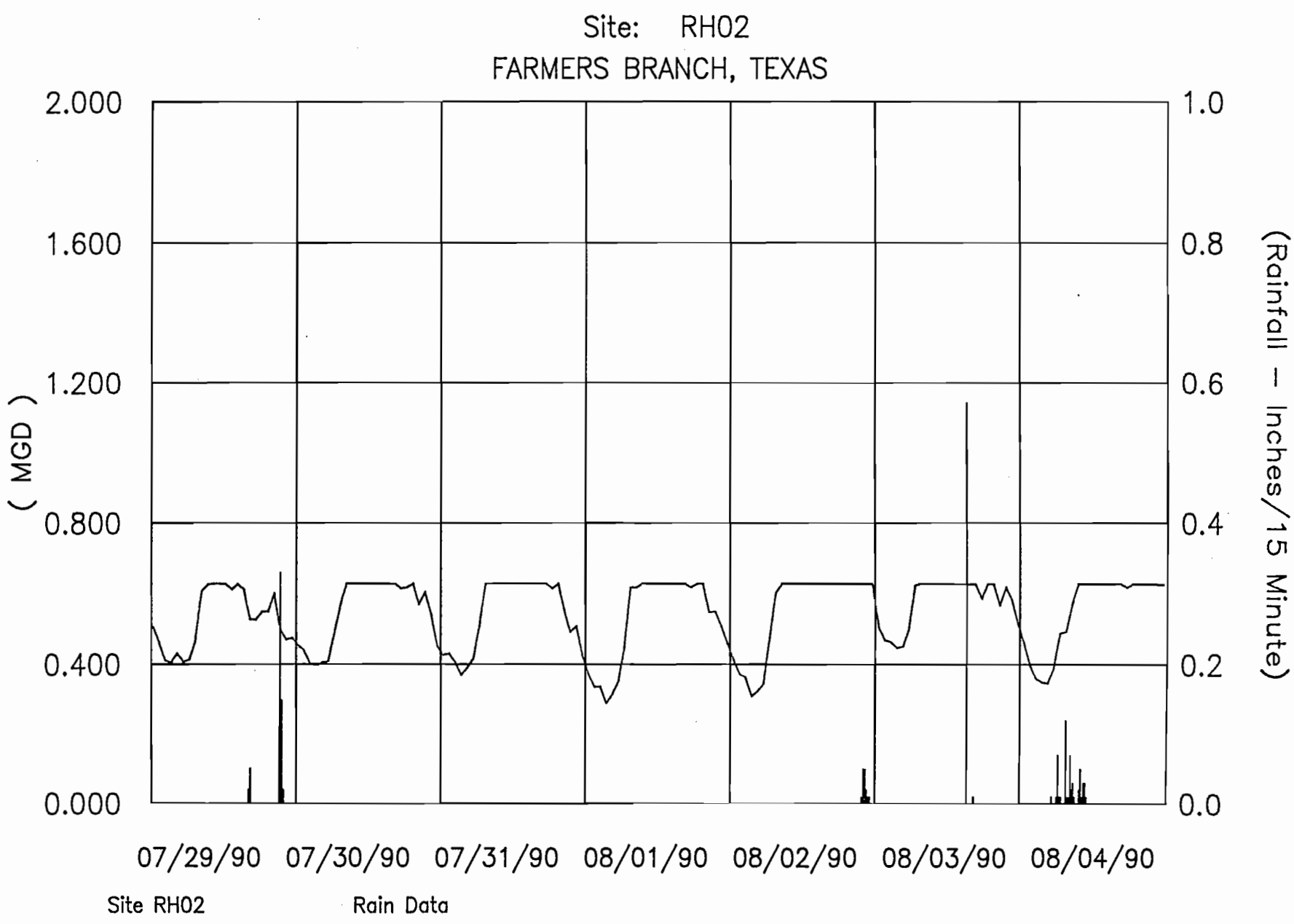
Mini System Character: XX Residential/Commercial/Industrial/Vacant XX

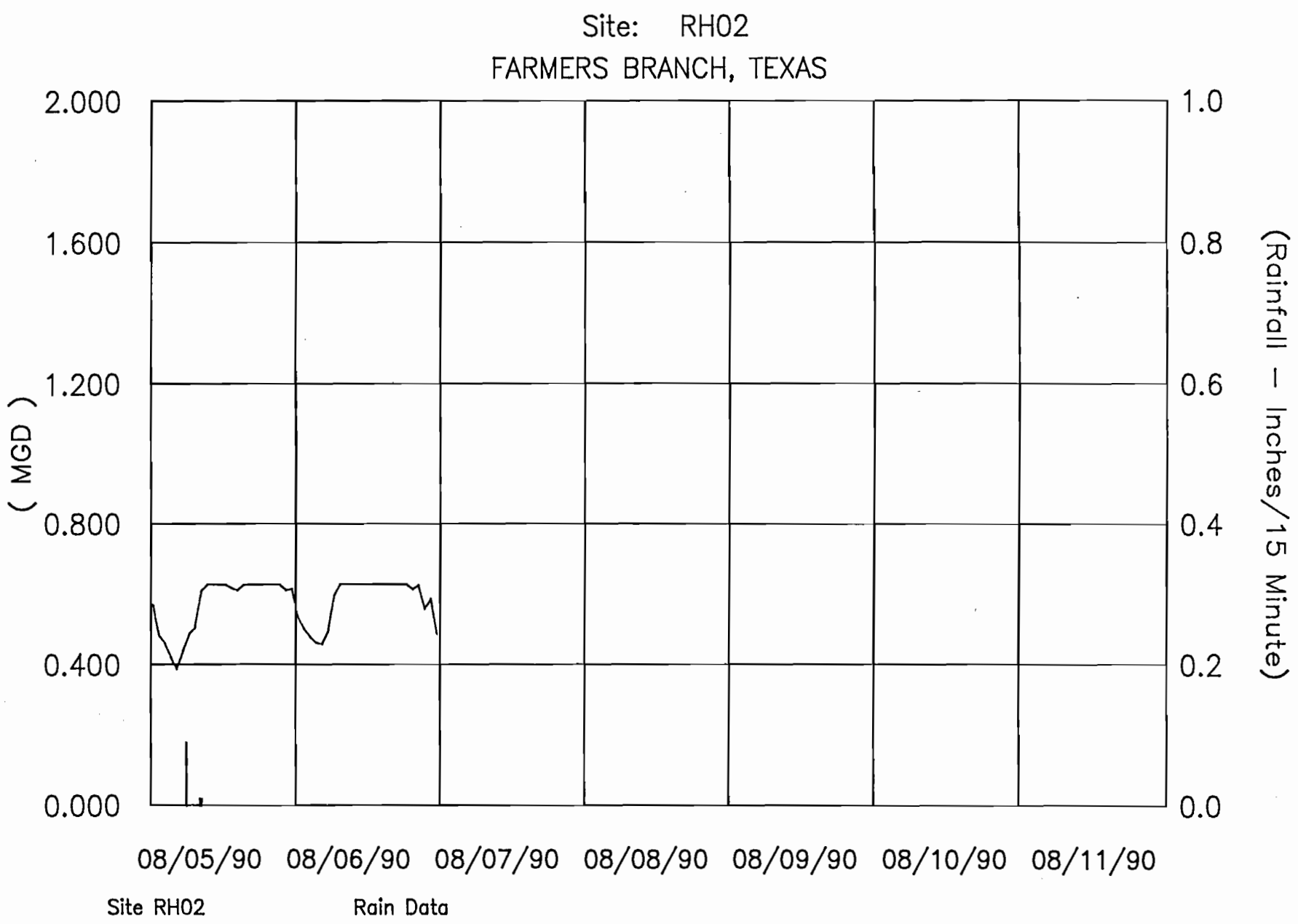

Site: RH02
FARMERS BRANCH, TEXAS
2.000
1.600
1.200
0.800
0.400
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
07/01/90
07/02/90
07/03/90
07/04/90
07/05/90
07/06/90
07/07/90
Site RH02
Rain Data


Site: RH02
FARMERS BRANCH, TEXAS
2.000
1.600
1.200
0.800
0.400
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
07/08/90
07/09/90
07/10/90
07/11/90
07/12/90
07/13/90
07/14/90
Site RH02
Rain Data


Site: RH02
FARMERS BRANCH, TEXAS
2.000
1.600
1.200
0.800
0.400
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
07/15/90
07/16/90
07/17/90
07/18/90
07/19/90
07/20/90
07/21/90
Site RH02
Rain Data


Site: RH02
FARMERS BRANCH, TEXAS
2.000
1.600
1.200
0.800
0.400
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
07/22/90
07/23/90
07/24/90
07/25/90
07/26/90
07/27/90
07/28/90
Site RH02 Rain Data


Site: RH02
FARMERS BRANCH, TEXAS
2.000
1.600
1.200
0.800
0.400
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
07/29/90
07/30/90
07/31/90
08/01/90
08/02/90
08/03/90
08/04/90
Site RH02
Rain Data


Site: RH02
FARMERS BRANCH, TEXAS
2.000
1.600
1.200
0.800
0.400
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
08/05/90
08/06/90
08/07/90
08/08/90
08/09/90
08/10/90
08/11/90
Site RH02
Rain Data

ID 1: @ CREEK EASEMENT W. OF ALPHA
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 8.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 5.763
MUD: 0.00

PROJECT: RAWHIDE
SITE: RH02
RAIN GAUGE: RG01
PEAK CAPACITY: 0.634

	SUNDAY 7/1/90		MONDAY 7/2/90		TUESDAY 7/3/90		WEDNESDAY 7/4/90		THURSDAY 7/5/90		FRIDAY 7/6/90		SATURDAY 7/7/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
0:00	--		--		--		4.7	0.318	4.4	0.279	7.4	0.621	5.4	0.423
:15	--		--		--		4.4		4.1		7.3		5.4	
:30	--		--		--		4.7		4.4		7.3		5.5	
:45	--		--		--		4.5		4.1		7.5		5.4	
1:00	--		--		--		4.6	0.305	4.2	0.245	7.5	0.620	5.4	0.400
:15	--		--		--		4.6		4.3		7.4		5.3	
:30	--		--		--		4.3		3.7		--		5.3	
:45	--		--		--		4.4		3.7		7.2		4.9	
2:00	--		--		--		4.1	0.240	3.7	0.210	7.2	0.611	4.8	0.354
:15	--		--		--		3.7		3.8		7.3		4.8	
:30	--		--		--		3.9		3.5		7.2		4.8	
:45	--		--		--		4.0		3.6		7.1		5.0	
3:00	--		--		--		4.1	0.228	3.6	0.208	7.3	0.622	5.0	0.294
:15	--		--		--		3.7		3.7		7.2		4.1	
:30	--		--		--		3.7		3.7		7.6		4.3	
:45	--		--		--		3.7		3.6		7.6		4.2	
4:00	--		--		--		3.7	0.211	3.4	0.197	7.2	0.609	4.2	0.287
:15	--		--		--		3.6		3.4		7.1		4.3	
:30	--		--		--		3.8		3.6		7.3		4.4	
:45	--		--		--		3.6		3.7		7.1		4.4	
5:00	--		--		--		3.7	0.220	4.1	0.249	7.4	0.623	4.2	0.295
:15	--		--		--		3.5		3.8		7.4		4.4	
:30	--		--		--		4.3		3.7		7.4		4.3	
:45	--		--		--		3.4		4.4		7.5		4.7	
6:00	--		--		--		3.7	0.235	4.5	0.335	7.5	0.626	4.9	0.350
:15	--		--		--		3.9		4.7		7.6		4.7	
:30	--		--		--		4.0		4.7		7.6		4.7	
:45	--		--		--		3.9		5.0		7.4		5.0	
7:00	--		--		--		4.2	0.291	4.8	0.391	7.4	0.582	5.3	0.412
:15	--		--		--		4.3		5.0		7.4		5.3	
:30	--		--		--		4.4		5.6		7.4		5.2	
:45	--		--		--		4.5		5.4		5.7		5.5	
8:00	--		--		--		4.7	0.355	6.0	0.502	6.0	0.494	5.8	0.466
:15	--		--		--		4.8		5.9		5.9		5.8	
:30	--		--		--		4.9		6.1		6.0		5.6	
:45	--		--		--		5.1		6.2		6.1		5.9	
9:00	--		--		--		5.4	0.396	5.7	0.463	5.9	0.501	5.7	0.471
:15	--		--		--		5.0		5.4		6.2		5.7	
:30	--		--		--		4.9		6.0		--		6.0	
:45	--		--		--		5.5		5.9		--		5.9	
10:00	--		--		--		5.0	0.410	5.9	0.502	5.8	0.491	6.1	0.491
:15	--		--		--		5.2		6.1		6.0		5.9	
:30	--		--		--		5.5		6.1		6.1		5.9	
:45	--		--		--		5.6		6.1		6.0		5.9	
11:00	--		--		--		5.3	0.367	6.1	0.505	5.6	0.490	6.3	0.491
:15	--		--		--		4.8		6.2		5.9		5.9	
:30	--		--		--		4.8		6.3		6.2		5.7	
:45	--		--		--		5.0		5.8		6.1		5.9	

	SUNDAY 7/1/90		MONDAY 7/2/90		TUESDAY 7/3/90		WEDNESDAY 7/4/90		THURSDAY 7/5/90		FRIDAY 7/6/90		SATURDAY 7/7/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
12:00	--		--		--		5.1	0.385	6.1	0.489	6.1	0.520	6.0	0.490
:15	--		--		--		5.1		5.9		6.3		6.2	
:30	--		--		--		5.4		5.9		6.4		5.7	
:45	--		--		--		4.8		5.9		6.1		5.9	
13:00	--		--		--		4.8	0.360	5.9	0.530	6.5	0.527	6.1	0.502
:15	--		--		--		5.1		6.1		6.5		6.2	
:30	--		--		--		4.9		6.1		6.5		5.9	
:45	--		--		--		4.9		7.5		5.7		6.1	
14:00	--		--		--		4.7	0.382	7.6	0.629	5.9	0.492	6.2	0.502
:15	--		--		--		4.8		7.6		6.2		6.3	
:30	--		--		--		5.9		7.5		6.1		6.0	
:45	--		--		--		5.1		7.6		5.7		5.8	
15:00	--		--		--		5.0	0.348	7.6	0.626	5.9	0.486	6.1	0.493
:15	--		--		--		4.7		7.5		5.6		6.1	
:30	--		--		--		4.6		7.5		6.1		5.9	
:45	--		--		--		5.0		7.5		6.1		5.9	
16:00	--		--		--	0.410	4.6	0.322	7.5	0.627	6.4	0.512	5.9	0.473
:15	--		--		--		4.7		7.5		6.0		5.6	
:30	--		--		--		4.3		7.5		6.1		6.1	
:45	--		--		5.3		4.8		7.5		6.1		5.7	
17:00	--		--		5.2	0.418	4.3	0.317	7.5	0.627	5.8	0.467	5.6	0.451
:15	--		--		5.6		4.4		7.5		5.8		5.7	
:30	--		--		5.5		4.8		7.5		5.8		5.5	
:45	--		--		5.3		4.8		7.5		5.7		5.8	
18:00	--		--		5.4	0.422	4.7	0.333	7.5	0.627	5.7	0.477	5.6	0.464
:15	--		--		5.4		4.8		7.5		5.9		5.8	
:30	--		--		5.4		4.8		7.5		5.9		5.7	
:45	--		--		5.5		4.5		7.5		6.0		5.8	
19:00	--		--		5.2	0.397	4.6	0.334	7.5	0.627	5.9	0.480	5.5	0.438
:15	--		--		5.3		4.6		7.5		--		5.4	
:30	--		--		5.2		5.0		7.5		5.8		5.6	
:45	--		--		5.2		4.6		7.5		5.9		5.7	
20:00	--		--		5.2	0.339	4.7	0.305	7.5	0.627	5.7	0.455	5.8	0.448
:15	--		--		4.5		4.6		7.5		5.9		5.6	
:30	--		--		4.7		4.3		7.5		5.4		5.6	
:45	--		--		4.6		4.4		7.5		5.7		5.5	
21:00	--		--		4.6	0.334	4.6	0.317	7.5	0.626	--	0.479	5.7	0.450
:15	--		--		4.9		4.5		7.5		6.1		5.6	
:30	--		--		4.7		4.5		7.5		5.7		5.5	
:45	--		--		4.6		4.6		7.5		5.7		5.7	
22:00	--		--		4.7	0.312	4.3	0.310	7.5	0.627	5.9	0.461	5.2	0.435
:15	--		--		4.6		4.5		7.5		5.9		5.6	
:30	--		--		4.4		4.2		7.5		5.5		5.6	
:45	--		--		4.4		5.0		7.5		5.6		5.6	
23:00	--		--		4.6	0.296	4.4	0.308	7.5	0.627	5.2	0.416	5.4	0.422
:15	--		--		4.4		4.8		7.5		5.4		5.6	
:30	--		--		4.1		4.4		7.5		5.5		5.3	
:45	--		--		4.5		4.4		7.5		5.4		5.4	
TOT RAIN:		0.00		0.00		0.00		0.00		0.00		0.00		0.00
TOT FLOW:		--		--		0.362		0.317		0.474		0.528		0.429
MMIN FLW:		--		--		--	5:45	0.186	4:00	0.186	2:45	0.603	3:15	0.255
MIN FLOW:		--		--	23:30	0.255	5:45	0.186	4:00	0.186	23:00	0.390	3:15	0.255
MAX FLOW:		--		--	17:15	0.439	14:30	0.478	14:00	0.629	3:30	0.628	11:00	0.524

DEPTH SENSOR USED: Ultrasonic

ID 1: @ CREEK EASEMENT W. OF ALPHA
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 8.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 5.763
MUD: 0.00

PROJECT: FARMBRAN
SITE: RH02
RAIN GAUGE: RG01
PEAK CAPACITY: 0.634

	SUNDAY 7/8/90		MONDAY 7/9/90		TUESDAY 7/10/90		WEDNESDAY 7/11/90		THURSDAY 7/12/90		FRIDAY 7/13/90		SATURDAY 7/14/90	
	RAIN DEPTH (in)	FLOW (in) (mgd)	RAIN DEPTH (in)	FLOW (in) (mgd)	RAIN DEPTH (in)	FLOW (in) (mgd)	RAIN DEPTH (in)	FLOW (in) (mgd)	RAIN DEPTH (in)	FLOW (in) (mgd)	RAIN DEPTH (in)	FLOW (in) (mgd)	RAIN DEPTH (in)	FLOW (in) (mgd)
0:00	5.2	0.395	5.7	0.449	--	--	--	--	--	--	--	--	--	--
:15	5.2		5.6		--	--	--	--	--	--	--	--	--	--
:30	5.2		5.6		--	--	--	--	--	--	--	--	--	--
:45	5.2		5.6		--	--	--	--	--	--	--	--	--	--
1:00	5.2	0.385	5.2	0.407	--	--	--	--	--	--	--	--	--	--
:15	5.2		5.4		--	--	--	--	--	--	--	--	--	--
:30	5.2		5.2		--	--	--	--	--	--	--	--	--	--
:45	5.0		5.3		--	--	--	--	--	--	--	--	--	--
2:00	5.2	0.386	5.4	0.403	--	--	--	--	--	--	--	--	--	--
:15	5.2		5.3		--	--	--	--	--	--	--	--	--	--
:30	5.1		5.2		--	--	--	--	--	--	--	--	--	--
:45	5.0		5.3		--	--	--	--	--	--	--	--	--	--
3:00	4.9	0.360	5.3	0.346	--	--	--	--	--	--	--	--	--	--
:15	5.1		--		--	--	--	--	--	--	--	--	--	--
:30	4.9		--		--	--	--	--	--	--	--	--	--	--
:45	4.8		4.3		--	--	--	--	--	--	--	--	--	--
4:00	5.0	0.367	5.0	0.377	--	--	--	--	--	--	--	--	--	--
:15	4.8		5.1		--	--	--	--	--	--	--	--	--	--
:30	5.1		5.0		--	--	--	--	--	--	--	--	--	--
:45	5.0		5.2		--	--	--	--	--	--	--	--	--	--
5:00	5.0	0.364	5.3	0.377	--	--	--	--	--	--	--	--	--	--
:15	4.8		5.0		--	--	--	--	--	--	--	--	--	--
:30	4.9		4.9		--	--	--	--	--	--	--	--	--	--
:45	5.1		5.0		--	--	--	--	--	--	--	--	--	--
6:00	5.0	0.386	5.8	0.454	--	--	--	--	--	--	--	--	--	--
:15	4.9		5.5		--	--	--	--	--	--	--	--	--	--
:30	5.3		5.7		--	--	--	--	--	--	--	--	--	--
:45	5.3		5.7		--	--	--	--	--	--	--	--	--	--
7:00	5.4	0.426	5.9	0.472	--	--	--	--	0.05	--	--	--	--	--
:15	5.6		5.9		--	--	--	--	0.38	--	--	--	--	--
:30	5.6		5.7		--	--	--	--	0.09	--	--	--	--	--
:45	5.2		5.7		--	--	--	--	0.04	--	--	--	--	--
8:00	5.6	0.469	6.0	0.515	--	--	--	--	0.04	--	--	--	--	--
:15	5.9		6.2		--	--	--	--	0.05	--	--	--	--	--
:30	5.7		6.2		--	--	--	--	0.02	--	--	--	--	--
:45	6.0		6.3		--	--	--	--	0.01	--	--	--	--	--
9:00	5.7	0.481	6.2	0.524	--	--	--	--		--	--	--	--	--
:15	5.7		6.4		--	--	--	--		--	--	--	--	--
:30	6.2		6.2		--	--	--	--	0.01	--	--	--	--	--
:45	6.0		6.2		--	--	--	--		--	--	--	--	--
10:00	6.0	0.491	6.1	0.515	--	--	--	--		--	--	--	--	--
:15	6.0		--		--	--	--	--		--	--	--	--	--
:30	6.0		--		--	--	--	--		--	--	--	--	--
:45	5.9		6.2		--	--	--	--		--	--	--	--	--
11:00	5.9	0.483	6.3	0.518	--	--	--	--		--	--	--	--	--
:15	6.0		6.2		--	--	--	--		--	--	--	--	--
:30	5.9		6.3		--	--	--	--		--	--	--	--	--
:45	5.9		6.0		--	--	--	--		--	--	--	--	--

	SUNDAY 7/8/90		MONDAY 7/9/90		TUESDAY 7/10/90		WEDNESDAY 7/11/90		THURSDAY 7/12/90		FRIDAY 7/13/90		SATURDAY 7/14/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
12:00	6.1	0.489	6.4	0.520	--		--		--		--		--	
:15	5.9		6.1		--		--		--		--		--	
:30	5.9		6.1		--		--		--		--		--	
:45	5.9		6.4		--		--		--		--		--	
13:00	5.7	0.462	--		--		--		--		--		--	
:15	5.7		--		--		--		--		--		--	
:30	5.7		--		--		--		--		--		--	
:45	5.8		--		--		--		--		--		--	
14:00	5.7	0.461	--		--		--		--		--		--	
:15	5.7		--		--		--		--		--		--	
:30	5.7		--		--		--		--		--		--	
:45	5.8		--		--		--		--		--		--	
15:00	5.5	0.459	--		--		--		--		--		--	
:15	5.6		--		--		--		--		--		--	
:30	5.8		--		--		--		--		--		--	
:45	5.9		--		--		--		--		--		--	
16:00	5.8	0.450	--		--		--		--		--		--	
:15	5.6		--		--		--		--		--		--	
:30	5.6		--		--		--		--		--		--	
:45	5.6		--		--		--		--		--		--	
17:00	5.6	0.459	--		--		--		--		--		--	
:15	5.7		--		--		--		--		--		--	
:30	5.8		--		--		--		--		--		--	
:45	5.6		--		--		--		--		--		--	
18:00	5.4	0.439	--		--		--		--		--		5.4	0.411
:15	5.7		--		--		--		--		--		5.2	
:30	5.5		--		--		--		--		--		5.4	
:45	5.6		--		--		--		--		--		5.3	
19:00	5.6	0.450	--		--		--		--		--		5.5	0.421
:15	5.6		--		--		--		--		--		5.4	
:30	5.6		--		--		--		--		--		5.3	
:45	5.7		--		--		--		--		--		5.4	
20:00	5.6	0.445	--		--		--		--		--		5.6	0.402
:15	5.6		--		--		--		--		--		5.0	
:30	5.7		--		--		--		--		--		5.6	
:45	5.6		--		--		--		--		--		4.9	
21:00	5.7	0.451	--		--		--		--		--		5.2	0.396
:15	5.6		--		--		--		--		--		5.1	
:30	5.7		--		--		--		--		--		5.3	
:45	5.6		--		--		--		--		--		5.2	
22:00	5.9	0.454	--		--		--		--		--		5.3	0.375
:15	5.6		--		--		--		--		--		5.2	
:30	5.7		--		--		--		--		--		4.8	
:45	5.5		--		--		--		--		--		4.9	
23:00	5.7	0.437	--		--		--		--		--		4.8	0.360
:15	5.5		--		--		--		--		--		5.3	
:30	5.4		--		--		--		--		--		4.7	
:45	5.6		--		--		--		--		--		4.8	
TOT RAIN:		0.00		0.00		0.00		0.00		0.69		0.00		0.00
TOT FLOW:		0.435		0.454		--		--		--		--		0.394
MMIN FLW:	3:45	0.340	3:45	0.287		--		--		--		--		--
MIN FLOW:	3:45	0.340	3:45	0.287		--		--		--		--	23:30	0.335
MAX FLOW:	9:30	0.515	12:00	0.541		--		--		--		--	20:30	0.444

DEPTH SENSOR USED: Ultrasonic

ID 1: @ CREEK EASEMENT W. OF ALPHA
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 8.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 5.763
MUD: 0.00

PROJECT: FARMBRAN
SITE: RH02
RAIN GAUGE: RG01
PEAK CAPACITY: 0.634

	SUNDAY 7/15/90		MONDAY 7/16/90		TUESDAY 7/17/90		WEDNESDAY 7/18/90		THURSDAY 7/19/90		FRIDAY 7/20/90		SATURDAY 7/21/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
0:00	4.7	0.326	4.6	0.323	5.0	0.344	5.2	0.385	5.3	0.405	4.8	0.348	5.3	0.352
:15	4.6		4.8		4.9		5.1		5.2		5.2		4.9	
:30	4.7		4.7		4.5		5.1		5.3		4.8		4.4	
:45	4.6		4.4		4.7		5.2		5.4		4.4		--	
1:00	4.7	0.327	4.6	0.296	5.1	0.356	5.0	0.370	5.2	0.385	5.1	0.364	2.6	0.185
:15	4.5		4.4		4.8		5.2		5.2		5.2		--	
:30	4.6		4.6		4.9		4.9		5.0		4.8		2.0	
:45	4.8		4.0		4.8		4.9		5.2		4.7		5.0	
2:00	4.4	0.283	4.4	0.287	4.7	0.322	4.8	0.337	5.2	0.337	5.0	0.314	5.1	0.325
:15	4.4		4.4		4.7		4.8		4.6		4.4		5.3	
:30	4.2		4.3		4.4		4.7		4.7		4.5		2.7	
:45	4.1		4.3		4.6		4.6		4.5		4.2		5.2	
3:00	3.9	0.259	4.3	0.236	4.6	0.306	4.8	0.326	4.8	0.327	3.9	0.203	3.9	0.115
:15	4.1		3.3		4.3		4.7		4.2		3.8		--	
:30	4.3		4.1		4.4		4.8		4.7		3.6		2.4	
:45	4.1		3.9		4.6		4.4		4.9		3.0		1.1	
4:00	4.1	0.238	3.7	0.246	4.6	0.314	4.5	0.300	2.4	0.277	4.3	0.293	0.7	0.139
:15	3.9		4.1		4.3		4.3		4.6		4.7		2.8	
:30	3.7		4.1		4.4		4.4		5.0		4.7		3.0	
:45	4.0		3.9		4.8		4.5		4.6		3.8		4.2	
5:00	4.3	0.279	4.1	0.271	4.9	0.349	4.2	0.308	4.8	0.303	3.8	0.293	5.2	0.338
:15	4.1		4.3		4.7		4.3		2.4		4.2		3.8	
:30	4.4		4.1		4.7		4.7		5.0		4.6		4.8	
:45	4.2		4.3		5.0		4.8		5.2		4.8		5.0	
6:00	4.3	0.314	4.2	0.366	5.2	0.448	5.0	0.439	5.2	0.446	4.7	0.390	5.0	0.364
:15	4.6		5.2		5.4		5.5		5.7		5.1		5.0	
:30	4.5		0.01 5.1		6.0		5.7		5.7		5.2		4.8	
:45	4.8		0.14 5.4		5.9		6.0		5.8		5.6		5.0	
7:00	4.3	0.344	0.04 5.5	0.445	5.9	0.504	5.7	0.490	6.1	0.507	6.1	0.470	5.4	0.410
:15	4.9		5.6		--		6.1		6.2		5.7		5.0	
:30	4.8		5.6		6.2		5.9		6.1		--		5.2	
:45	5.2		5.7		6.1		6.1		6.1		5.6		5.6	
8:00	5.0	0.405	5.6	0.458	6.0	0.503	6.0	0.497	6.0	0.528	5.6	0.510	5.3	0.422
:15	5.2		5.5		0.01 6.2		6.0		6.1		5.8		5.4	
:30	5.3		5.7		6.0		6.0		5.9		7.5		5.6	
:45	5.6		6.1		--		6.1		7.6		6.0		5.4	
9:00	5.7	0.450	6.0	0.522	6.2	0.585	6.1	0.557	6.1	0.577	5.9	0.493	5.6	0.410
:15	5.9		6.1		7.6		6.2		6.4		5.8		3.7	
:30	5.4		6.2		6.7		7.6		7.6		6.2		4.8	
:45	5.6		6.7		7.6		6.8		7.6		6.1		7.6	
10:00	5.6	0.432	6.4	0.520	7.6	0.628	5.6	0.545	7.6	0.629	7.2	0.622	7.2	0.593
:15	5.6		6.4		7.5		7.6		7.6		7.3		6.4	
:30	5.4		6.0		7.5		6.4		7.6		7.6		7.6	
:45	5.4		6.1		7.6		6.7		7.6		7.6		--	
11:00	5.8	0.491	6.1	0.514	7.0	0.617	6.7	0.611	7.4	0.628	7.5	0.627	5.2	0.440
:15	6.2		6.3		7.5		7.5		7.6		7.6		6.2	
:30	6.1		6.2		7.6		7.4		7.6		7.5		5.7	
:45	5.8		6.1		7.2		7.6		7.5		7.5		5.1	

	SUNDAY 7/15/90		MONDAY 7/16/90		TUESDAY 7/17/90		WEDNESDAY 7/18/90		THURSDAY 7/19/90		FRIDAY 7/20/90		SATURDAY 7/21/90	
	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)
12:00		5.2	0.445		6.0	0.501		6.8	0.580		6.7	0.599		7.6	0.524		7.5	0.627		5.7	0.492
:15		6.1			6.0			6.7			6.6			4.8			7.6			5.7	
:30		5.8			6.2		0.02	--			7.6			5.9			7.6			7.7	
:45		5.4			6.1		0.02	6.9			7.6			7.6			7.5			5.4	
13:00		5.7	0.468		5.7	0.502	0.01	7.6	0.559		7.6	0.631		7.6	0.629		7.6	0.628		5.2	0.518
:15		6.0			6.9			7.6			7.6			7.6			7.5			5.5	
:30		5.8			6.0			5.8			7.7			7.6			7.6			7.5	
:45		5.6			5.7			6.1			7.6			7.6			--			7.6	
14:00		5.9	0.471		5.7	0.438		6.4	0.559		7.6	0.618		7.6	0.608		6.5	0.609		6.2	0.463
:15		5.9			5.3			7.5			7.6			7.6			7.6			5.6	
:30		6.0			5.6			6.4			7.5			6.4			7.6			5.6	
:45		5.5			5.6			6.3			6.9			7.6			7.6			5.6	
15:00		5.6	0.427		5.6	0.297		6.1	0.530		7.6	0.629		6.7	0.533		7.6	0.628		5.2	0.357
:15		5.6			3.9			6.9			7.5			5.9			7.6			4.7	
:30		5.2			4.1			6.0			7.6			6.1			7.5			5.2	
:45		5.3			3.9			6.3			7.6			6.9			7.5			4.5	
16:00		5.5	0.428		4.1	0.252		6.0	0.506		7.6	0.594		7.5	0.600		7.6	0.628		4.2	0.310
:15		5.2			4.0			6.1			5.9			7.6			7.5			4.5	
:30		5.9			4.0			6.1		0.22	7.6			7.6			7.6			4.0	
:45		5.3			4.1			6.2		0.45	7.6			6.2			7.6			5.4	
17:00		5.5	0.401		3.9	0.207		5.9	0.497	0.28	7.6	0.568		5.8	0.485		7.6	0.554		5.1	0.361
:15		5.2			3.7			6.2		0.04	7.6			5.9			7.6			4.5	
:30		5.3			3.2			6.0		0.01	6.1			5.9			7.5			5.0	
:45		5.0			3.7			6.0			6.1			6.1			4.7			5.1	
18:00		5.1	0.407		3.7	0.200		6.0	0.506		6.1	0.555		6.0	0.497		7.6	0.560		5.0	0.370
:15		5.5			3.4			6.2		0.01	6.8			6.0			7.5			5.2	
:30		5.5			3.5			6.0			7.6			5.8			7.1			4.8	
:45		5.2			3.6			6.2			6.1			6.2			5.1			5.1	
19:00		4.9	0.380		3.7	0.280		5.9	0.494		7.6	0.523		5.8	0.479		5.5	0.324		5.0	0.381
:15		5.1			4.1			5.9			6.2			6.0			5.3			5.2	
:30		5.1			3.7			6.1			5.9			5.9			2.9			5.3	
:45		5.2			5.6			6.1			5.7			5.7			--			4.8	
20:00		4.8	0.364		5.9	0.448		5.8	0.484		6.1	0.473		5.6	0.457		4.8	0.382		5.2	0.407
:15		5.1			5.8			6.0			5.8			5.9			5.8			5.4	
:30		4.8			5.4			5.9			5.6			5.6			4.7			5.5	
:45		5.0			5.4		0.01	5.9			5.9			5.7			5.0			5.1	
21:00		5.5	0.407		5.4	0.427	0.01	6.0	0.499		5.7	0.464		5.9	0.457		5.8	0.392		5.2	0.332
:15		5.3			5.6			6.2			5.7			5.7			4.4			5.1	
:30		5.2			5.4			5.9			5.7			5.6			5.7			3.6	
:45		5.2			5.4			6.0			5.9			5.7			4.8			4.8	
22:00		4.8	0.375		5.1	0.429		5.6	0.449		5.6	0.463		5.3	0.437		4.8	0.360		4.7	0.392
:15		5.2			5.7			5.6			5.5			5.6			4.8			5.6	
:30		5.0			5.1			5.8			6.0			5.7			5.1			5.4	
:45		5.2			5.9			5.5			5.9			5.5			5.0			5.1	
23:00		4.8	0.350		5.2	0.390		5.5	0.418		5.4	0.422		5.6	0.416		5.2	0.337		5.1	0.375
:15		4.8			5.2			5.5			5.5			5.7			4.5			4.9	
:30		4.8			5.2			5.4			5.5			5.3			4.3			--	
:45		4.8			5.0			5.2			5.3			4.9			4.9			5.2	
TOT RAIN:			0.00			0.19			0.08			1.01			0.00			0.00			0.00
TOT FLOW:			0.378			0.369			0.471			0.488			0.478			0.456			0.371
MIN FLW:	4:30		0.211	3:15		0.174		3:15	0.283		5:00	0.273	4:00		0.091	3:45		0.144	4:00		0.008
MIN FLOW:	4:30		0.211	17:30		0.163		3:15	0.283		5:00	0.273	4:00		0.091	19:30		0.137	4:00		0.008
MAX FLOW:	11:15		0.520	13:15		0.591		9:45	0.631		13:30	0.632	8:45		0.631	10:30		0.629	12:30		0.632

DEPTH SENSOR USED: Ultrasonic

ID 1: @ CREEK EASEMENT W. OF ALPHA
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 8.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 5.763
MUD: 0.00

PROJECT: FARMBRAN
SITE: RH02
RAIN GAUGE: RG01
PEAK CAPACITY: 0.634

	SUNDAY 7/22/90		MONDAY 7/23/90		TUESDAY 7/24/90		WEDNESDAY 7/25/90		THURSDAY 7/26/90		FRIDAY 7/27/90		SATURDAY 7/28/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
0:00	--	0.302	5.2	0.313	7.6	0.631	7.7	0.632	5.9	0.460	5.9	0.481	6.1	0.508
:15	4.2		4.7		7.6		7.7		5.7		5.8		6.1	
:30	4.7		3.6		7.6		7.7		5.9		6.1		6.3	
:45	4.4		--		7.7		7.7		5.4		5.8		6.1	
1:00	5.4	0.297	5.3	0.395	--	0.577	7.7	0.632	5.3	0.424	5.6	0.451	5.5	0.463
:15	5.3		5.2		--		7.7		5.5		5.7		5.7	
:30	3.5		5.2		6.8		7.7		5.5		5.6		5.9	
:45	3.2		5.1		6.8		7.7		5.4		5.6		5.9	
2:00	3.4	0.339	5.2	0.333	6.8	0.580	7.7	0.611	5.8	0.462	5.6	0.438	5.6	0.419
:15	5.1		5.3		6.8		7.6		5.9		5.6		5.6	
:30	5.2		2.8		6.8		--		5.8		5.6		5.2	
:45	5.2		5.3		6.8		6.7		5.5		5.5		5.2	
3:00	4.1	0.294	5.3	0.339	6.6	0.560	7.3	0.615	5.4	0.410	5.5	0.412	5.1	0.410
:15	4.1		3.1		6.7		7.2		5.6		5.5		5.3	
:30	5.0		5.1		6.5		7.2		5.0		5.4		5.3	
:45	4.4		5.3		6.5		7.3		5.2		4.9		5.6	
4:00	3.2	0.268	5.0	0.391	6.8	0.571	7.3	0.620	5.9	0.453	5.0	0.389	5.3	0.407
:15	4.0		5.3		6.5		7.3		5.9		5.2		5.4	
:30	4.8		5.1		6.5		7.6		5.1		5.4		5.2	
:45	4.6		5.3		7.1		7.3		5.7		5.0		5.3	
5:00	4.6	0.297	5.1	0.408	7.3	0.619	7.3	0.364	5.8	0.457	5.3	0.416	5.2	0.408
:15	4.5		5.5		7.6		--		5.5		5.2		5.2	
:30	4.1		5.4		7.3		4.0		5.6		5.2		5.4	
:45	4.4		5.3		7.2		3.8		6.0		5.7		5.4	
6:00	3.6	0.342	5.5	0.435	7.7	0.632	3.5	0.277	6.7	0.612	6.0	0.575	5.6	0.440
:15	5.2		5.4		7.7		4.2		7.6		7.0		5.5	
:30	5.0		5.5		7.7		--		7.5		6.8		5.6	
:45	5.2		5.7		7.7		4.9		7.5		7.6		5.6	
7:00	5.4	0.426	5.8	0.475	7.7	0.632	5.5	0.518	7.5	0.627	7.6	0.629	5.4	0.504
:15	5.6		5.5		7.7		6.2		7.5		7.6		6.2	
:30	5.1		5.7		7.7		7.5		7.5		7.6		5.9	
:45	5.7		6.4		0.01 7.7		6.1		7.5		7.6		6.9	
8:00	5.6	0.439	6.1	0.494	7.6	0.626	6.3	0.572	7.5	0.627	7.6	0.629	6.9	0.617
:15	5.6		5.9		7.5		6.1		7.6		7.6		7.6	
:30	5.3		6.0		7.4		7.6		7.5		7.6		7.5	
:45	5.6		6.0		7.6		7.4		7.5		7.6		7.6	
9:00	5.6	0.470	6.0	0.490	7.4	0.623	7.6	0.628	7.5	0.627	7.6	0.629	7.6	0.629
:15	5.6		5.8		7.4		7.4		7.5		7.6		7.6	
:30	5.7		6.0		7.4		7.6		7.5		7.6		7.6	
:45	6.3		6.1		7.5		7.6		7.5		7.6		7.6	
10:00	4.8	0.381	6.1	0.504	7.6	0.628	7.6	0.629	7.6	0.628	7.6	0.629	7.6	0.628
:15	5.3		6.2		7.6		0.03 7.6		7.6		7.6		7.6	
:30	5.2		6.1		7.6		7.6		7.6		7.6		7.6	
:45	5.1		6.0		7.5		7.6		7.5		7.6		7.6	
11:00	5.2	0.413	5.9	0.497	7.5	0.627	7.6	0.630	7.5	0.627	7.6	0.629	7.6	0.628
:15	5.4		6.0		7.5		7.6		7.6		7.6		7.6	
:30	5.6		6.1		7.5		7.6		7.5		7.6		7.6	
:45	5.2		6.1		7.6		7.6		7.5		7.6		7.6	

	SUNDAY 7/22/90			MONDAY 7/23/90			TUESDAY 7/24/90			WEDNESDAY 7/25/90			THURSDAY 7/26/90			FRIDAY 7/27/90			SATURDAY 7/28/90	
	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)
12:00		5.6	0.432		--	0.546		7.7	0.630		7.6	0.630		7.5	0.627		7.6	0.629		7.6	0.628
:15		5.3			6.2			7.7			7.6			7.6			7.6			7.6	
:30		5.7			6.0			7.6			7.6			7.5			7.6			7.6	
:45		5.3			7.5			7.6			7.6			7.6			7.6			7.6	
13:00		5.8	0.446		5.8	0.487		7.7	0.632		7.6	0.631		7.5	0.627		7.6	0.629		7.6	0.628
:15		5.5			5.9			7.7			7.6			7.5			7.6			7.6	
:30		5.7			6.1			7.7			7.6			7.6			7.6			7.6	
:45		5.5			5.9			7.7			7.6			7.6			7.6			7.6	
14:00		5.3	0.435		5.8	0.478	0.11	7.7	0.632		7.6	0.630		7.6	0.628		7.6	0.628		7.6	0.628
:15		5.4			5.8		0.01	7.7			7.6			7.5			7.6			7.6	
:30		5.6			5.8			7.7			7.6			7.6			7.6			7.6	
:45	0.10	5.8			6.1			7.7			7.5			7.6			7.6			7.6	
15:00		5.5	0.416		5.9	0.482		7.7	0.632		7.6	0.631		7.5	0.628		7.6	0.629		7.6	0.628
:15		5.6			5.9			7.7			7.6			7.6			7.6			7.5	
:30	0.03	5.2			5.9			7.7			7.6			7.5			7.6			7.6	
:45		5.2			5.9			7.7			7.6			7.6			7.6			7.6	
16:00		5.9	0.440		5.9	0.442		7.7	0.632		7.6	0.629		7.6	0.629		7.6	0.629		7.6	0.628
:15		5.6			6.0			7.7			7.6			7.6			7.6			7.6	
:30		5.3			5.5			7.7			7.6			7.6			7.6			7.6	
:45		5.5			4.9			7.7			7.6			7.6			7.6			7.6	
17:00		5.6	0.473		5.2	0.566		7.7	0.632		7.6	0.630		7.6	0.628		7.6	0.629		7.5	0.628
:15		5.7			7.6			7.7			7.6			7.6			7.6			7.6	
:30		6.1			7.1			7.7			7.6			7.6			7.6			7.5	
:45		6.0			7.7			7.7			7.6			7.6			7.6			7.6	
18:00		5.8	0.442		7.3	0.615		7.7	0.632		7.6	0.630		7.5	0.628		7.6	0.629		7.6	0.607
:15		5.7			7.1			7.7			7.6			7.6			7.6			6.9	
:30		5.2			7.3			7.7			7.6			7.6			7.6			7.6	
:45		5.6			7.5			7.7			7.6			7.6			7.6			6.9	
19:00		5.5	0.387		7.6	0.631		7.7	0.632		7.6	0.629		7.6	0.628		7.6	0.629		6.8	0.602
:15		5.4			7.6			7.7			7.6			7.6			7.6			6.7	
:30		4.9			7.6			7.7			7.6			7.6			7.6			7.5	
:45		4.8			7.6			7.7			7.6			7.5			7.6			7.6	
20:00		5.1	0.412		7.6	0.631		7.7	0.632		7.6	0.628		7.5	0.628		7.6	0.629		6.8	0.591
:15		5.5			7.6			7.7			7.6			7.6			7.6			6.9	
:30		5.4			7.6			7.7			7.5			7.6			7.6			7.1	
:45		5.4			7.6			7.7			7.5			7.6			7.6			6.9	
21:00		5.5	0.418		7.6	0.631		7.6	0.631		7.5	0.590		7.6	0.627		7.6	0.628		7.6	0.591
:15		5.6			7.6		0.01	7.6			7.4			7.6			7.5			7.0	
:30		5.6			7.6			7.6			7.6			7.5			7.6			6.7	
:45		4.8			7.7			7.7			5.9			7.5			7.6			6.7	
22:00		4.7	0.394		7.7	0.631		7.7	0.632		5.6	0.583		6.9	0.617		6.8	0.606		5.9	0.497
:15		5.6			7.6			7.7			7.5			7.4			6.9			6.1	
:30		5.3			7.6			7.7			7.6			7.6			7.6			6.2	
:45		5.2			7.7			7.7			7.6			7.5			7.6			5.9	
23:00		5.4	0.374		7.7	0.631		7.7	0.632		7.5	0.574		7.6	0.547		7.6	0.628		6.5	0.526
:15		5.1			7.6			7.7			7.6			6.1			7.6			6.2	
:30		5.2			7.6			7.7			5.8			6.4			7.6			6.3	
:45		4.5			7.7			7.7			--			6.2			7.6			6.1	
TOT RAIN:			0.13			0.16			0.14			0.03			0.00			0.00			0.00
TOT FLOW:			0.390			0.495			0.621			0.595			0.577			0.576			0.552
AMMIN FLW:		1:45	0.163		2:30	0.130		3:30	0.550		6:00	0.199		3:30	0.375		3:45	0.360		3:00	0.385
MIN FLOW:		1:45	0.163		2:30	0.130		3:30	0.550		6:00	0.199		3:30	0.375		3:45	0.360		3:00	0.385
MAX FLOW:		9:45	0.533		17:45	0.632		0:45	0.632		0:00	0.632		6:15	0.629		6:45	0.629		8:45	0.629

DEPTH SENSOR USED: Ultrasonic

ID 1: @ CREEK EASEMENT W. OF ALPHA
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 8.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 5.763
MUD: 0.00

PROJECT: FARMBRAN
SITE: RH02
RAIN GAUGE: RG01
PEAK CAPACITY: 0.634

	SUNDAY 7/29/90		MONDAY 7/30/90		TUESDAY 7/31/90		WEDNESDAY 8/1/90		THURSDAY 8/2/90		FRIDAY 8/3/90		SATURDAY 8/4/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
0:00	6.2	0.506	5.7	0.455	5.5	0.426	5.3	0.376	5.4	0.415	6.7	0.504	5.9	0.461
:15	6.2		5.8		--		5.0		5.5		5.8		5.9	
:30	6.1		5.3		5.5		4.8		5.4		6.2		5.6	
:45	5.9		5.9		5.3		5.0		5.1		5.7		5.5	
1:00	6.2	0.463	5.2	0.439	5.4	0.430	5.0	0.338	5.0	0.374	5.6	0.469	5.6	0.402
:15	5.6		5.7		6.0		4.7		5.0		5.9		5.4	
:30	5.6		5.6		5.4		4.6		5.0		5.7		4.9	
:45	5.6		5.7		5.2		4.7		5.0		5.9		5.2	
2:00	5.1	0.411	5.4	0.402	5.4	0.406	4.8	0.339	5.0	0.365	5.8	0.463	5.0	0.361
:15	5.4		5.4		5.1		4.7		5.2		6.1		5.0	
:30	5.5		5.2		5.4		5.0		4.8		5.4		4.9	
:45	5.3		5.1		5.2		4.6		4.8		5.7		4.8	
3:00	5.6	0.406	5.3	0.400	4.8	0.371	4.4	0.292	4.6	0.312	5.9	0.446	5.1	0.351
:15	5.2		5.2		4.8		4.4		4.4		5.5		4.6	
:30	5.3		5.3		5.4		4.4		4.4		5.5		4.8	
:45	5.0		5.2		4.9		4.2		4.7		5.6		4.8	
4:00	5.8	0.432	5.1	0.406	5.2	0.392	4.6	0.317	4.7	0.327	5.6	0.451	4.9	0.349
:15	5.4		5.4		5.2		4.5		4.6		5.6		4.8	
:30	5.4		5.4		5.0		4.3		4.6		5.6		4.8	
:45	5.4		5.3		5.3		4.9		4.8		5.8	0.01	4.7	
5:00	5.4	0.407	4.9	0.409	5.4	0.418	4.8	0.355	4.5	0.348	5.7	0.501	4.9	0.391
:15	5.2		5.2		5.2		5.0		4.7		5.8		5.0	
:30	5.2		5.5		5.4		4.9		5.1		6.1	0.01	5.3	
:45	5.4		5.7		5.6		4.9		5.0		6.8	0.07	5.5	
6:00	5.0	0.413	5.6	0.492	5.9	0.508	5.0	0.448	5.5	0.476	7.2	0.625	0.01	5.7	0.488
:15	5.7		6.2		5.8		5.6		5.9		7.6	0.01	6.1	
:30	5.3		6.2		6.0		5.9		5.8		7.6		6.2	
:45	5.4		5.9		6.9		6.0		6.2		7.6		5.8	
7:00	5.4	0.465	6.1	0.568	7.5	0.629	6.9	0.618	6.8	0.603	7.6	0.629	0.12	5.7	0.493
:15	6.1		6.1		7.6		7.6		6.8		7.6	0.01	6.2	
:30	5.4		7.6		7.6		7.6		7.4		7.6	0.01	6.2	
:45	6.3		7.5		7.6		7.6		7.6		7.6	0.07	5.9	
8:00	6.5	0.607	7.6	0.629	7.6	0.629	7.6	0.618	7.6	0.629	7.6	0.629	0.02	6.1	0.568
:15	7.5		7.5		7.6		6.9		7.6		7.6	0.03	6.8	
:30	7.5		7.6		7.6		7.6		7.6		7.6	0.01	6.6	
:45	7.6		7.6		7.6		7.6		7.6		7.6		7.6	
9:00	7.6	0.627	7.6	0.629	7.6	0.629	7.6	0.630	7.6	0.629	7.6	0.629	7.6	0.629
:15	7.5		7.6		7.6		7.6		7.6		7.6	0.02	7.6	
:30	7.4		7.6		7.6		7.6		7.6		7.6	0.05	7.6	
:45	7.6		7.6		7.6		7.6		7.6		7.6	0.01	7.6	
10:00	7.6	0.629	7.6	0.629	7.6	0.630	7.6	0.629	7.6	0.629	7.6	0.629	0.03	7.6	0.628
:15	7.5		7.6		7.6		7.6		7.6		7.6	0.03	7.6	
:30	7.6		7.6		7.6		7.6		7.6		7.6	0.01	7.6	
:45	7.6		7.6		7.6		7.6		7.6		7.6		7.6	
11:00	7.6	0.629	7.6	0.629	7.6	0.631	7.6	0.629	7.6	0.629	7.6	0.629	7.6	0.628
:15	7.6		7.6		7.6		7.6		7.6		7.6		7.6	
:30	7.6		7.6		7.6		7.6		7.6		7.6		7.6	
:45	7.6		7.6		7.6		7.6		7.6		7.6		7.6	

	SUNDAY 7/29/90			MONDAY 7/30/90			TUESDAY 7/31/90			WEDNESDAY 8/1/90			THURSDAY 8/2/90			FRIDAY 8/3/90			SATURDAY 8/4/90	
	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)
12:00		7.6	0.627		7.6	0.629		7.6	0.630		7.6	0.629		7.6	0.629		7.6	0.629		7.6	0.628
:15		7.6			7.6			7.6			7.6			7.6			7.6			7.5	
:30		7.5			7.6			7.6			7.6			7.6			7.6			7.6	
:45		7.4			7.6			7.6			7.6			7.6			7.6			7.6	
13:00		7.6	0.612		7.6	0.629		7.6	0.631		7.6	0.629		7.6	0.629		7.6	0.628		7.6	0.628
:15		7.6			7.6			7.6			7.6			7.6			7.6			7.6	
:30		6.7			7.6			7.6			7.6			7.6			7.6			7.6	
:45		7.5			7.6			7.6			7.6			7.6			7.6			7.6	
14:00		7.6	0.628		7.6	0.629		7.6	0.630		7.6	0.629		7.6	0.629		7.6	0.628		7.6	0.628
:15		7.6			7.6			7.6			7.6			7.6			7.6			7.6	
:30		7.4			7.6			7.6			7.6			7.6		0.57	7.6			7.6	
:45		7.6			7.6			7.6			7.6			7.6			7.6			7.6	
15:00		6.7	0.612		7.6	0.628		7.6	0.630		7.6	0.629		7.6	0.629		7.6	0.628		7.6	0.629
:15		7.6			7.6			7.6			7.6			7.6			7.6			7.6	
:30		7.4			7.6			7.6			7.6			7.6			7.6			7.6	
:45	0.02	7.5			7.5			7.6			7.6			7.6		0.01	7.6			7.6	
16:00	0.05	7.6	0.527		7.6	0.629		7.6	0.630		7.6	0.629		7.6	0.629		7.6	0.628		7.6	0.628
:15		6.1			7.6			7.6			7.6			7.6			7.6			7.6	
:30		6.1			7.6			7.6			7.6			7.6			7.6			7.6	
:45		5.8			7.6			7.6			7.6			7.6			7.6			7.6	
17:00		6.7	0.526		7.6	0.615		7.6	0.629		7.6	0.618		7.7	0.630		7.6	0.586		7.6	0.618
:15		6.9			7.6			7.6			7.6			7.6			7.6			7.6	
:30		5.9			7.6			7.6			7.6			7.6			6.9			7.6	
:45		5.7			6.7			7.6			6.9			7.6			6.0			6.9	
18:00		5.9	0.549		7.6	0.618		6.7	0.614		7.6	0.629		7.6	0.629		7.6	0.628		7.6	0.627
:15		6.1			7.6			7.6			7.6			7.6			7.6			7.5	
:30		7.6			7.5			7.6			7.5			7.6			7.6			7.5	
:45		6.9			6.9			7.6			7.6			7.6			7.6			7.5	
19:00		6.5	0.549		7.6	0.629		7.6	0.629		7.6	0.629		7.6	0.629		7.6	0.628		7.5	0.628
:15		6.7			7.6			7.6			7.6			7.6			7.6			7.6	
:30		6.7			7.6			7.5			7.6			7.6			7.6			7.6	
:45		6.1			7.6			7.6			7.6			7.6			7.6			7.6	
20:00		6.7	0.602		7.6	0.569		6.7	0.556		7.6	0.549		7.6	0.629		6.8	0.568		7.6	0.629
:15		6.8			6.9			7.6			6.8			7.6			7.6			7.6	
:30		7.6			5.9			6.2			5.9			7.6			6.0			7.6	
:45	0.11	7.5			6.7			6.2			6.0			7.6			6.7			7.6	
21:00	0.33	7.6	0.501		7.5	0.606		5.9	0.492		6.2	0.550		7.6	0.629		7.6	0.620		7.6	0.627
:15	0.15	5.7			6.9			6.2			7.6		0.01	7.6			7.6			7.5	
:30	0.02	6.0			7.6			5.9			6.2		0.05	7.6			7.6			7.6	
:45		5.4			6.8			5.9			6.4		0.05	7.6			7.0			7.5	
22:00		5.7	0.471		6.1	0.542		5.9	0.508		6.3	0.507	0.02	7.6	0.629		6.0	0.584		7.6	0.627
:15		5.6			7.5			6.2			5.9		0.01	7.6			6.9			7.5	
:30		5.9			6.1			6.1			6.1		0.01	7.6			7.6			7.5	
:45		6.0			6.3			6.3			6.1			7.6			7.5			7.5	
23:00		5.9	0.475		5.7	0.453		5.4	0.430		5.9	0.462		7.5	0.627		6.1	0.515		7.5	0.627
:15		5.9			5.9			5.8			5.8			7.6			6.1			7.5	
:30		5.5			5.5			5.7			5.6			7.5			6.3			7.6	
:45		6.1			5.6			5.0			5.6			7.6			6.2			7.5	
TOT RAIN:			0.68			0.00			0.00			0.00			0.15			0.58			0.53
TOT FLOW:			0.528			0.553			0.547			0.528			0.554			0.578			0.553
MMIN FLW:		6:00	0.370		5:00	0.360		3:00	0.350		3:45	0.273		3:30	0.292		2:30	0.415		3:15	0.326
MIN FLOW:		6:00	0.370		5:00	0.360		3:00	0.350		3:45	0.273		3:30	0.292		2:30	0.415		3:15	0.326
MAX FLOW:		10:00	0.631		7:30	0.629		10:30	0.631		8:30	0.631		17:00	0.632		6:15	0.629		20:15	0.631

DEPTH SENSOR USED: Ultrasonic

	SUNDAY 8/5/90			MONDAY 8/6/90																
	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)
12:00		7.6	0.628		7.6	0.629														
:15		7.6			7.6															
:30		7.5			7.6															
:45		7.5			7.6															
13:00		6.9	0.618		7.6	0.629														
:15		7.6			7.6															
:30		7.5			7.6															
:45		7.5			7.6															
14:00		7.6	0.612		7.6	0.629														
:15		7.4			7.6															
:30		6.7			7.6															
:45	0.01	7.6			7.6															
15:00	0.08	7.6	0.628		7.6	0.629														
:15	0.06	7.5			7.6															
:30	0.03	7.6			7.6															
:45	0.03	7.6			7.6															
16:00		7.6	0.629		7.6	0.629														
:15	0.01	7.6			7.6															
:30	0.02	7.6			7.6															
:45	0.02	7.6			7.6															
17:00	0.01	7.6	0.629		7.6	0.629														
:15		7.6			7.6															
:30		7.6			7.6															
:45		7.6			7.6															
18:00		7.6	0.629		7.6	0.629														
:15		7.6			7.6															
:30		7.6			7.6															
:45		7.6			7.6															
19:00		7.6	0.629		7.6	0.615														
:15		7.6			7.6															
:30		7.6			6.7															
:45		7.6			7.6															
20:00		7.6	0.629		7.6	0.626														
:15		7.6			7.6															
:30		7.6			7.6															
:45		7.6			7.3															
21:00		7.6	0.629		7.1	0.558														
:15		7.6			6.5															
:30		7.6			5.9															
:45		7.6			6.9															
22:00		7.6	0.613		7.6	0.588														
:15		6.7			6.9															
:30		7.6			6.8															
:45		7.4			6.6															
23:00		7.4	0.615		6.2	0.487														
:15		7.6			5.9															
:30		7.6			5.7															
:45		6.8			5.9															
TOT RAIN:			0.38			0.00														
TOT FLOW:			0.573			0.582														
AMMIN FLW:		4:30	0.370		3:30	0.439														
MIN FLOW:		4:30	0.370		3:30	0.439														
MAX FLOW:		8:45	0.629		0:00	0.631														

DEPTH SENSOR USED: Ultrasonic

Site RH03
Flow Monitoring Data
and
Hydrographs

ADS Services, Inc.

1500 Site Report

REWARD IF FOUND - (205) 883-9323

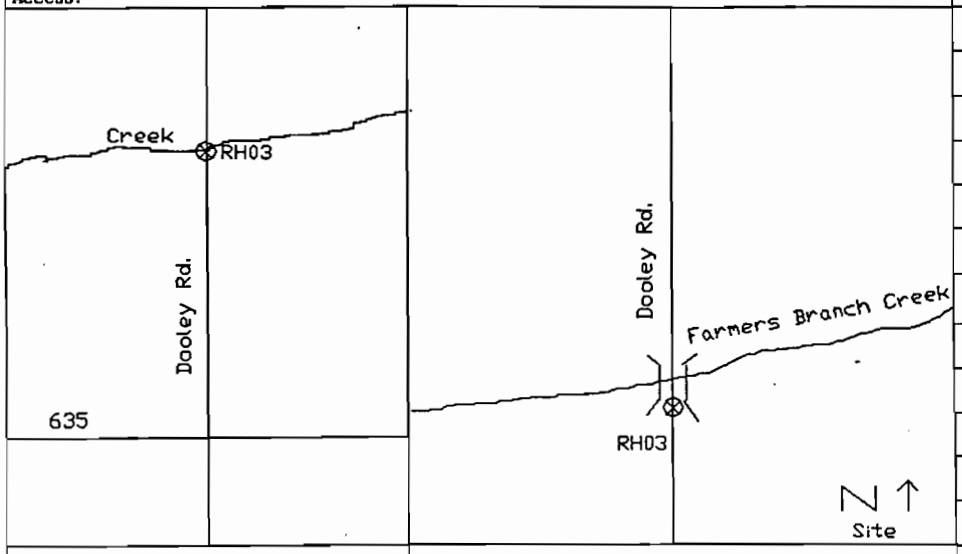
Manhole #	AN	Monitor #
	RH03	8300
V-Sensor #	**Bat Serial #**	**Press. X-ducer #**
2610	048831418	039009981
Dist. to X-ducer	**Physical Offset**	**Diameter**
24"	1.25"	24"

Project/Phase: Farmers Branch, TX Date: 07/04/90 Name: BF

Address/Location: On Dooley @ Farmers Branch Creek

Access:

INSTALLATION Pressure, Ultrasonics and Velocity



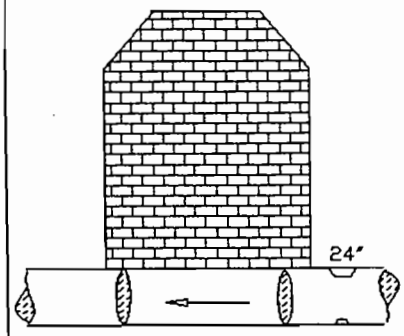
SAFETY

Manhole Depth: 12"

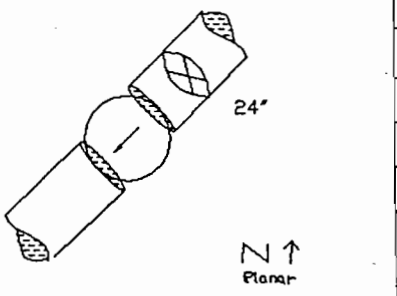
Traffic: Heavy

Gas @ Investigation: Use blower

Manhole Condition: Good



Cross Section



Rain Gauge Zone: RG01

Drop/Fall:

Install QC: Date: Int.:

Comments:

Pipe Type: Concrete 24"

BACKUP	Y	N	?	DISTANCE
Trunk	X			
Lift Sta.		X		
STP		X		
Other Input		X		
Ind. U/S		X		
L/S U/S		X		

General Condition, overflows, bypasses, weirs, special information, monitor characteristics, surcharge
* Please make a precise drawing if odd-shaped pipe or special installation

RATING: B

Hydraulics: Good smooth flow, no sediment in pipe.

Recommended Analysis Days:

Master List of Recommended Days:

Additional Comments - Final Data Review

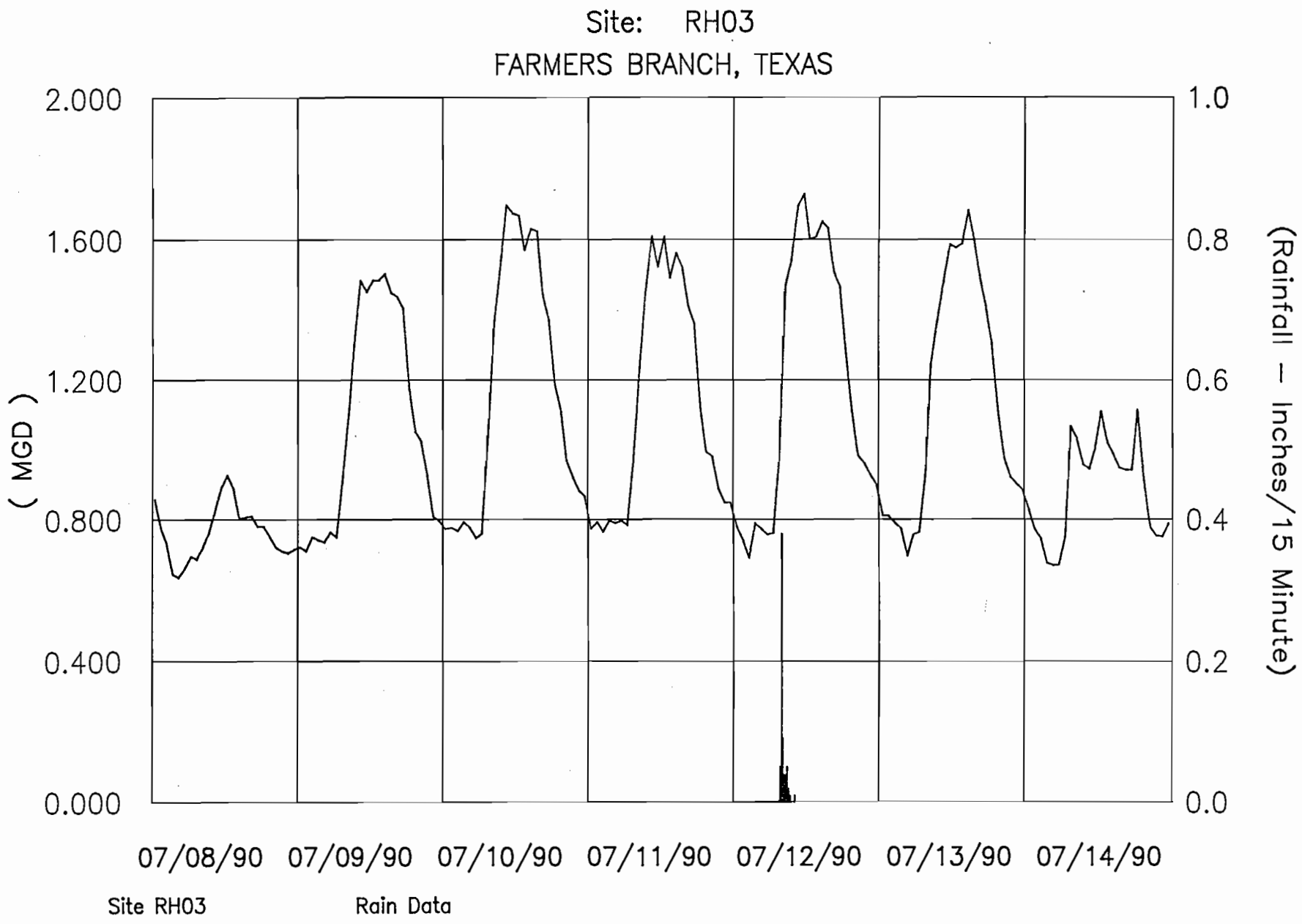
Surcharge: Yes Height: 10'

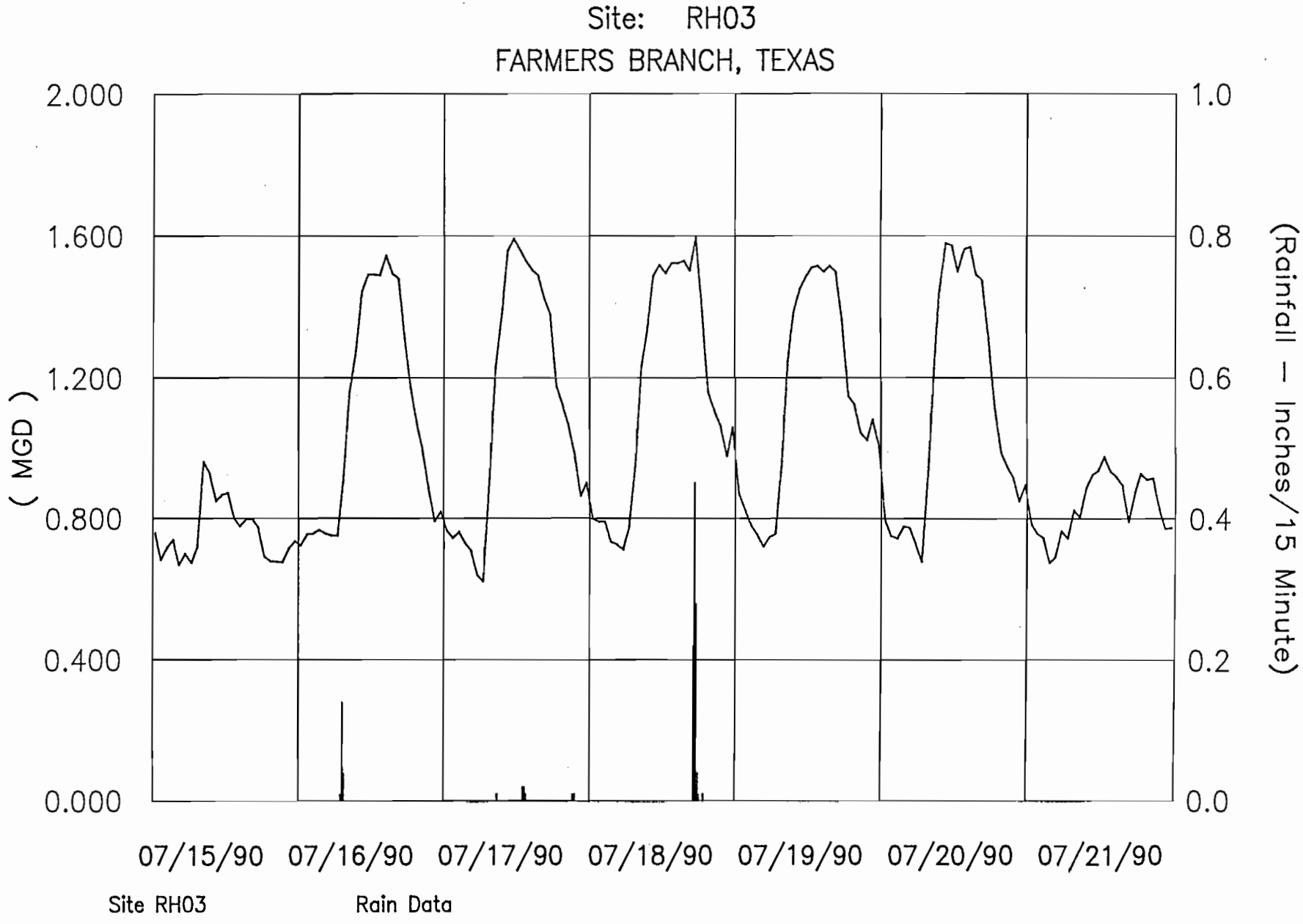
Inv.: DOF: 8" +/- 0 Time: 11:00 Vel: 1.44 fps Silt: 0

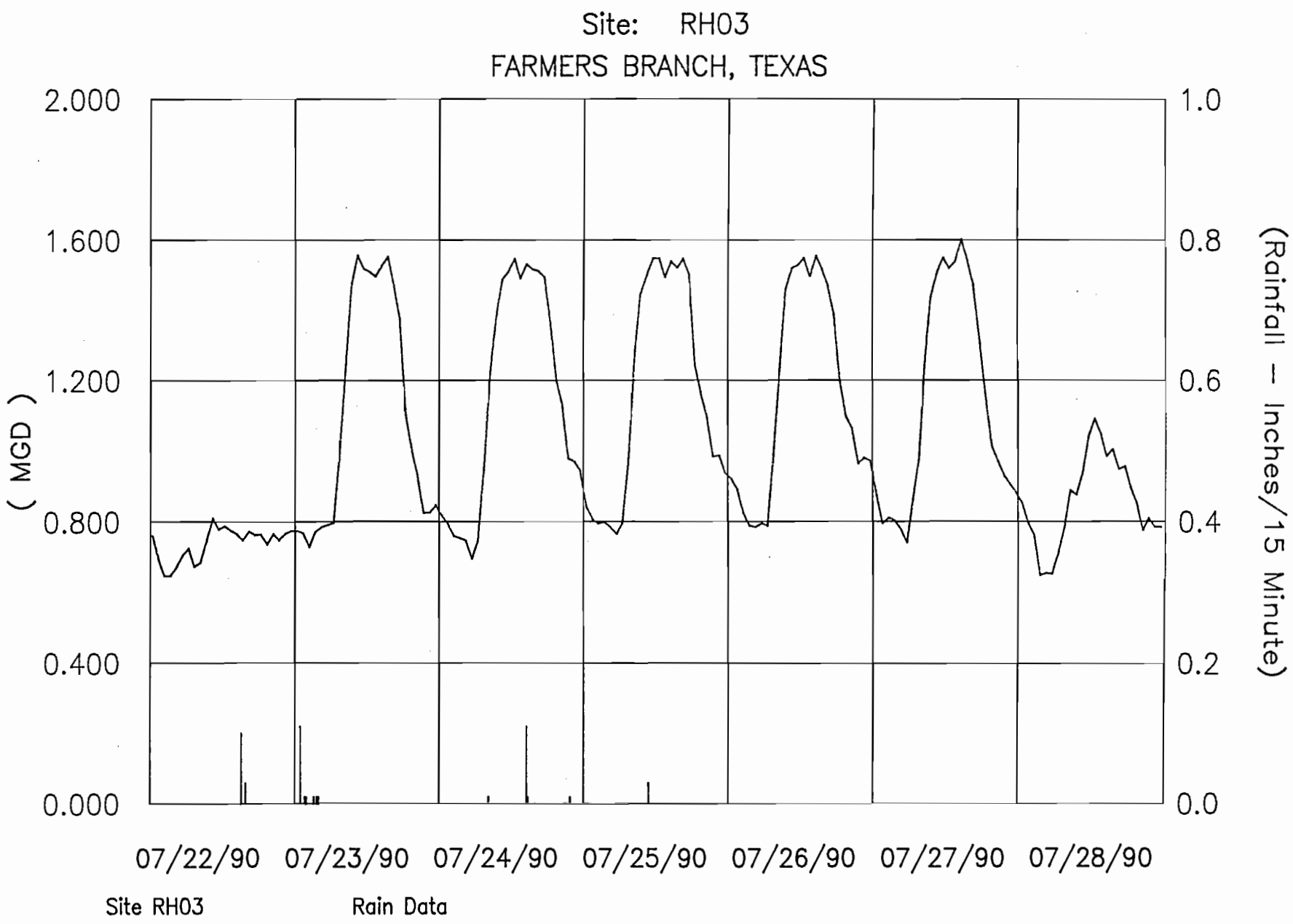
Upstream Manhole Poor site

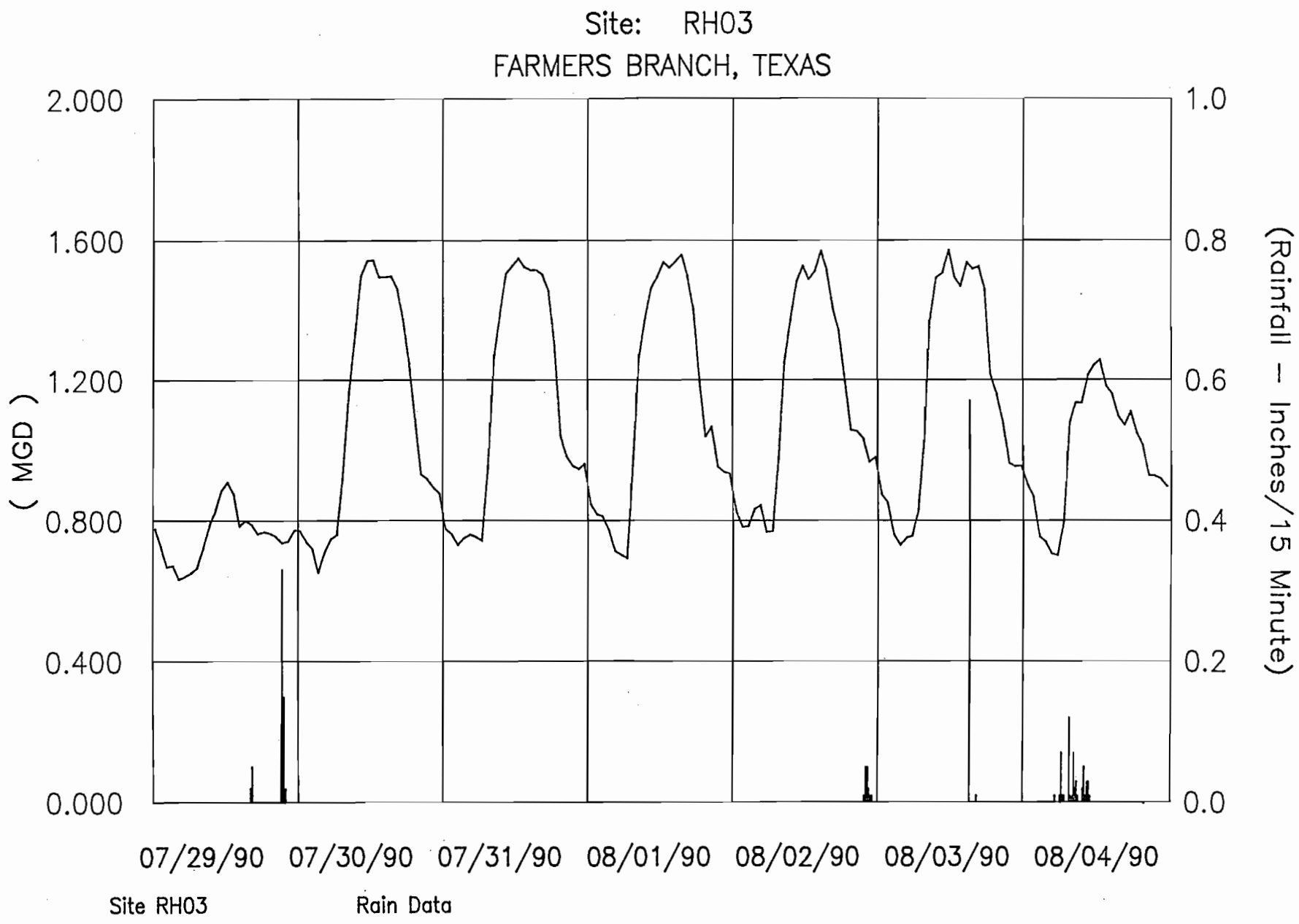
Downstream Manhole Not located

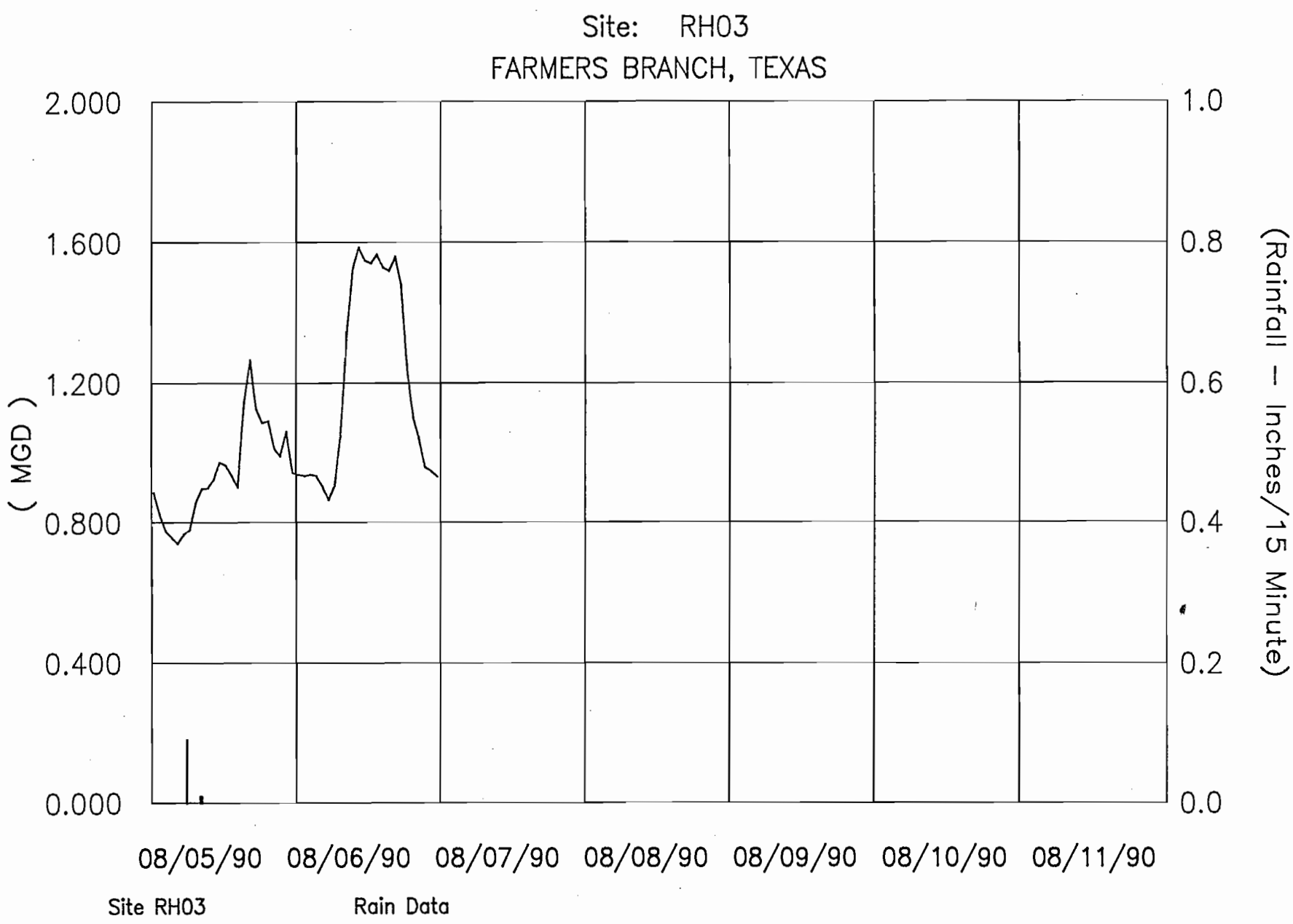
Mini System Character: XX Residential/Commercial/Industrial/Vacant XX


Site: RH03
FARMERS BRANCH, TEXAS
2.000
1.600
1.200
0.800
0.400
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
07/08/90
07/09/90
07/10/90
07/11/90
07/12/90
07/13/90
07/14/90
Site RH03
Rain Data


Site: RH03
FARMERS BRANCH, TEXAS
2.000
1.600
1.200
0.800
0.400
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
07/15/90
07/16/90
07/17/90
07/18/90
07/19/90
07/20/90
07/21/90
Site RH03
Rain Data


Site: RH03
FARMERS BRANCH, TEXAS
2.000
1.600
1.200
0.800
0.400
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
07/22/90
07/23/90
07/24/90
07/25/90
07/26/90
07/27/90
07/28/90
Site RH03
Rain Data


Site: RH03
FARMERS BRANCH, TEXAS
2.000
1.600
1.200
0.800
0.400
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
07/29/90
07/30/90
07/31/90
08/01/90
08/02/90
08/03/90
08/04/90
Site RH03
Rain Data


Site: RH03
FARMERS BRANCH, TEXAS
2.000
1.600
1.200
0.800
0.400
0.000
(MGD)
1.0
0.8
0.6
0.4
0.2
0.0
(Rainfall - Inches/15 Minute)
08/05/90
08/06/90
08/07/90
08/08/90
08/09/90
08/10/90
08/11/90
Site RH03
Rain Data

ID 1: DOOLEY @ FARMERS BRANCH CREEK
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 24.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 2.041
MUD: 0.13

PROJECT: RAWHIDE
SITE: RH03
RAIN GAUGE: RG01
PEAK CAPACITY: 4.197

	SUNDAY 7/1/90		MONDAY 7/2/90		TUESDAY 7/3/90		WEDNESDAY 7/4/90		THURSDAY 7/5/90		FRIDAY 7/6/90		SATURDAY 7/7/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
0:00	--		--		--		--		7.3	0.668	8.1	0.754	8.1	0.781
:15	--		--		--		--		7.4		8.0		8.1	
:30	--		--		--		--		7.5		7.7		8.1	
:45	--		--		--		--		7.8		8.0		8.1	
1:00	--		--		--		--		8.1	0.763	8.1	0.767	8.0	0.760
:15	--		--		--		--		8.1		8.0		8.0	
:30	--		--		--		--		8.0		8.0		8.0	
:45	--		--		--		--		7.9		8.1		8.0	
2:00	--		--		--		--		7.6	0.678	7.9	0.710	8.1	0.745
:15	--		--		--		--		7.8		8.1		7.9	
:30	--		--		--		--		7.4		7.4		7.9	
:45	--		--		--		--		7.3		7.4		7.8	
3:00	--		--		--		--		7.3	0.652	7.9	0.749	7.3	0.654
:15	--		--		--		--		7.3		8.1		7.6	
:30	--		--		--		--		7.4		8.0		7.4	
:45	--		--		--		--		7.5		7.8		7.4	
4:00	--		--		--		--		7.4	0.654	7.8	0.680	7.3	0.700
:15	--		--		--		--		7.4		7.5		7.4	
:30	--		--		--		--		7.4		7.4		8.1	
:45	--		--		--		--		7.5		7.4		7.9	
5:00	--		--		--		--		7.4	0.639	7.3	0.691	7.9	0.760
:15	--		--		--		--		7.3		7.5		7.9	
:30	--		--		--		--		7.4		7.8		8.0	
:45	--		--		--		--		7.2		7.9		8.1	
6:00	--		--		--		--		7.3	0.677	7.9	0.729	7.9	0.751
:15	--		--		--		--		7.5		7.8		7.9	
:30	--		--		--		--		7.4		7.8		7.9	
:45	--		--		--		--		7.9		7.8		8.0	
7:00	--		--		--		--		7.9	0.808	7.8	0.797	7.8	0.760
:15	--		--		--		--		7.9		8.1		7.8	
:30	--		--		--		--		8.2		8.1		8.1	
:45	--		--		--		--		9.0		8.7		8.1	
8:00	--		--		--		--		9.0	1.057	8.9	1.080	8.5	0.800
:15	--		--		--		--		9.3		9.6		8.1	
:30	--		--		--		--		9.8		9.7		8.1	
:45	--		--		--		--		9.8		10.1		8.1	
9:00	--		--		--		--		9.7	1.284	9.8	1.360	8.7	0.899
:15	--		--		--		--		10.4		10.9		8.5	
:30	--		--		--		--		10.6		11.2		8.9	
:45	--		--		--		--		11.2		11.3		8.8	
10:00	--		--		--		--		11.1	1.469	11.4	1.507	9.0	0.949
:15	--		--		--		--		11.5		11.5		8.9	
:30	--		--		--		--		11.3		11.4		8.9	
:45	--		--		--		--		11.3		11.5		9.0	
11:00	--		--		--		--	0.823	11.2	1.476	11.5	1.513	8.9	1.013
:15	--		--		--		--		11.4		11.5		9.0	
:30	--		--		--		8.7		11.4		11.4		9.7	
:45	--		--		--		8.0		11.3		12.0v		9.5	

	SUNDAY 7/1/90		MONDAY 7/2/90		TUESDAY 7/3/90		WEDNESDAY 7/4/90		THURSDAY 7/5/90		FRIDAY 7/6/90		SATURDAY 7/7/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
12:00	--		--		--		8.3	0.789	11.9	1.566	11.6	1.556	9.6	1.114
:15	--		--		--		8.1		11.9		11.5		10.3	
:30	--		--		--		8.1		11.5		11.9		9.6	
:45	--		--		--		8.0		11.4		11.5		9.4	
13:00	--		--		--		7.9	0.752	11.5	1.514	11.5	1.497	9.6	1.031
:15	--		--		--		8.0		11.4		11.4		9.3	
:30	--		--		--		7.9		11.5		11.3		9.0	
:45	--		--		--		8.0		11.5		11.5		9.6	
14:00	--		--		--		7.9	0.749	11.3	1.500	11.4	1.536	9.4	1.018
:15	--		--		--		7.8		11.5		11.4		9.6	
:30	--		--		--		8.1		11.5		11.5		9.3	
:45	--		--		--		7.9		11.4		11.9		9.0	
15:00	--		--		--		7.9	0.740	11.5	1.502	12.0v	1.519	8.9	0.939
:15	--		--		--		7.8		11.4		11.9		8.9	
:30	--		--		--		7.8		11.4		11.4		9.0	
:45	--		--		--		8.0		11.5		11.5		8.9	
16:00	--		--		--		8.0	0.722	11.2	1.450	11.5	1.486	8.8	0.888
:15	--		--		--		7.9		11.1		11.5		8.8	
:30	--		--		--		7.8		11.1		11.3		8.8	
:45	--		--		--		7.4		11.3		11.2		8.3	
17:00	--		--		--		7.8	0.699	11.0	1.335	11.2	1.384	8.7	0.859
:15	--		--		--		7.5		10.8		11.3		8.2	
:30	--		--		--		7.8		10.6		10.7		8.4	
:45	--		--		--		7.6		10.5		10.5		8.7	
18:00	--		--		--		7.8	0.736	10.0	1.108	10.1	1.135	8.7	0.840
:15	--		--		--		7.8		10.2		9.7		8.6	
:30	--		--		--		7.8		9.6		9.8		8.3	
:45	--		--		--		8.0		9.0		9.8		8.1	
19:00	--		--		--		7.5	0.666	9.1	0.961	9.7	1.104	8.1	0.778
:15	--		--		--		7.4		8.9		9.6		8.0	
:30	--		--		--		7.4		9.0		9.7		8.1	
:45	--		--		--		7.7		9.1		9.7		8.1	
20:00	--		--		--		7.8	0.752	8.9	0.935	9.3	0.947	8.1	0.772
:15	--		--		--		8.0		9.0		8.9		8.0	
:30	--		--		--		8.0		9.0		8.9		7.9	
:45	--		--		--		8.0		8.7		8.7		8.1	
21:00	--		--		--		8.0	0.770	8.3	0.817	8.3	0.878	8.0	0.772
:15	--		--		--		8.1		8.3		8.8		8.1	
:30	--		--		--		8.1		8.3		8.7		8.1	
:45	--		--		--		8.0		8.3		8.7		8.0	
22:00	--		--		--		7.8	0.672	8.1	0.804	8.1	0.787	8.1	0.785
:15	--		--		--		7.4		8.3		8.1		8.1	
:30	--		--		--		7.3		8.3		8.1		8.1	
:45	--		--		--		7.4		8.1		8.2		8.2	
23:00	--		--		--		7.9	0.693	8.1	0.780	8.0	0.772	8.3	0.876
:15	--		--		--		7.8		8.0		8.0		8.7	
:30	--		--		--		7.4		8.1		8.1		8.7	
:45	--		--		--		7.3		8.1		8.1		8.7	
TOT RAIN:	0.00		0.00		0.00			0.00		0.00		0.00		0.00
TOT FLOW:	--		--		--			0.732		1.046		1.081		0.843
AMMIN FLW:	--		--		--			--	5:45	0.620	5:00	0.634	3:00	0.634
MIN FLOW:	--		--		--		23:45	0.634	5:45	0.620	5:00	0.634	3:00	0.634
MAX FLOW:	--		--		--		11:30	0.887	12:00	1.629	12:30	1.629	12:15	1.232

DEPTH SENSOR USED: Ultrasonic

	SUNDAY 7/8/90		MONDAY 7/9/90		TUESDAY 7/10/90		WEDNESDAY 7/11/90		THURSDAY 7/12/90		FRIDAY 7/13/90		SATURDAY 7/14/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
12:00	8.9	0.929	11.3	1.485	12.2	1.668	12.2	1.610	12.2	1.602	11.9	1.578	9.7	1.111
:15	8.9		11.3		12.1		12.0		12.0		12.0		9.8	
:30	8.8		11.4		12.1		11.8		11.5		11.5		9.6	
:45	8.9		11.4		12.0		11.4		11.5		11.4		9.8	
13:00	8.9	0.889	11.3	1.485	11.5	1.571	11.1	1.493	11.5	1.609	11.6	1.590	9.3	1.022
:15	8.7		11.4		11.4		11.4		11.9		11.5		9.2	
:30	8.6		11.3		11.9		11.5		11.9		11.9		9.3	
:45	8.5		11.4		12.0		11.5		12.1		12.0		9.5	
14:00	8.1	0.804	11.4	1.505	11.9	1.631	11.5	1.565	11.9	1.651	12.0	1.683	9.2	0.989
:15	8.3		11.5		11.9		11.5		12.1		12.2		8.9	
:30	8.2		11.4		11.9		11.8		12.0		12.2		9.1	
:45	8.2		11.4		12.0		11.9		12.1		12.1		9.4	
15:00	8.2	0.807	11.2	1.450	12.2	1.625	11.8	1.522	12.0	1.634	12.2	1.602	9.1	0.949
:15	8.1		11.4		12.3		11.5		11.9		12.0		9.1	
:30	8.5		11.1		11.9		11.3		11.7		11.5		8.9	
:45	8.2		11.1		11.3		11.4		12.2		11.5		8.8	
16:00	8.7	0.812	11.1	1.440	11.3	1.447	11.5	1.418	11.4	1.512	11.5	1.497	9.0	0.943
:15	8.2		11.1		11.1		11.3		11.5		11.5		8.9	
:30	8.1		11.1		11.1		11.1		11.5		11.4		8.9	
:45	8.1		11.3		11.3		10.4		11.4		11.3		--	
17:00	8.1	0.781	11.4	1.408	11.1	1.372	10.6	1.363	11.3	1.466	11.3	1.412	9.0	0.943
:15	8.1		11.5		10.9		11.1		11.0		11.3		8.9	
:30	8.1		10.6		11.0		11.1		11.4		10.7		8.9	
:45	8.1		10.7		10.5		10.6		11.4		10.8		8.9	
18:00	8.1	0.781	10.6	1.180	10.4	1.190	10.0	1.126	10.8	1.276	10.7	1.308	9.7	1.115
:15	8.2		10.3		10.0		9.9		10.7		11.1		9.8	
:30	8.1		9.6		10.3		9.8		10.4		10.4		9.8	
:45	8.1		9.6		9.7		9.5		10.0		10.2		9.8	
19:00	8.0	0.752	9.6	1.053	10.0	1.111	9.0	0.996	9.9	1.113	9.8	1.117	8.9	0.915
:15	8.0		9.4		9.7		9.0		9.8		9.9		8.8	
:30	8.1		9.5		9.5		9.0		9.6		9.7		8.7	
:45	7.8		9.3		9.7		9.7		9.6		9.6		8.8	
20:00	7.8	0.722	9.3	1.026	9.6	0.970	9.3	0.983	9.4	0.985	9.3	0.979	8.1	0.778
:15	7.6		9.1		9.0		9.3		9.2		9.1		8.1	
:30	7.9		9.5		8.9		9.0		9.1		9.0		8.1	
:45	7.8		9.4		8.9		8.9		8.9		9.1		8.1	
21:00	7.8	0.711	9.0	0.927	8.8	0.923	8.8	0.889	9.1	0.963	9.0	0.923	7.9	0.754
:15	7.8		8.9		9.0		8.7		9.0		8.9		8.0	
:30	7.6		8.8		8.8		8.5		9.0		8.8		8.0	
:45	7.8		8.8		8.8		8.7		9.1		8.7		8.0	
22:00	7.4	0.706	8.3	0.809	8.6	0.884	8.3	0.849	8.9	0.931	8.6	0.903	8.0	0.751
:15	7.8		8.2		8.5		8.5		8.9		8.9		7.8	
:30	7.8		8.2		8.6		8.4		8.9		8.9		8.0	
:45	7.8		8.3		8.8		8.6		8.9		8.6		7.9	
23:00	7.5	0.717	8.1	0.796	8.8	0.867	8.1	0.849	8.7	0.901	8.9	0.886	8.2	0.789
:15	7.9		8.2		8.7		8.3		8.6		8.6		8.0	
:30	7.9		8.3		8.6		8.7		8.9		8.6		8.3	
:45	7.8		8.1		8.1		8.7		8.7		8.5		8.1	
TOT RAIN:		0.00		0.00		0.00		0.00		0.69		0.00		0.00
TOT FLOW:		0.764		1.084		1.165		1.123		1.182		1.146		0.882
MMIN FLW:	7:15	0.627	0:30	0.668	5:15	0.731	2:15	0.752	2:30	0.647	4:15	0.675	5:45	0.627
MIN FLOW:	7:15	0.627	0:30	0.668	5:15	0.731	2:15	0.752	2:30	0.647	4:15	0.675	5:45	0.627
MAX FLOW:	12:00	0.943	14:15	1.531	15:15	1.728	12:00	1.698	11:30	1.819	14:15	1.708	8:15	1.126

DEPTH SENSOR USED: Ultrasonic

ID 1: DOOLEY @ FARMERS BRANCH CREEK
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 24.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 2.041
MUD: 0.13

PROJECT: FARMBRAN
SITE: RH03
RAIN GAUGE: RG01
PEAK CAPACITY: 4.197

	SUNDAY 7/8/90		MONDAY 7/9/90		TUESDAY 7/10/90		WEDNESDAY 7/11/90		THURSDAY 7/12/90		FRIDAY 7/13/90		SATURDAY 7/14/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
0:00	8.4	0.859	8.0	0.724	8.1	0.774	8.1	0.774	8.5	0.782	8.2	0.813	8.7	0.828
:15	8.8		7.8		8.0		8.0		8.1		8.2		8.4	
:30	8.6		7.5		8.1		8.1		7.8		8.3		8.1	
:45	8.2		7.9		8.1		8.0		8.0		8.3		8.1	
1:00	8.1	0.781	7.7	0.712	8.2	0.778	8.1	0.794	8.1	0.742	8.3	0.811	8.1	0.774
:15	8.2		7.5		8.1		8.4		7.8		8.3		8.0	
:30	8.1		7.9		8.0		8.0		8.0		8.3		8.1	
:45	8.1		7.8		8.1		8.1		7.8		8.2		8.1	
2:00	7.9	0.734	7.9	0.752	8.0	0.769	8.1	0.767	7.5	0.692	8.3	0.791	8.2	0.748
:15	7.9		8.1		8.0		8.0		7.6		8.1		8.0	
:30	7.8		7.9		8.2		8.0		7.4		8.1		8.0	
:45	7.8		7.9		7.9		8.0		8.0		8.1		7.5	
3:00	7.4	0.647	8.0	0.743	8.0	0.795	8.3	0.798	8.0	0.789	8.1	0.776	7.6	0.678
:15	7.4		7.8		8.0		8.0		8.0		8.1		7.5	
:30	7.4		7.8		8.5		8.1		8.6		8.1		7.5	
:45	7.4		8.0		8.1		8.3		8.1		8.0		7.5	
4:00	7.4	0.637	7.8	0.736	8.1	0.778	8.1	0.791	8.1	0.774	7.7	0.699	7.4	0.671
:15	7.3		7.8		8.1		8.4		8.1		7.5		7.4	
:30	7.3		8.0		8.1		8.1		8.1		7.5		7.8	
:45	7.3		8.0		8.1		8.1		8.1		7.9		7.4	
5:00	7.4	0.663	8.0	0.767	8.0	0.749	8.4	0.798	8.0	0.758	7.8	0.758	7.6	0.673
:15	7.3		8.0		7.8		8.1		8.1		8.0		7.8	
:30	7.4		8.1		8.0		8.1		7.9		8.0		7.4	
:45	7.8		8.1		7.9		8.2		8.0		8.1		7.2	
6:00	7.9	0.698	8.0	0.751	8.0	0.761	8.5	0.785	8.0	0.763	8.0	0.767	7.2	0.752
:15	7.9		7.9		8.0		8.0		8.1		8.0		8.2	
:30	7.4		7.9		8.1		8.0		8.1		8.1		8.1	
:45	7.3		8.0		8.0		8.1		7.9		8.0		8.2	
7:00	7.4	0.689	8.1	0.908	8.7	1.037	8.3	0.969	0.05 8.1	0.979	8.7	0.924	9.0	1.069
:15	7.2		8.6		9.1		8.9		0.38 8.9		8.7		9.8	
:30	7.9		8.6		9.6		9.5		0.09 9.1		8.5		9.7	
:45	7.9		9.6		10.0		9.5		0.04 10.3		9.5		9.6	
8:00	7.5	0.724	9.6	1.104	10.4	1.363	9.8	1.233	0.04 11.0	1.469	9.7	1.244	9.7	1.034
:15	8.0		9.6		10.5		10.4		0.05 11.3		10.4		9.8	
:30	7.8		9.7		11.1		10.4		0.02 11.4		10.6		9.1	
:45	7.9		9.8		11.3		10.5		0.01 11.5		10.7		8.9	
9:00	7.9	0.765	10.4	1.319	11.1	1.529	11.0	1.447	11.5	1.544	10.7	1.368	8.9	0.959
:15	7.9		10.5		11.4		11.1		11.5		10.6		9.0	
:30	8.1		10.7		11.5		11.3		0.01 11.4		10.7		9.1	
:45	8.1		11.1		12.0		11.4		12.0		11.3		9.0	
10:00	8.1	0.830	11.2	1.486	12.2	1.698	11.8	1.612	12.1	1.696	11.2	1.481	8.9	0.945
:15	8.4		11.5		12.2		11.9		12.2		11.3		8.7	
:30	8.2		11.5		12.2		12.0		12.2		11.4		9.0	
:45	8.7		11.2		12.2		11.9		12.3		11.4		9.1	
11:00	8.7	0.890	11.1	1.452	12.1	1.673	11.4	1.524	12.2	1.728	11.5	1.587	8.9	1.006
:15	8.4		11.4		12.1		11.1		12.2		11.8		9.2	
:30	8.7		11.2		12.1		11.9		12.7		12.0		9.4	
:45	8.9		11.1		12.2		11.7		12.2		11.9		9.4	

ID 1: DOOLEY @ FARMERS BRANCH CREEK
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 24.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 2.041
MUD: 0.13

PROJECT: FARMBRAN
SITE: RH03
RAIN GAUGE: RG01
PEAK CAPACITY: 4.197

	SUNDAY 7/15/90		MONDAY 7/16/90		TUESDAY 7/17/90		WEDNESDAY 7/18/90		THURSDAY 7/19/90		FRIDAY 7/20/90		SATURDAY 7/21/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
0:00	8.0	0.760	7.4	0.724	8.1	0.767	8.3	0.800	8.9	0.872	8.4	0.794	8.1	0.785
:15	7.9		7.8		7.9		8.3		8.6		8.1		8.2	
:30	8.0		8.0		8.1		8.1		8.5		8.1		8.1	
:45	8.1		8.0		8.1		8.1		8.3		8.1		8.0	
1:00	7.8	0.684	8.0	0.756	8.1	0.746	8.1	0.791	8.5	0.824	8.1	0.751	8.1	0.758
:15	7.4		8.1		8.0		8.1		8.3		7.8		8.1	
:30	7.5		7.9		8.0		8.1		8.2		8.0		8.0	
:45	7.5		7.9		7.6		8.2		8.3		7.9		7.8	
2:00	7.3	0.718	8.0	0.758	7.8	0.763	8.2	0.793	8.2	0.781	7.6	0.744	7.8	0.745
:15	7.6		8.0		8.1		8.3		8.1		8.1		8.0	
:30	8.0		8.0		8.1		8.1		8.1		7.8		8.0	
:45	8.1		7.9		8.0		8.1		8.0		8.1		7.9	
3:00	8.1	0.740	8.0	0.769	8.0	0.731	8.0	0.735	8.1	0.754	8.1	0.778	7.7	0.675
:15	8.1		8.0		8.0		8.0		7.8		8.0		7.4	
:30	7.9		8.1		8.0		7.9		8.0		8.1		7.5	
:45	7.4		8.1		7.4		7.6		8.0		8.1		7.4	
4:00	7.7	0.670	8.1	0.758	7.9	0.710	7.6	0.726	7.8	0.720	8.1	0.774	7.6	0.692
:15	7.4		8.0		7.7		8.0		8.0		8.1		7.4	
:30	7.4		7.9		7.8		7.7		7.6		8.0		7.7	
:45	7.4		7.9		7.5		8.0		7.8		8.1		7.8	
5:00	7.8	0.703	7.8	0.753	7.5	0.641	7.7	0.712	8.3	0.747	8.1	0.729	8.0	0.765
:15	8.0		7.9		7.4		7.5		8.0		8.0		8.1	
:30	7.5		8.1		7.3		7.8		7.7		7.5		7.9	
:45	7.5		8.1		7.1		8.0		7.8		7.8		8.0	
6:00	7.9	0.675	8.0	0.752	7.0	0.622	8.2	0.778	8.0	0.758	7.4	0.679	7.8	0.743
:15	7.3		7.8		7.3		8.1		8.0		7.4		8.0	
:30	7.4		0.01 8.0		7.2		8.0		8.0		7.4		7.9	
:45	7.5		0.14 8.0		7.4		8.0		8.0		7.9		7.9	
7:00	7.3	0.719	0.04 8.1	0.910	7.8	0.902	8.1	0.951	8.1	0.958	8.2	0.925	8.2	0.824
:15	7.4		8.3		8.3		8.8		8.9		8.7		8.5	
:30	7.4		9.0		9.0		9.3		9.2		8.9		8.4	
:45	8.8		9.6		9.7		9.6		9.8		9.6		8.3	
8:00	9.3	0.963	10.0	1.163	10.1	1.228	9.9	1.230	9.9	1.239	9.8	1.206	8.3	0.804
:15	8.9		10.2		0.01 10.3		10.4		10.3		9.9		8.1	
:30	9.0		9.9		10.2		10.4		10.5		10.5		8.3	
:45	8.9		9.8		10.5		10.4		10.5		10.4		8.2	
9:00	9.1	0.929	10.0	1.275	10.5	1.378	10.6	1.330	10.3	1.382	10.6	1.446	8.1	0.886
:15	8.8		10.5		10.4		10.6		10.8		11.4		8.8	
:30	8.9		10.6		11.3		10.7		11.1		11.4		8.9	
:45	8.8		10.7		11.4		11.0		11.4		11.4		8.8	
10:00	8.8	0.849	10.9	1.443	11.4	1.558	11.1	1.488	12.0v	1.449	11.9	1.580	8.9	0.925
:15	8.6		11.2		11.8		11.4		12.0v		12.1v		8.9	
:30	8.3		11.3		11.5		11.4		12.0v		11.7		8.7	
:45	8.1		11.3		11.9		11.5		11.6v		11.9		8.9	
11:00	8.3	0.868	11.5	1.493	11.9	1.593	11.7	1.519	12.0v	1.485	11.7	1.574	8.8	0.937
:15	8.6		11.3		12.0v		12.0v		12.1v		11.9		9.0	
:30	8.7		11.4		11.9		12.2v		12.2v		12.0v		8.8	
:45	8.7		11.3		11.9		12.2v		12.1v		11.9		9.0	

	SUNDAY 7/22/90			MONDAY 7/23/90			TUESDAY 7/24/90			WEDNESDAY 7/25/90			THURSDAY 7/26/90			FRIDAY 7/27/90			SATURDAY 7/28/90	
	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)
12:00		8.0	0.789		12.2v	1.511		12.3v	1.549		12.7v	1.549		11.5	1.551		11.6	1.522		9.6	1.093
:15		8.2			12.1v			12.6v			12.4v			11.9			11.6			9.5	
:30		8.2			11.4			12.4v			12.2v			11.5			11.4			9.8	
:45		8.1			12.0v			12.2v			12.1v			11.5			11.4			9.7	
13:00		8.3	0.776		11.4	1.498		12.2v	1.491		12.1v	1.496		11.3	1.497		11.4	1.541		9.6	1.049
:15		8.1			11.5			12.3v			12.0v			11.4			11.6			9.2	
:30		8.0			11.5			12.2v			12.0v			11.4			11.4			9.5	
:45		8.0			12.0v			12.1v			12.1v			11.5			11.9			9.6	
14:00		8.1	0.767		12.0v	1.528	0.11	12.2v	1.533		12.1v	1.541		11.7	1.557		11.7	1.604		9.1	0.985
:15		8.0			12.1v		0.01	12.2v			12.3v			12.2v			11.9			9.0	
:30		8.0			11.9			12.2v			12.2v			11.6			11.9			9.4	
:45	0.10	8.0			12.1v			12.4v			12.4v			11.7			11.9			9.1	
15:00		7.9	0.749		12.0v	1.554		12.2v	1.518		12.2v	1.522		12.2v	1.520		11.7	1.547		9.0	1.006
:15		8.0			12.0v			12.3v			12.2v			11.7			12.3v			9.5	
:30	0.03	7.8			11.7			12.2v			12.1v			11.5			11.7			9.5	
:45		8.1			11.9			12.2v			12.3v			11.4			11.5			8.9	
16:00		8.1	0.774		--	1.470		12.0v	1.513		11.7	1.548		11.4	1.471		11.4	1.476		9.1	0.949
:15		8.1			11.3			11.5			12.0v			11.5			11.4			8.9	
:30		8.0			11.3			11.5			11.9			11.4			11.2			8.9	
:45		8.1			11.2			11.5			11.5			10.9			11.2			8.9	
17:00		8.2	0.763		11.5	1.378		11.5	1.495		11.6	1.502		11.2	1.389		10.7	1.321		9.0	0.957
:15		8.0			10.8			11.5			11.5			11.1			10.8			8.9	
:30		8.0			11.0			11.3			11.3			10.7			10.6			8.9	
:45		7.8			10.4			11.4			11.3			10.7			10.5			9.1	
18:00		8.0	0.765		9.8	1.108		11.1	1.361		11.1	1.245		10.5	1.197		10.4	1.163		8.8	0.898
:15		8.0			9.8			11.1			10.4			10.3			9.9			8.9	
:30		8.1			9.7			10.7			9.9			9.8			9.8			8.9	
:45		8.0			9.6			10.4			9.9			9.9			9.8			8.3	
19:00		8.1	0.736		9.3	1.004		10.4	1.199		9.9	1.165		9.8	1.100		9.4	1.016		8.7	0.853
:15		7.9			9.0			10.0			9.8			9.8			9.1			8.7	
:30		7.9			9.0			9.8			10.2			9.3			9.1			8.3	
:45		7.6			9.6			10.3			10.0			9.8			9.6			8.2	
20:00		7.8	0.767		8.9	0.933		10.3	1.131		9.7	1.098		9.6	1.066		9.1	0.973		8.1	0.776
:15		8.0			8.9			9.8			9.6			9.3			9.1			8.0	
:30		8.1			8.9			9.6			9.7			9.6			9.0			8.1	
:45		8.2			8.8			9.6			9.7			9.5			9.1			8.1	
21:00		7.9	0.749		8.7	0.826		9.2	0.979		9.1	0.985		9.1	0.965		8.9	0.931		8.1	0.811
:15		8.1			8.2		0.01	9.3			9.1			9.1			8.9			8.2	
:30		7.9			8.2			8.9			9.4			9.0			9.0			8.2	
:45		7.8			8.2			9.0			8.9			9.0			8.7			8.5	
22:00		7.9	0.767		8.7	0.827		9.0	0.971		9.1	0.989		9.1	0.981		8.9	0.907		8.3	0.785
:15		8.0			8.2			9.1			9.3			9.3			8.7			8.1	
:30		8.0			8.3			9.0			9.1			9.1			8.7			8.0	
:45		8.2			8.1			9.3			9.2			9.1			8.8			8.1	
23:00		8.1	0.776		8.7	0.849		9.0	0.945		8.9	0.939		9.1	0.973		8.8	0.884		8.1	0.785
:15		8.1			8.7			9.0			9.0			9.1			8.7			8.1	
:30		8.1			8.2			9.0			8.9			9.1			8.5			8.1	
:45		8.0			8.2			8.9			8.9			9.1			8.6			8.1	
TOT RAIN:			0.13			0.16			0.14			0.03			0.00			0.00			0.00
TOT FLOW:			0.739			1.108			1.148			1.163			1.158			1.136			0.857
AMMIN FLW:		2:30	0.634		2:00	0.675		5:45	0.647		3:45	0.760		3:45	0.774		5:15	0.703		3:45	0.634
MIN FLOW:		2:30	0.634		2:00	0.675		5:45	0.647		3:45	0.760		3:45	0.774		5:15	0.703		3:45	0.634
MAX FLOW:		10:30	0.872		14:30	1.629		12:15	1.599		16:30	1.629		12:15	1.619		9:45	1.629		12:30	1.126

DEPTH SENSOR USED: Ultrasonic

ID 1: DOOLEY @ FARMERS BRANCH CREEK
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 24.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 2.041
MUD: 0.13

PROJECT: FARMBRAN
SITE: RH03
RAIN GAUGE: RG01
PEAK CAPACITY: 4.197

	SUNDAY 7/29/90		MONDAY 7/30/90		TUESDAY 7/31/90		WEDNESDAY 8/1/90		THURSDAY 8/2/90		FRIDAY 8/3/90		SATURDAY 8/4/90	
	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)	RAIN DEPTH (in)	FLOW (mgd)
0:00	8.1	0.778	8.1	0.772	8.1	0.778	8.5	0.849	8.8	0.829	8.6	0.876	8.8	0.903
:15	8.1		8.1		8.1		8.7		8.3		8.6		8.9	
:30	8.1		8.0		8.1		8.4		8.1		8.6		8.8	
:45	8.0		8.0		8.0		8.3		8.1		8.5		8.5	
1:00	8.0	0.728	8.0	0.740	8.1	0.763	8.2	0.819	8.1	0.783	8.7	0.853	8.7	0.870
:15	8.1		8.0		8.0		8.2		8.1		8.5		8.4	
:30	7.8		7.8		8.1		8.5		8.1		8.6		8.6	
:45	7.4		7.8		7.8		8.3		8.1		8.1		8.6	
2:00	7.5	0.669	7.9	0.719	7.8	0.731	8.3	0.813	8.1	0.785	8.1	0.761	8.1	0.756
:15	7.4		8.0		7.8		8.3		8.1		8.1		7.9	
:30	7.6		7.7		7.9		8.3		8.1		8.0		8.0	
:45	7.4		7.4		7.8		8.2		8.1		7.8		7.8	
3:00	7.4	0.673	7.4	0.652	7.8	0.751	8.1	0.774	8.5	0.834	7.8	0.731	8.0	0.740
:15	7.6		7.4		8.1		8.1		8.1		7.8		7.8	
:30	7.7		7.4		7.9		8.1		8.2		7.9		7.8	
:45	7.3		7.4		8.0		8.0		8.6		7.9		7.9	
4:00	7.2	0.634	7.4	0.708	7.8	0.761	8.0	0.713	8.7	0.846	7.7	0.753	7.9	0.706
:15	7.3		7.6		8.0		7.6		8.7		8.1		7.7	
:30	7.3		8.0		8.0		7.7		8.3		8.1		7.8	
:45	7.3		7.8		8.2		7.6		8.1		7.9	0.01	7.4	
5:00	7.4	0.642	7.8	0.747	8.0	0.754	7.8	0.703	7.9	0.769	8.0	0.758	7.4	0.701
:15	7.2		7.8		8.1		7.9		8.0		7.8		7.8	
:30	7.3		8.1		8.0		7.7		8.2		8.0	0.01	7.8	
:45	7.4		8.0		7.8		7.3		8.1		8.1	0.07	7.6	
6:00	7.4	0.652	8.0	0.761	7.8	0.743	7.3	0.693	8.1	0.771	8.6	0.828	7.8	0.799
:15	7.4		8.1		8.0		7.4		8.1		8.1	0.01	8.1	
:30	7.4		8.0		7.8		7.8		8.0		8.2		8.1	
:45	7.3		8.0		8.1		8.0		8.1		8.5		8.7	
7:00	7.4	0.666	8.3	0.919	8.3	0.948	8.1	0.956	8.7	0.976	8.9	1.028	0.12 --	1.078
:15	7.4		8.7		8.9		9.1		8.9		9.0	0.01	8.8	
:30	7.4		8.6		9.1		9.0		9.1		9.6	0.01	9.6	
:45	7.7		9.6		9.5		9.8		9.6		9.8	0.07	10.4	
8:00	7.4	0.721	9.6	1.164	9.8	1.262	10.4	1.266	9.7	1.253	10.4	1.368	0.02 10.4	1.135
:15	7.6		9.8		10.6		10.4		10.7		10.6	0.03	9.7	
:30	8.0		10.3		10.5		10.5		10.5		11.1	0.01	9.6	
:45	8.1		10.2		10.7		10.4		10.6		11.3		9.6	
9:00	8.1	0.787	10.5	1.335	10.6	1.399	11.1	1.372	10.5	1.373	11.2	1.495	9.7	1.135
:15	8.1		10.7		10.8		10.9		10.6		11.2	0.02	10.3	
:30	8.1		10.5		11.5		10.7		11.1		11.3	0.05	9.7	
:45	8.1		11.2		--		10.7		11.3		11.9	0.01	9.7	
10:00	8.3	0.832	11.1	1.500	11.5	1.507	11.1	1.464	11.2	1.483	12.1v	1.510	0.03 9.6	1.215
:15	8.6		11.4		12.0v		11.1		11.4		12.1v	0.03	10.2	
:30	8.3		11.5		12.0v		11.3		11.3		12.2v	0.01	10.4	
:45	8.2		11.7		12.1v		11.4		11.5		12.3v		10.5	
11:00	8.4	0.886	11.8	1.543	12.1v	1.530	11.4	1.498	11.9	1.529	12.2v	1.575	10.4	1.243
:15	8.9		12.0v		11.6		11.5		11.5		12.3v		10.4	
:30	8.7		11.7		11.5		12.0v		11.5		12.9v		10.2	
:45	8.7		12.0v		11.7		12.0v		11.3		12.8v		10.4	

	SUNDAY 7/29/90			MONDAY 7/30/90			TUESDAY 7/31/90			WEDNESDAY 8/1/90			THURSDAY 8/2/90			FRIDAY 8/3/90			SATURDAY 8/4/90		
	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)
12:00		8.6	0.911		12.1v	1.546		11.9	1.550		12.2v	1.541		11.4	1.490		12.3v	1.498		10.6	1.259
:15		8.7			12.2v			12.0v			12.0v			11.5			12.2v			10.5	
:30		8.9			11.9			11.7			11.5			11.4			12.1v			10.3	
:45		8.9			12.0v			12.0v			11.8			11.2			12.0v			10.3	
13:00		8.7	0.876		11.3	1.498		11.7	1.527		11.5	1.524		11.3	1.515		12.0v	1.471		9.7	1.184
:15		8.7			11.5			12.0v			11.6			11.3			12.0v			9.7	
:30		8.7			11.4			12.0v			11.5			11.4			12.0v			10.4	
:45		8.3			12.0v			12.1v			12.1v			11.9			12.1v			10.4	
14:00		8.1	0.785		12.0v	1.498		12.3v	1.516		12.3v	1.542		12.0v	1.572		12.1v	1.539		10.2	1.161
:15		8.1			12.0v			12.1v			12.4v			11.9			12.2v			9.8	
:30		8.1			11.5			12.1v			12.3v			11.8		0.57	12.4v			9.8	
:45		8.1			11.3			12.0v			12.2v			11.8			12.8v			10.0	
15:00		8.1	0.802		11.3	1.500		12.2v	1.516		12.3v	1.561		11.5	1.517		12.6v	1.520		9.6	1.098
:15		8.3			11.5			12.0v			12.1v			11.8			12.2v			9.7	
:30		8.2			11.4			11.5			12.1v			11.4			12.2v			9.8	
:45	0.02	8.2			11.5			11.4			11.9			11.3		0.01	12.1v			9.5	
16:00	0.05	8.1	0.789		11.5	1.462		11.6	1.505		11.4	1.502		11.2	1.410		12.2v	1.527		9.6	1.072
:15		8.1			11.5			11.5			11.5			11.1			12.2v			9.6	
:30		8.3			11.3			11.3			11.6			11.0			12.0v			9.4	
:45		8.1			10.7			11.3			11.1			10.8			11.6			9.5	
17:00		8.1	0.763		11.3	1.375		11.3	1.457		11.2	1.405		10.9	1.340		11.8	1.463		9.7	1.111
:15		8.0			10.7			11.2			11.2			10.9			11.4			9.7	
:30		8.0			10.7			11.1			10.6			10.4			11.2			9.9	
:45		7.9			10.9			11.3			11.0			10.7			10.6			9.6	
18:00		8.0	0.769		10.5	1.251		10.7	1.300		10.6	1.204		10.3	1.201		10.5	1.219		9.5	1.051
:15		8.0			10.5			10.7			10.4			10.3			10.4			9.5	
:30		8.0			10.6			10.5			9.9			9.8			10.1			9.4	
:45		8.2			9.8			10.4			9.6			10.2			9.8			9.4	
19:00		8.1	0.763		9.9	1.084		9.9	1.040		9.6	1.039		9.6	1.057		9.8	1.161		9.4	1.012
:15		8.1			9.8			9.5			9.5			9.4			10.4			9.6	
:30		7.9			9.6			9.0			9.2			9.5			9.8			9.2	
:45		7.8			9.1			9.2			9.3			9.5			9.8			8.9	
20:00		8.0	0.754		9.1	0.933		9.1	0.985		9.5	1.068		9.3	1.053		9.6	1.080		8.8	0.929
:15		8.0			9.1			9.1			9.6			9.4			10.1			9.0	
:30		7.9			8.9			9.2			9.6			9.6			9.6			8.9	
:45	0.11	8.0			8.4			9.2			9.4			9.6			9.0			8.8	
21:00	0.33	7.8	0.737		8.7	0.919		9.3	0.957		9.0	0.955		9.5	1.032		9.0	0.963		8.9	0.927
:15	0.15	7.6			8.9			8.9			9.0		0.01	9.4			9.2			8.8	
:30	0.02	8.1			8.9			8.9			9.1		0.05	9.3			9.1			8.9	
:45		8.0			8.9			8.9			8.9		0.05	9.3			8.9			8.9	
22:00		7.9	0.742		8.8	0.895		8.9	0.947		9.0	0.939	0.02	8.9	0.967		8.9	0.955		8.9	0.919
:15		7.8			8.7			8.9			8.9		0.01	8.9			9.2			8.9	
:30		7.9			8.9			9.0			8.8		0.01	9.4			8.9			8.9	
:45		8.0			8.4			8.9			9.0			9.1			9.0			8.6	
23:00		8.0	0.774		8.5	0.878		9.3	0.963		8.9	0.935		9.1	0.981		8.8	0.957		8.6	0.897
:15		8.1			8.4			9.0			8.9			9.0			9.3			8.7	
:30		8.1			8.8			9.0			9.0			9.4			9.0			8.8	
:45		8.1			8.7			8.8			8.7			8.9			8.9			8.7	
TOT RAIN:			0.68			0.00			0.00			0.00			0.15			0.58			0.53	
TOT FLOW:			0.756			1.100			1.130			1.131			1.140			1.162			0.995	
AMMIN FLW:		4:00	0.620		3:00	0.647		2:15	0.717		6:00	0.634		5:00	0.745		4:00	0.703		5:00	0.647
MIN FLOW:		4:00	0.620		3:00	0.647		2:15	0.717		6:00	0.634		5:00	0.745		4:00	0.703		5:00	0.647
MAX FLOW:		12:30	0.943		12:30	1.629		12:00	1.629		15:45	1.619		11:00	1.609		11:30	1.631		12:00	1.296

DEPTH SENSOR USED: Ultrasonic

ID 1: DOOLEY @ FARMERS BRANCH CREEK
ID 2: FARMERS BRANCH, TEXAS
BASIN: RAWHIDE CREEK

PIPE DIAMETER: 24.000
PIPE SHAPE: CIRCULAR
ENERGY GRADIENT: 2.041
MUD: 0.13

PROJECT: FARMBRAN
SITE: RH03
RAIN GAUGE: RG01
PEAK CAPACITY: 4.197

	SUNDAY 8/5/90			MONDAY 8/6/90														
	RAIN DEPTH (in)	(in)	FLOW (mgd)	RAIN DEPTH (in)	(in)	FLOW (mgd)	RAIN DEPTH (in)	(in)	FLOW (mgd)	RAIN DEPTH (in)	(in)	FLOW (mgd)	RAIN DEPTH (in)	(in)	FLOW (mgd)	RAIN DEPTH (in)	(in)	FLOW (mgd)
0:00		8.8	0.886		9.0	0.937												
:15		8.7			8.9													
:30		8.7			8.9													
:45		8.4			8.9													
1:00		8.3	0.826		8.9	0.933												
:15		8.7			8.9													
:30		8.2			8.9													
:45		8.2			8.9													
2:00		8.1	0.778		8.9	0.937												
:15		8.1			8.9													
:30		8.1			8.9													
:45		8.1			8.9													
3:00		8.1	0.760		8.9	0.933												
:15		8.0			8.9													
:30		7.9			8.9													
:45		8.0			8.9													
4:00		7.8	0.742		8.9	0.903												
:15		7.8			8.9													
:30		8.0			8.7													
:45		7.9			8.5													
5:00		8.0	0.769		8.6	0.864												
:15		8.0			8.5													
:30	0.09	8.1			8.7													
:45		8.1			8.4													
6:00		8.0	0.781		8.7	0.907												
:15		8.2			8.7													
:30		8.1			8.9													
:45		8.1			8.8													
7:00		8.6	0.855		9.0	1.050												
:15		8.4			9.5													
:30		8.1			9.6													
:45	0.01	8.8			9.7													
8:00	0.01	8.8	0.896		10.4	1.342												
:15		8.9			10.7													
:30		8.8			10.7													
:45		8.3			11.3													
9:00		8.6	0.899		11.1	1.527												
:15		8.8			11.4													
:30		8.7			11.8													
:45		8.8			12.1v													
10:00		8.7	0.925		12.2v	1.588												
:15		8.9			12.2v													
:30		8.9			12.1v													
:45		8.9			12.2v													
11:00		8.9	0.973		12.3v	1.549												
:15		9.4			12.1v													
:30		9.0			12.1v													
:45		9.0			12.2v													

	SUNDAY 8/5/90			MONDAY 8/6/90																
	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)	RAIN (in)	DEPTH (in)	FLOW (mgd)
12:00		9.4	0.963		12.2v	1.541														
:15		9.1			12.2v															
:30		8.9			12.0v															
:45		8.7			12.0v															
13:00		8.8	0.933		12.0v	1.568														
:15		8.9			12.2v															
:30		9.0			12.2v															
:45		8.9			12.2v															
14:00		8.8	0.901		12.2v	1.531														
:15		8.7			12.2v															
:30		8.7			12.2v															
:45	0.01	8.7			12.2v															
15:00	0.08	10.3	1.144		12.3v	1.520														
:15	0.06	--			12.2v															
:30	0.03	9.6			12.2v															
:45	0.03	9.8			12.2v															
16:00		10.5	1.268		12.6v	1.561														
:15	0.01	10.5			12.2v															
:30	0.02	10.4			12.1v															
:45	0.02	10.4			12.1v															
17:00	0.01	9.9	1.130		11.4	1.483														
:15		9.9			11.4															
:30		9.7			11.5															
:45		9.8			11.1															
18:00		9.6	1.087		10.4	1.246														
:15		9.7			10.4															
:30		9.6			10.6															
:45		9.6			9.9															
19:00		9.6	1.093		9.6	1.104														
:15		9.8			9.7															
:30		9.6			9.6															
:45		9.5			9.8															
20:00		9.3	1.012		9.5	1.043														
:15		9.1			9.4															
:30		9.2			9.6															
:45		9.5			9.3															
21:00		9.0	0.992		9.0	0.959														
:15		9.1			8.9															
:30		9.1			9.1															
:45		9.5			9.0															
22:00		9.5	1.062		9.0	0.947														
:15		9.5			9.0															
:30		9.5			8.9															
:45		9.5			8.9															
23:00		8.9	0.943		8.9	0.931														
:15		8.9			8.9															
:30		8.9			8.9															
:45		8.9			8.8															
TOT RAIN:			0.38			0.00														
TOT FLOW:			0.940			1.204														
AMMIN FLW:		4:00	0.731		5:45	0.841														
MIN FLOW:		4:00	0.731		5:45	0.841														
MAX FLOW:		16:00	1.277		10:45	1.663														

DEPTH SENSOR USED: Ultrasonic