# Large Scale Rainwater Collection at Texas Public Schools

## Bandera High School
## Bandera, Texas
## 2014


18 1:08PM


10 10:38AM


17 4:16PM


14 3:02PM


22 1:28PM


24 1:38PM

# Large-Scale Rainwater Harvesting at Texas Public Schools

Bandera High School, Bandera, Texas

Gary Bitzkie, Principal
Regina Howell, Superintendent

A project of the Architectural Drafting Class at Bandera High School 2013-14
Partially funded by a grant from the Hill Country Alliance

## Acknowledgements and Thankyous

Over the course of the last 4 years the following people and organizations provided help in time, money and expertise as we carried out this project: Hal & Charlie Peterson Foundation; LCRA; Bandera ISD Foundation; Bandera Electric Coop; D'Spain's Sales and Service; Bandera True Value Hardware; Alex Garza, Irrigation Consultant; Raba-Kistner Civil Engineers; Mel Danysh, Structural Engineer; Hevenor Lumber Co.; Hill Country Alliance; David Jeffery and Roy Chancey at the Bandera County River Authority and Groundwater District; John Paul Jones, Texas Watermaster; Chuck Wyatt, Rancher

# Table of Contents


| | | |
|---|---|---|
| Introduction | | |
| Chapter 1 | Bandera High School | Brad Flink, Teacher |
| Chapter 2 | Bandera Middle School | Tommy Garcia |
| Chapter 3 | Boerne High School | Bobby Ketterer |
| Chapter 4 | Fredericksburg High School | Matt King |
| Chapter 5 | Hondo High School | Dillon Vikari |
| Chapter 6 | Junction High School | Jamison Landolt |
| Chapter 7 | Leakey High School | Jonathon Skipper |
| Chapter 8 | Sabinal High School | Wyatt Clemenson |
| Chapter 9 | Southside High School | Greg Macias |
| Chapter 10 | Southwest High School | Tylor Perry |
| Chapter 11 | Tivy High School | Keano Jannell |
| Chapter 12 | Warren High School | Rachel Barker |

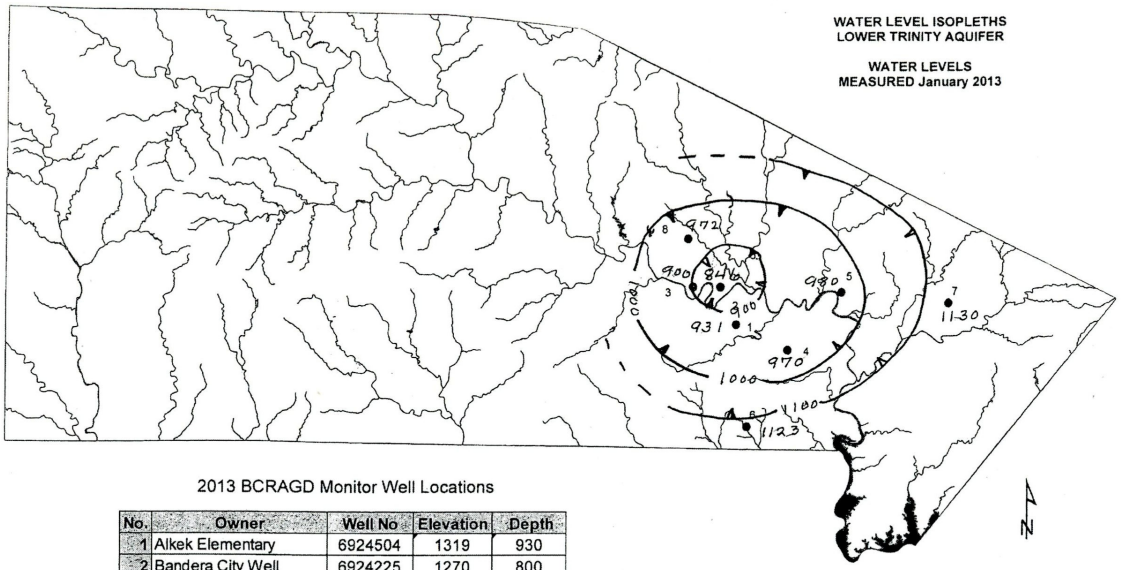

**Our objective:** Texas House Bill 3391 encourages school districts to implement rainwater harvesting systems. The purpose of this book is to share our experience and to encourage the conservation of water. We think our rainwater collection system is a good idea and we are imagining how it might be implemented at a variety of other schools. In 2013 Bandera received 22 inches of rainfall. We caught and sprayed onto the baseball field a half a million gallons of rainwater. That is approximately 5% of the total water pumped out of the aquifer that is used by the high school for all purposes during a year.

**Disclaimer:** We are not civil, structural or mechanical engineers. We are not plumbers, electricians or licensed irrigators. **We have consulted** with engineers, plumbers, licensed irrigators and others and have tried to build this system according the the best management practices. The information included in this book is to give you an idea of what is possible and what it cost us. (Remember, our only costs were for materials…no labor, overhead, taxes, insurance or profit.) If you want to build a system at your school, you will need to engage the help of several professionals to carry out the plans successfully. Brand names are given only to give you a starting place on building your own system.

## Introduction

- Bandera HS is one of 1445 high schools, 1591 middle schools and 4001 elementary schools in Texas[1]. Most of these schools have large roofs, large parking lots, and large areas of grass that need to be watered. Usually the water used for irrigating the athletic fields comes from the potable water supply for the school. **The idea of this project is to reduce the use of potable water by substituting minimally treated rainwater caught and stored on the site for irrigation.**

- Bandera High School has its "own" well and pumps its "own" water out of the Lower Trinity Aquifer. We use about 9,000,000 gallons per year (27.5 Acre-feet). Approximately half of this goes to irrigate athletic fields. David Jeffery, Geologist with the *Bandera County River Authority and Groundwater District* has drawn a map of the "cone of depression" in the aquifer (see figure below) surrounding the town of Bandera. The water coming out of the aquifer has been dated to thousands of years ago which indicates that the recharge is happening very slowly (like when it rains out by Ozona). When water is pumped under these conditions, we refer to it as "mining" "fossil water." It can be likened to pumping oil out of an oil well. The oil (or the water) does not get replenished in our era or epoch or eon or any time soon.

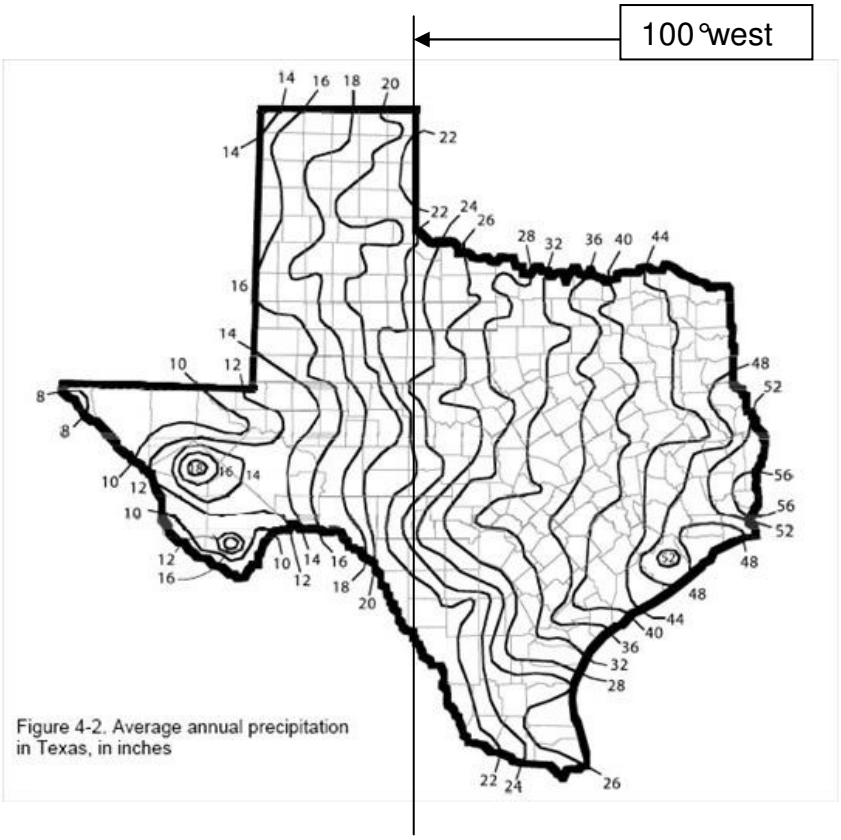



2013 BCRAGD Monitor Well Locations

| No. | Owner | Well No | Elevation | Depth |
|---|---|---|---|---|
| 1 | Alkek Elementary | 6924504 | 1319 | 930 |
| 2 | Bandera City Well | 6924225 | 1270 | 800 |
| 3 | Bandera Sports Cpx LT | 6924114 | 1264 | 870 |
| 4 | Bridlegate LT | 6924605 | 1308 | 940 |
| 5 | Cielo Rio Ranch | 6817112 | 1233 | 760 |
| 6 | Flying A | 6924809 | 1391 | |
| 7 | Latigo Ranch | 6817303 | 1538 | 1080 |
| 8 | TxDot | 6916702 | 1337 | 798 |

- They[2] say you cannot farm west of 100°W in the United States unless you irrigate your crop. In Bandera, grass will not stay green unless you irrigate it during the dry spells between rainfalls. Grass needs about one inch of water per week to stay green. That is about 50,000 gallons per week for our baseball field. We water our field three times per week spraying on about 1/3" each time. This is not the best way to water grass but it allows the field to be used on a daily basis.

Map from Texas Manual on Rainwater Harvesting[4]




- These "case studies" will examine other schools and their sites and propose designs for rainwater systems for their particular location and topography. We will try to do some economic evaluation based on the prices we paid for materials here at BHS and the dollar cost of water at the various other schools. One evaluation does not involve dollars but is important nevertheless. That is, how much water is there? We need to conserve water for the doubling of the population we are looking forward to in Central Texas[3] in the next fifty years.

## Chapter 1. Bandera High School by Brad Flink

### THE LOCATION

Bandera High School is a Class 3A high school with about 800 students. It is the only high school in the Bandera Independent School District. It sits just outside of the city limits of Bandera in Bandera County. It is in the Bandera County River Authority and Groundwater District and sits on top of the Lower Trinity Aquifer from which it draws its water. David Jeffery is the District Geologist.
It is in Region J of the Texas Water Development Board's Regional Water Planning Areas. Connie Townsend is the Regional Water Planner.
Bandera High School sits right next to the Medina River which flows into the San Antonio River which flows into San Antonio Bay.
Bandera H.S. is within the Hill Country Priority Groundwater Management Area as designated by the Texas Commission on Environmental Quality. Bandera H.S. is in the SouthTexas Watermaster Area, John Paul Jones is the Watermaster.
Bandera High School does not buy water from a supplier, it has its own well.

The electricity is supplied by the Bandera Electric Coop which buys it from the Lower Colorado River Authority.
Republic Services handles the trash disposal and any waste (silt) the tanks generate.

## THE NEED

Bandera High School sits at 99° west longitude. Our average rainfall is 26"/year. Our evaporation rate is 65"/year and the average length of drought in Bandera is 100 days[4]. When you are trying to capture and use rainwater…what really matters is the size of your collection area, the volume of your tanks, and how many times during the year the tanks will be filled or partially filled, and then sprayed out on the fields and then refilled again without overflowing. This is determined by rainfall amounts and the time between rainfalls. If the tank is too small and it overflows, you lose the chance of using that rainfall later. Another consideration is the hot sun. In May of 2012 we had three inches of rain. One week later we were spraying water on the field. A three inch rain does not eliminate the need for irrigation for the next three weeks. It means that our storage should be big enough to catch a two or three inch rain based on the size of catchment area we have, assuming the grass area is big enough to utilize the water.

Photo showing parking lot, channels, collector boxes, 12" and 15" pipes, tanks and pump house

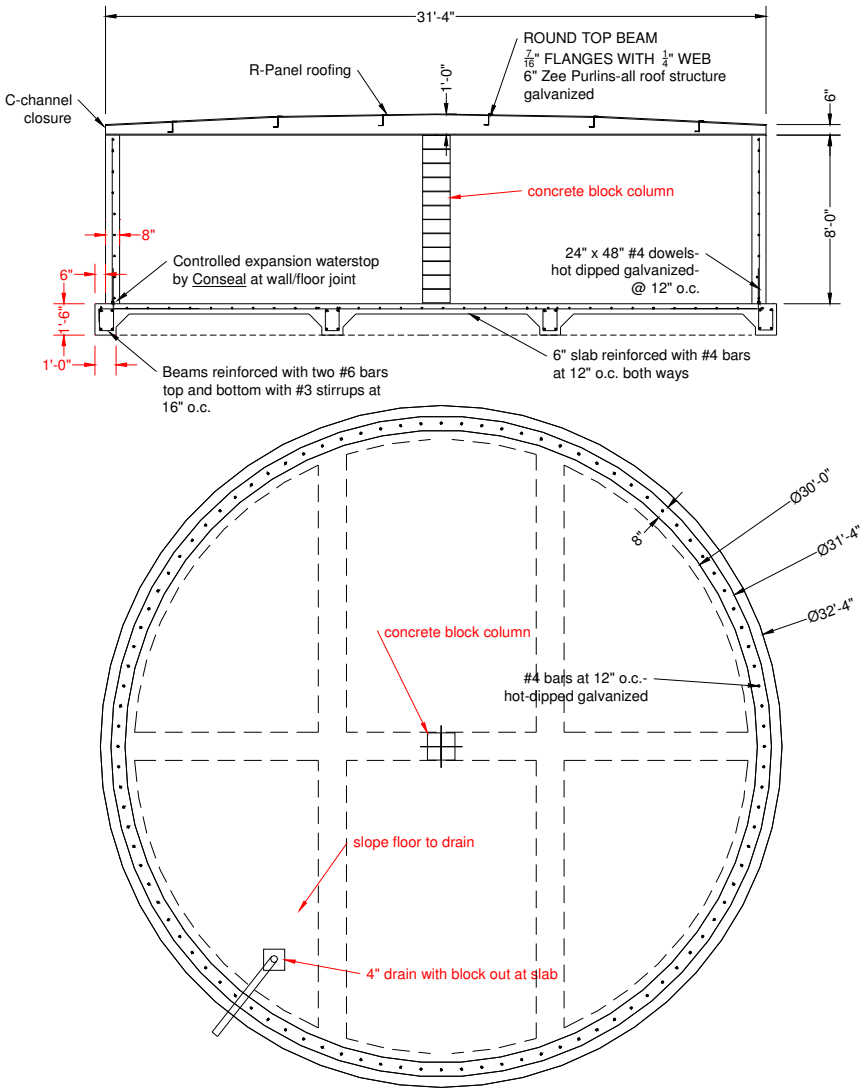
## THE SITE

Bandera High School is sited on a hilltop. Our building site is about 53 acres. The buildings are placed in the middle on the highest point, the parking lots are below the buildings and the fields are below the parking lots. This topography allowed us to place our tanks below the parking lots (and buildings) allowing rainwater to be collected from the roofs *and* parking and piped into the tanks through gravity flow. Not only were the elevations fortuitous, the existing ground at the bottom of the tank footings was a solid limestone ledge, level and at least one foot thick. This gives our tanks a non-moving foundation, hopefully minimizing future cracks and leaks. Different building sites will encounter different conditions.

Bandera High School is a campus of about six separate buildings. Total area of the roofs is 142,000 square feet. We have asphalt parking areas and roads totaling 258,000 sq.ft. We have four athletic fields

of the following sizes: football 100,000, baseball 114,000, practice 58,000 and softball 33,000. Total impervious area is 400,000 sq. ft. Total grass area is 305,000 sq. ft.

## THE RAINWATER COLLECTION SYSTEM




Tank floor plan and section

As of 2013 we have built two concrete tanks that each hold 42,000 gallons. We keep 1 ½ feet of water in the tanks which allows us to catch a about 70,000 gallons before they overflow. We catch water off of the faculty parking lot which is 60,000 s.f. A one-inch rain will generate (60,000s.f. x .6 gal/s.f.) 36,000 gallons. A two-inch rain will fill up both tanks. The tanks are hooked up to water the baseball field only. That amounts to almost two weeks of watering. The school also has a football, softball and practice field- therefore, we could use more tanks, pumps, and piping. We have plenty of collection area. Our system is designed to be automatic. No man power is needed except to set the timer on the sprinkler system. When there is no rainwater, the tank is filled (up to 1 1/2') with potable water from the school's water system. This is a drawback because we have to pressurize water twice. This occurs when we are in a dry period and was done for the sake of automation. We cut into the existing sprinkler system to hook up our rainwater system. We have an RPZ, backflow preventer, and air gap between the potable system

and our non-potable rainwater. The pump is a variable speed pump that runs on 460 volts. We have an *Amiad* filter with a 300 micron stainless steel screen filter in the pump house before the water goes to the sprinkler system.

Our cast-in-place concrete tanks are 30 feet in diameter which works out just right for the *Symons* forms supplied by *CMC Construction Services*. We used stainless steel ties with neoprene washers with the formwork. The foundation we built (similar to a house foundation) had a 5" slab, 12" by 18" perimeter beam and also 12"x18" beams crossing the middle at the interior. The walls are 8 feet tall and 8 inches thick. The concrete was 3000 psi (straight cement, no fly ash) with a 4 ½" slump with pea gravel and fibers. We vibrated it a lot! The wall reinforcing was 1/2" bars at 12 "on center both ways with an extra bar added at the top perimeter. We took the wall rebar (and our roof beam) over to *Southwest Galvanizing* and had them galvanized. This added $800 to the cost but we are trying to make our tanks last 50 years. The joint between the walls and the floor is waterproofed with CS-231 Controlled Expansion Waterstop Sealant by *Conseal.* We also used this to seal around our pipe penetrations in the walls and slab.

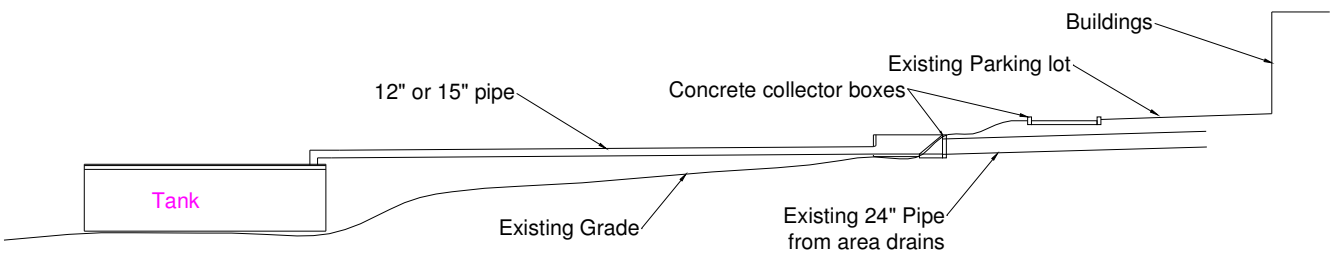
We plastered the interior of the tank where we had honeycomb. We used acrylic-based concrete bonder in the liquid for the plaster. Once the big voids were covered, we painted the interior walls and floor with two coats of Tamoseal cement based waterproofing finish available at *I-10 Building Materials*.

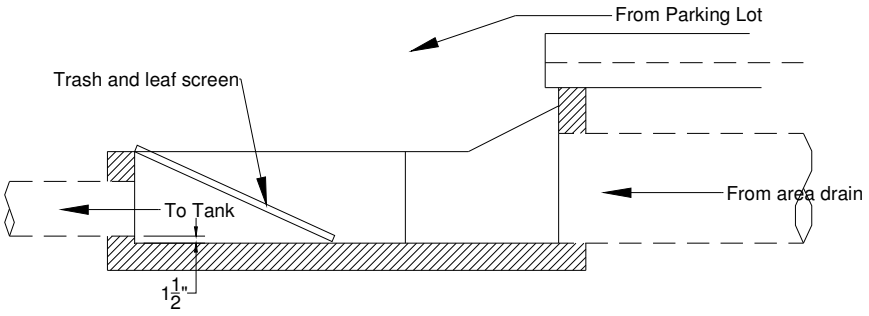
The roof is R-Panels attached to galvanized Z-purlins which are bolted to the top of the wall and are supported by a steel beam (which was also galvanized) across the middle of the tank. The purpose of the roof is to keep out light, mosquitoes, bats, leaves and trash and minimize evaporation.

We will need to clean out the silt from the tank perhaps every other year. It will be tested before we dump it back on our site or haul it to a waste site. We had it tested at *San Antonio Testing Lab* for the RCRA8 (heavy metals) and TPH (total petroleum hydrocarbons). The metals were within background levels. The TPH was a little high. We will treat the silt with "Micro-Blaze" from Verde Environmental in Houston, Tx. to reduce the TPH. We will then test it again before we can hopefully dispose of it on our site.

We test the water in the tank on a monthly basis for coliforms and e.coli and the water has usually tested suitable for swimming. In other words,.. no e.coli. One time the e.coli was high and we added a gallon of bleach to 20,000 gallons in the tanks. That treatment took care of the bacteria. We have locks on the roof hatches and warning signs to keep kids out of the tanks. It is a "confined space" and must be treated as such. To enter the tank safely we have tested the atmosphere with a *QRAEII* tester and have not found dangerous conditions. We also have signs around the baseball field stating "Non-potable water, do not drink."

Water is directed off of the parking lot by the curbs which feed into channels that pour into concrete "collector boxes." The water then enters either a 12" or a 15" pipe and flows into the top of the tank by gravity. It is a "dry pipe" system. We have ¼" hardware cloth screens that keep the leaves and large trash out of the tanks. We also have hardware cloth screens inside the tanks over the outlets at the bottom of the tanks.






Section through Collector Box

ECONOMICS

The cost of our system so far has been $25,000 for each tank, collector box and pipe. The pump house and equipment and underground piping cost about $15,000. Our total cost so far has been about $65,000. This is for materials only. Students have provided the labor. If a school does not have a Building Trades program, then a contractor would have to be involved.

The electric bill for pumping water averages about $75 per month or $900 per year.
So far we have not caught any air- conditioning condensate but that is highly recommended if possible. Our air conditioner units are scattered over the roofs and the condensate flows into the gutters and evaporates.

| | |
|---|---|
| Construction cost | 65,000 **( note: this is materials only)** |
| ÷ life of tank 30 years | ÷ 30 |
| | $ 2166/ yr |

Operating and Maintenance

| | |
|---|---|
| electricity | 900/yr |
| maintenance | 300/yr |
| | $3366 /yr |

Water caught: 500,000 gallons

Water Production Cost-- $ 3366 /500,000 gal. = $ .0067/gallon = $.67/100 gallons
(If we use 50 years for the life of the tank, the cost is reduced to $.50/100 gallons.)

This compares to about $.55/100 gallons from the city of Bandera at the Middle School

References:

1. http://texas.educationbug.org/public-schools/
2. Stegner, Wallace (1954). *Beyond the Hundredth Meridian: John Wesley Powell and the Second Opening of the West*. University of Nebraska Press. ISBN 0-8032-4133-X (and other reprint editions).
3. http://www.twdb.state.tx.us/waterplanning/data/projections/2012/popproj.asp
4. *The Texas Manual on Rainwater Harvesting*
   **Texas Water Development Board**
   in cooperation with
   Chris Brown Consulting
   Jan Gerston Consulting

Stephen Colley/Architecture
Dr. Hari J. Krishna, P.E., Contract Manager

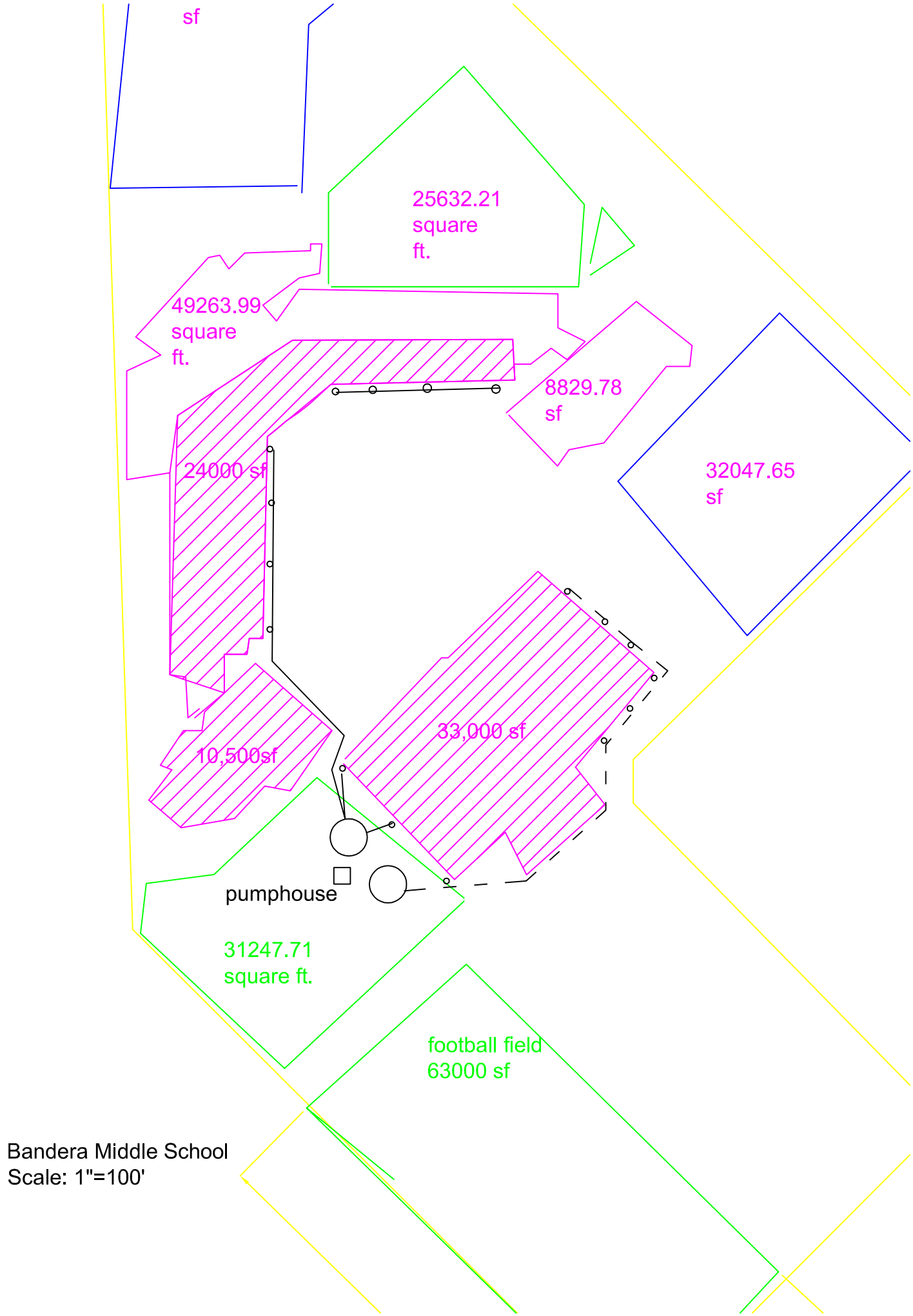
Chapter 2 Rainwater Collection for Bandera Middle School by Tommy Garcia

Bandera Middle School is located in the city of Bandera, TX.
557 students attend Bandera Middle School and there is not a Building Trades Program at the school, but there is one at the nearby high school.
The school currently gets its water from the city of Bandera which pumps it out of the Lower Trinity Aquifer. Water costs $.60/100 gallons.

The system we are proposing for Bandera Middle School consists of catching water off of the roofs and storing the water in two above-ground concrete tanks. The untreated water will then be used to irrigate the football field. This system assumes we will catch water off of 60,000+ square feet of roof area. A one inch rain should produce about 37,500 gallons of water. Two tanks would be able to catch and store 65,000 gallons when empty.

Bandera Middle School recieves on average 28" of rain per year. With 60,000s.f. of roof area we could catch over a million gallons of water per year. (60,000sfx.625 gal/sf x28"= 1,050,000 gallons). A more realistic estimate would be that we would catch 60% of the total possible… say 630,000 gallons. At .60/100 gallons, that equals $3780 worth of water per year.

Our system would cost about $100,000 for materials and labor. If we produced 3780 worth of water per year it would pay for itself in 26 years.




Bandera Middle School
Scale: 1"=100'

## Cost Estimate for rainwater collection system... Bandera Middle School

| Amount | units | Description | Materials Unit Cost | Materials total | Labor Unit Cost | Labor Total | Misc. or subcontractors |
|---|---|---|---|---|---|---|---|
| | | **General Requirements** | | | | | |
| 1 | ea | permits | 100 | 100 | | | |
| 1 | ea | safety equipment | 500 | 500 | | | |
| | | | | | | | |
| | | engineers | | | | | 5000 |
| | | **Site Work** | | | | | |
| | | Fencing | | | | | |
| 100 | lin. Ft | Silt fence | 0.5 | 50 | | | |
| 200 | lin. ft. | dig ditches... subcontractor | 2 | 400 | | | |
| | | | | | | | |
| | | **Tanks** | | | | | |
| 2 | ea | Concrete Tanks | 23000 | 46000 | | | |
| | | guess at the labor for a contractor to do the work | | | | 25000 | |
| | | **Gutters and downspouts** | | | | | |
| 332 | lin. Ft. | Gutters | 1 | 332 | | | |
| 17 | ea | downspouts with funnel and screen | 30 | 510 | | | |
| 1 | ea | roofwasher | 200 | 200 | | | |
| 800 | lin. Ft. | 6" trunkline | 2.89 | 2312 | | | |
| | | ditching | | | | | 2000 |
| | | | | | | | |
| | | | | | | | |
| | | **Pump House and pumps** | | | | | |
| 1 | ea | pump house or "hot box" | 5000 | 5000 | | | |
| 1 | ea | pump/controller/pressure tank/ valves | 5500 | 5500 | | | |
| 1 | ea | filter/recirculate valves/timer | 700 | 700 | | | |
| 2 | ea | water meters | 500 | 1000 | | | |
| 1 | ea | RPZ (reduced pressure zone) | 500 | 500 | | | |
| | | plumber...hook up RPZ | | 0 | | | 500 |
| 100 | lf | 3" Sched 40 fill pipes | 3 | 300 | | | |
| 1000 | lf | 3" sched. 40 pipes to field | 3 | 3000 | | | |
| | | electrician...hook up electrical/ pump | | 0 | | | 1500 |
| 1 | ea | electrical Supply. (poles/transformers/ switchgear | 1000 | 1000 | | | |
| | | | | | | | |
| | | | | | | | |
| | | total | | 67404 | | 25000 | 9000 |
| | | sum total of all | | | | | 101404 |

Chapter 3. Rainwater Collection System for Boerne High School by Bobby Ketterer

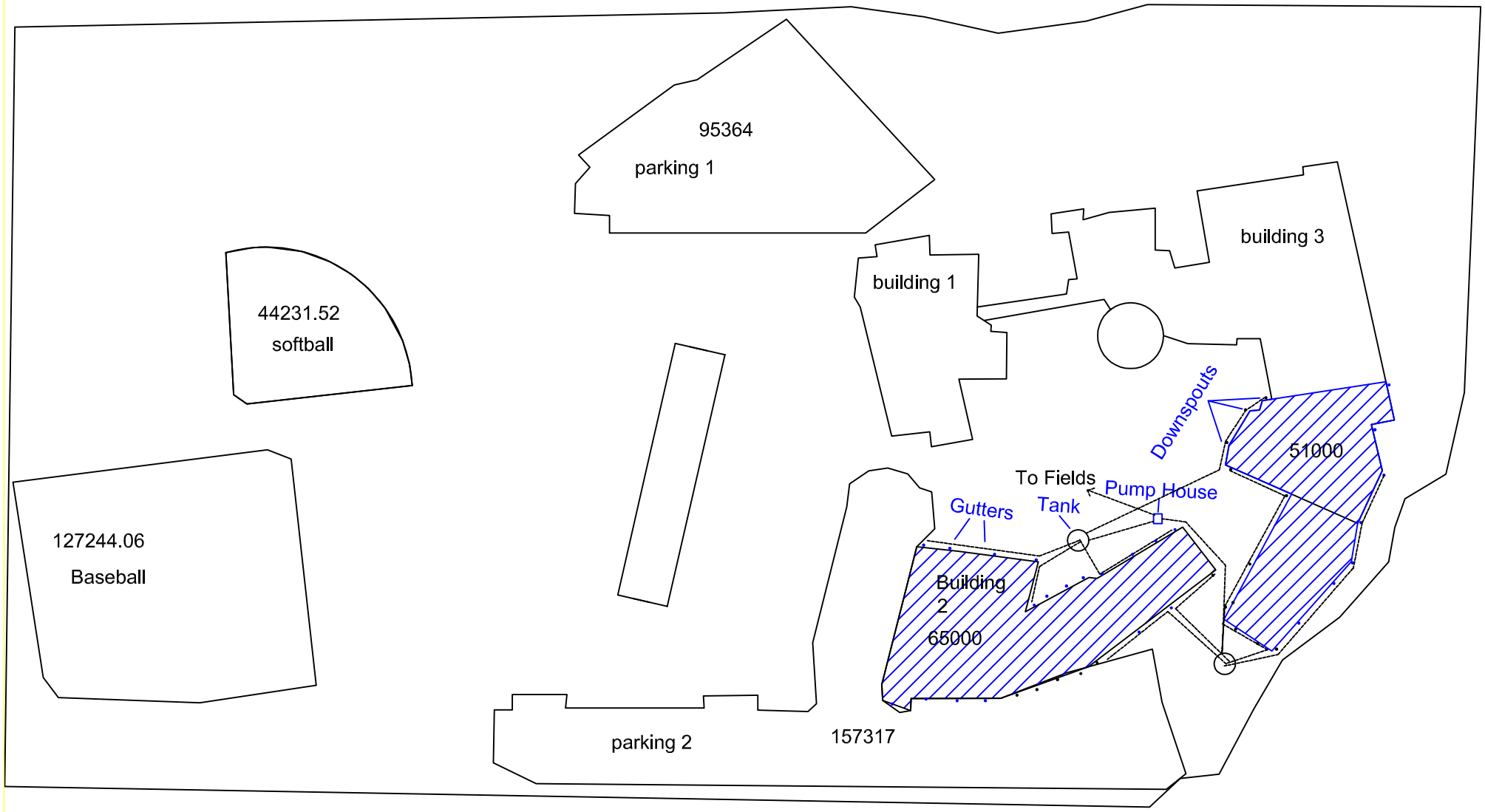
Boerne High School (BHS) is located in the city of Boerne, Texas. 881 students attend Boerne and there may be a Building Trades Program in the future at the school. The school currently gets its water from the city of Boerne which pumps it out of the Middle Trinity Aquifer, Canyon Lake and Boerne Lake. Water costs $.51/100 gallons (for 65,000 gallons).

The system we are proposing for BHS consists of catching water off of the roofs and storing the water in several above-ground concrete tanks. Catching water off the roofs would be much cleaner than off the parking lots and would be nearly potable. This system assumes we will catch water off of 85,000 square feet of roof area. A one inch rainfall should produce about 42500 gallons of water. When empty, two tanks would be able to catch and store 70,000 gallons.

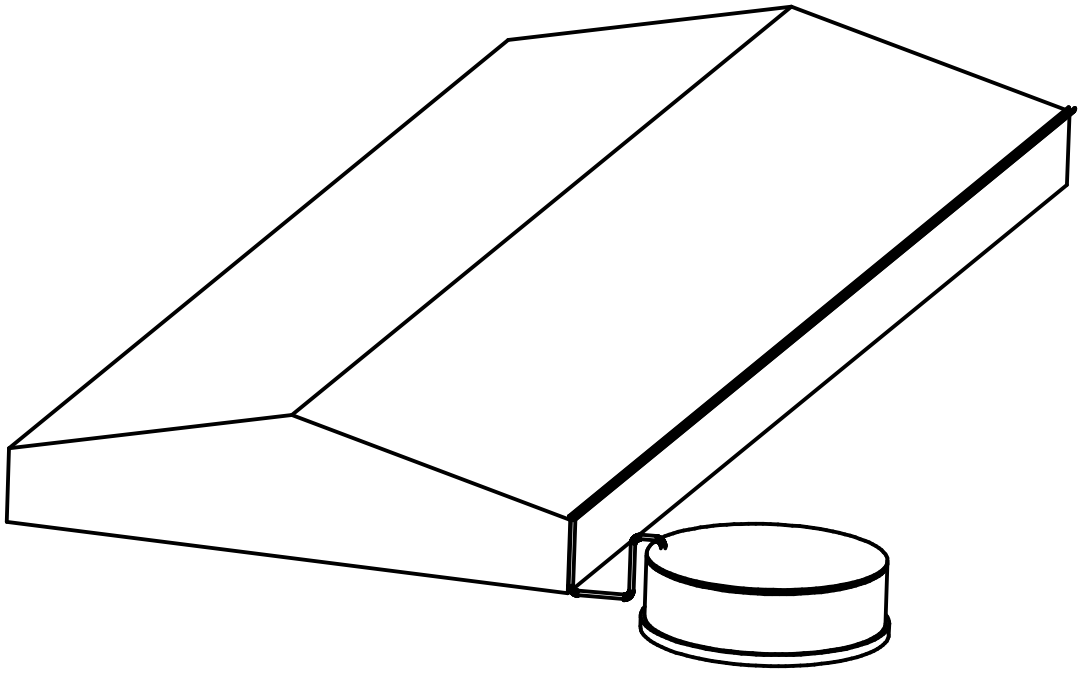
Boerne receives on average 34" of rain per year. With 85,000 square feet of roof area, we would catch 1,445,000 gallons of water per year. A more realistic estimate would be that we would catch 60% of the total possible. That would give a total of 867,000 gallons of water.

Our system would cost about $75,000 for materials only (assuming the students would build it.) If we produced $4400 (867000/100 x .51) worth of water per year it would pay for itself in 17 years.

Schematic Site Plan
Bobby Ketterer
Scale: 1"=200'



Boerne High School

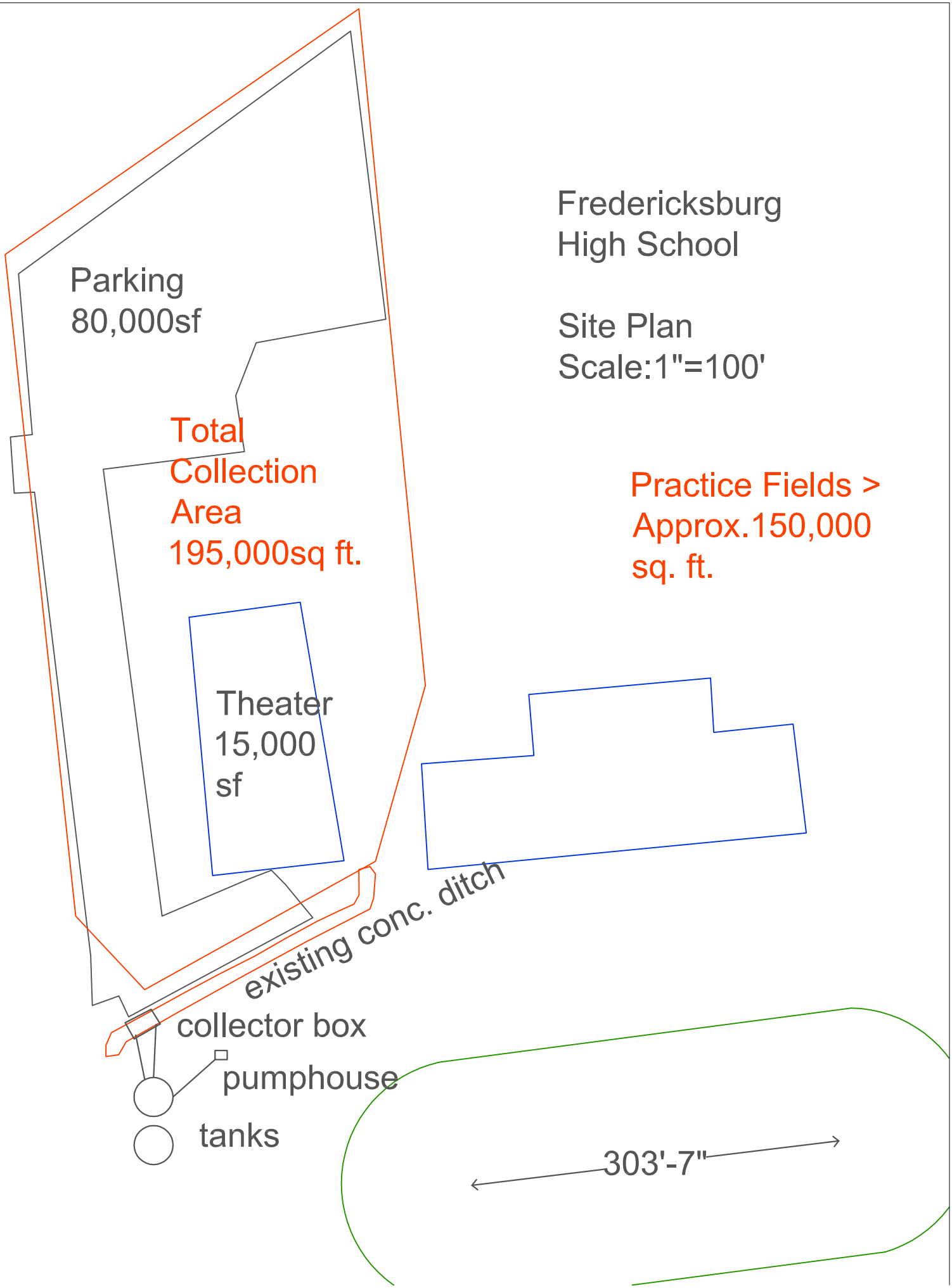


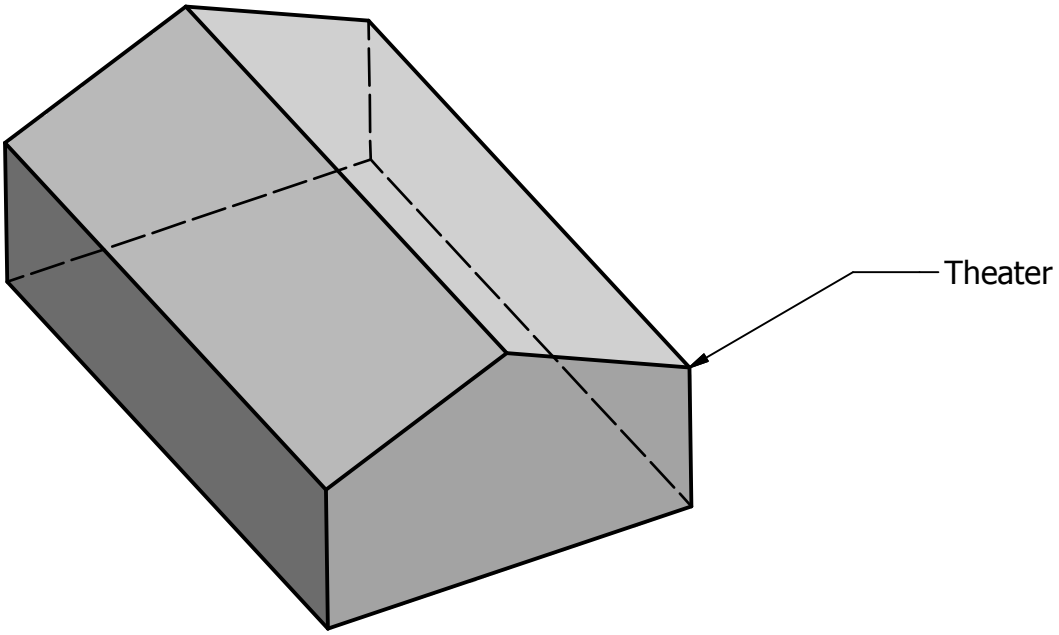
| Boerne High School…estimate | | | | | | | |
|---|---|---|---|---|---|---|---|
| amount | units | description | materials unit cost | materials total | labor unit cost | labor total | misc. or subcontractors |
| | | **1 General requirements** | | 0 | | | |
| 1 | ea | permits | 100.00 | 100 | | | |
| | | Engineering | | 0 | | | 3,000.00 |
| 1 | ea | safety equipment | 1,000.00 | 1,000 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **2 Site Work** | | 0 | | | |
| | | fencing | | 0 | | | |
| 100 | lf | silt fence | 0.50 | 50 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **3 Tanks** | | 0 | | | |
| 2 | ea | concrete tank | 23,000.00 | 46,000 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **4 gutters and downspouts** | | 0 | | | |
| | | gutters | 2.65 | 0 | | | |
| 28 | ea | downspout/roof washers | 50.00 | 1,400 | | | |
| 1300 | lf | 6" Trunklines | 4.00 | 5,200 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **5 pump house and pumps** | | 0 | | | |
| 1 | ea | pump house or "hot box" | 5000 | 5000 | | | |
| 1 | ea | pump/controller/pressure tank/ valves | 5500 | 5500 | | | |
| 1 | ea | filter/recirculate valves/timer | 700 | 700 | | | |
| 2 | ea | water meters | 500 | 1000 | | | |
| 1 | ea | RPZ (reduced pressure zone) | 500 | 500 | | | |
| | | plumber…hook up RPZ | | 0 | | | 500.00 |
| 100 | lf | 3" Sched 40 fill pipes | 3 | 300 | | | |
| 1000 | lf | 3" sched. 40 pipes to field | 3 | 3000 | | | |
| | | electrician…hook up electrical/ pump | | 0 | | | 1,000.00 |
| 1 | ea | electrical Supply. (poles/transformers/ switchgear | 1000 | 1000 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | total | | 70,750 | | 0.00 | 4,500.00 |

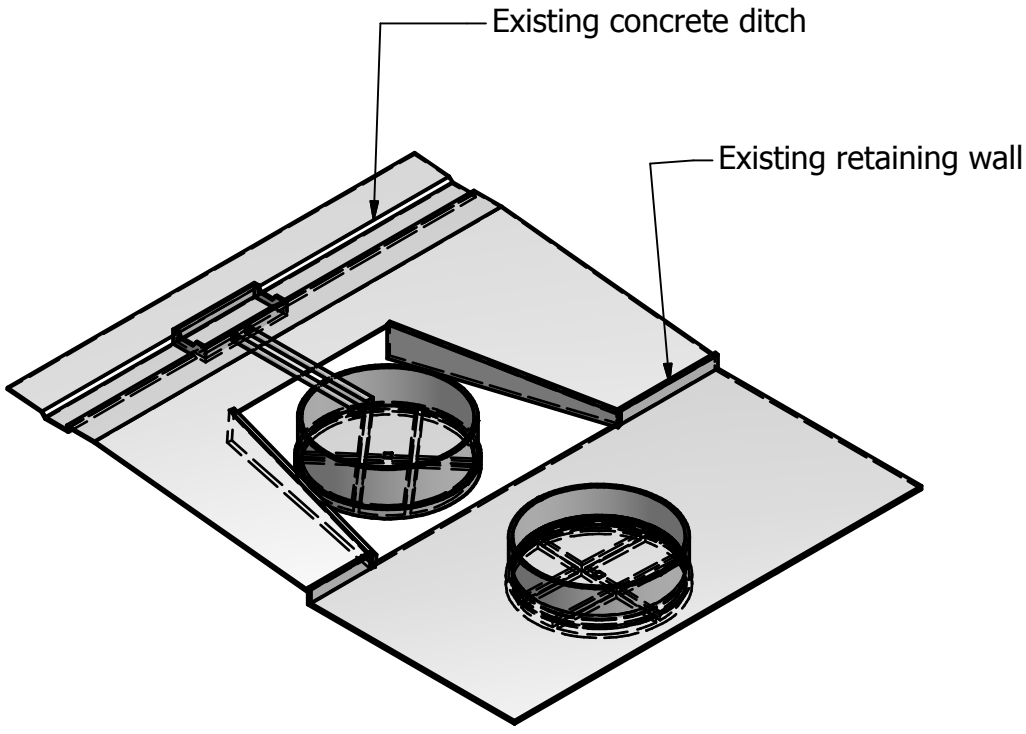
Chapter 4 Rainwater Collection System for Fredericksburg High School by Matt King

Fredericksburg High School (FHS) is located on highway 16 in Fredericksburg, Texas. It is a 3a school that currently serves around one thousand students in grades 9-12 and has a Building Trades program. The school currently gets its water from the city of Fredericksburg which pumps it out of the Ellenberger aquifer for $.63/100 gallons.

The system we are proposing for FHS consists of catching water off of the contributing parking lots and storing the water in two above ground concrete tanks. The untreated water will then be used to irrigate the game field or practice fields. This system assumes we will catch water off of around 80,000 square feet of student and faculty parking lot. A one inch rainfall should produce about 50,000 gallons of untreated water. Two tanks would be able to catch and store 70,000 gallons. Fredericksburg receives an average of 32" of precipitation per year. With about 80,000 square feet of parking lot we would be able to catch an average of 1,600,000 gallons of water per year. However, a more realistic estimate would be that we would catch 50% of the total possible, which would be 800,000 gallons. At .63/100 gallons, that equals around $5000 worth of water. Our system would cost about $78,000 for materials only (we are assuming the students would build it.) If we produced $5000 worth of water per year it would pay for itself in 16 years. Another way to look at this would be that 600,000 gallons would provide water for the field for 12 weeks.


Fredericksburg
High School
Site Plan
Scale:1"=100'
Parking
80,000sf
Total
Collection
Area
195,000sq ft.
Practice Fields >
Approx.150,000
sq. ft.
Theater
15,000
sf
existing conc. ditch
collector box
pumphouse
tanks
303'-7"




# Fredericksburg High School

Cost estimate for rainwater collection system…Fredericksburg

| Amount | Units | | Description | materials unit cost | materials total | labor unit cost | labor total | misc. or subcontractors |
|---|---|---|---|---|---|---|---|---|
| | | **1** | **General Requirements** | | | | | |
| | | | Permits | | 100 | | | |
| | | | Safety Equipment | | 500 | | | |
| | | | | | | | | |
| | | | engineers | | | | | 5000 |
| | | | | | | | | |
| | | | | | | | | |
| | | **2** | **Site Work** | | 0 | | | |
| 1 | | | Excavation For Underground Tank andnew retaining wall | 2000 | 2000 | | | 4500 |
| 2 | | | Silt Fence/sq. ft | 0.5 | 1 | | | |
| | | | | | | | | |
| | | | | | 0 | | | |
| | | **3** | **Tanks** | | | | | |
| 2 | | | Concrete Tank | 23000 | 46000 | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | **4** | **Collector Boxes And Pipes** | | | | | |
| 1 | ea | | Concrete Collector Box | 1000 | 1000 | | | |
| 120 | if | | 15" pipe | 12.41 | 1489.2 | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | **5** | **Pump Hotbox** | | | | | |
| 1 | ea | | pump house or "hot box" | 5000 | 5000 | | | |
| 1 | ea | | pump/controller/pressure tank/ valves | 5500 | 5500 | | | |
| 1 | ea | | filter/recirculate valves/timer | 700 | 700 | | | |
| 2 | ea | | water meters | 500 | 1000 | | | |
| 1 | ea | | RPZ (reduced pressure zone) | 500 | 500 | | | |
| | | | plumber…hook up RPZ | | 0 | | | 500 |
| 100 | lf | | 3" Sched 40 fill pipes | 3 | 300 | | | |
| 500 | lf | | 3" sched. 40 pipes to field | 3 | 1500 | | | |
| | | | electrician…hook up electrical/ pump | | 0 | | | 1500 |
| 1 | ea | | electrical Supply. (poles/transformers/ switchgear | 1000 | 1000 | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | Total | | 66590.2 | | | 11500 |

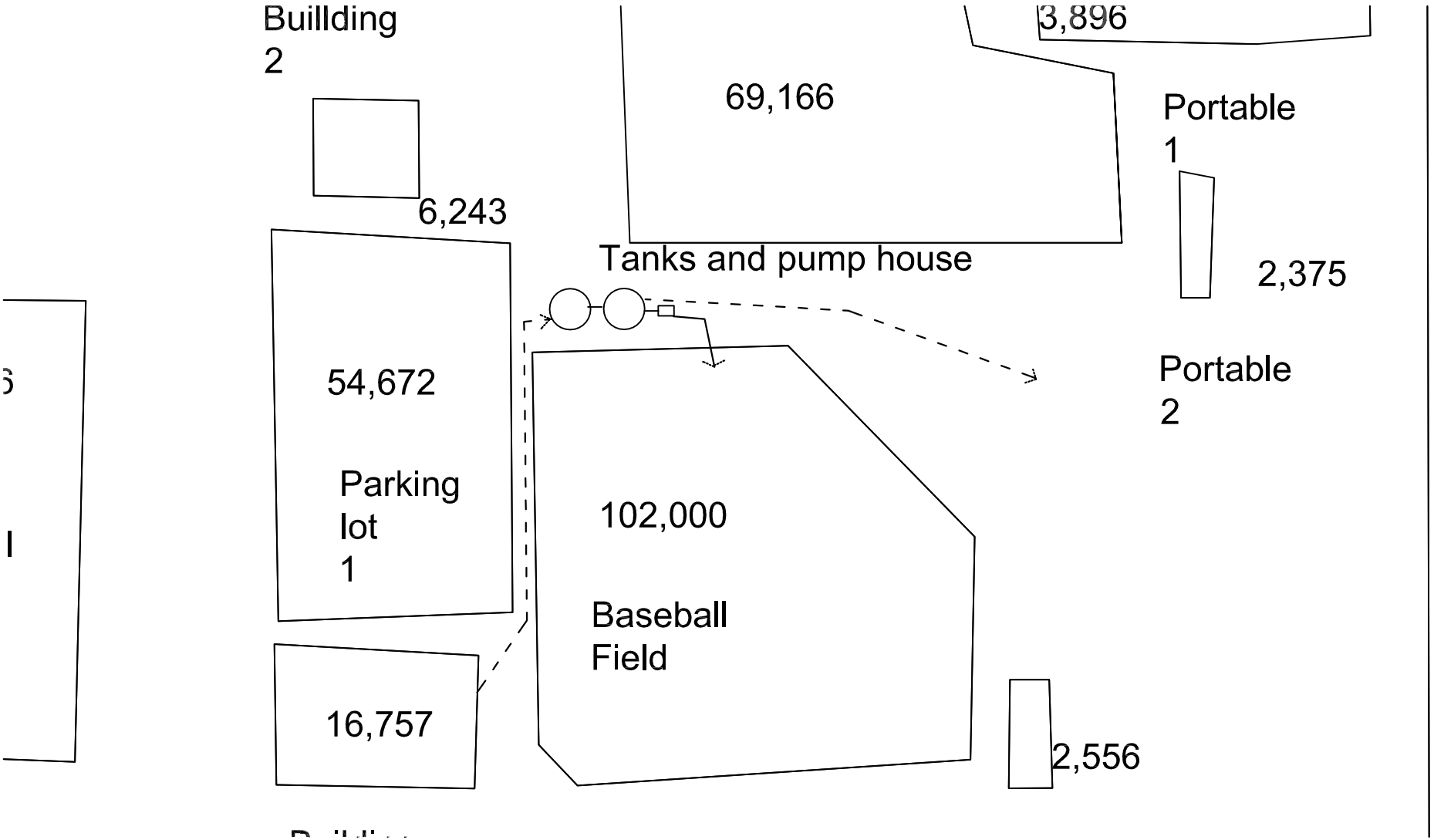
Chapter 5 Hondo High School by Dillon Vikari

Hondo High school is located in the city of Hondo TX. 500 students attend Hondo and there is a building trades program at the school. The school currently gets its water from the city of Hondo which pumps it out of the Edwards aquifer. Water cost 57 cents for 100 gallons.

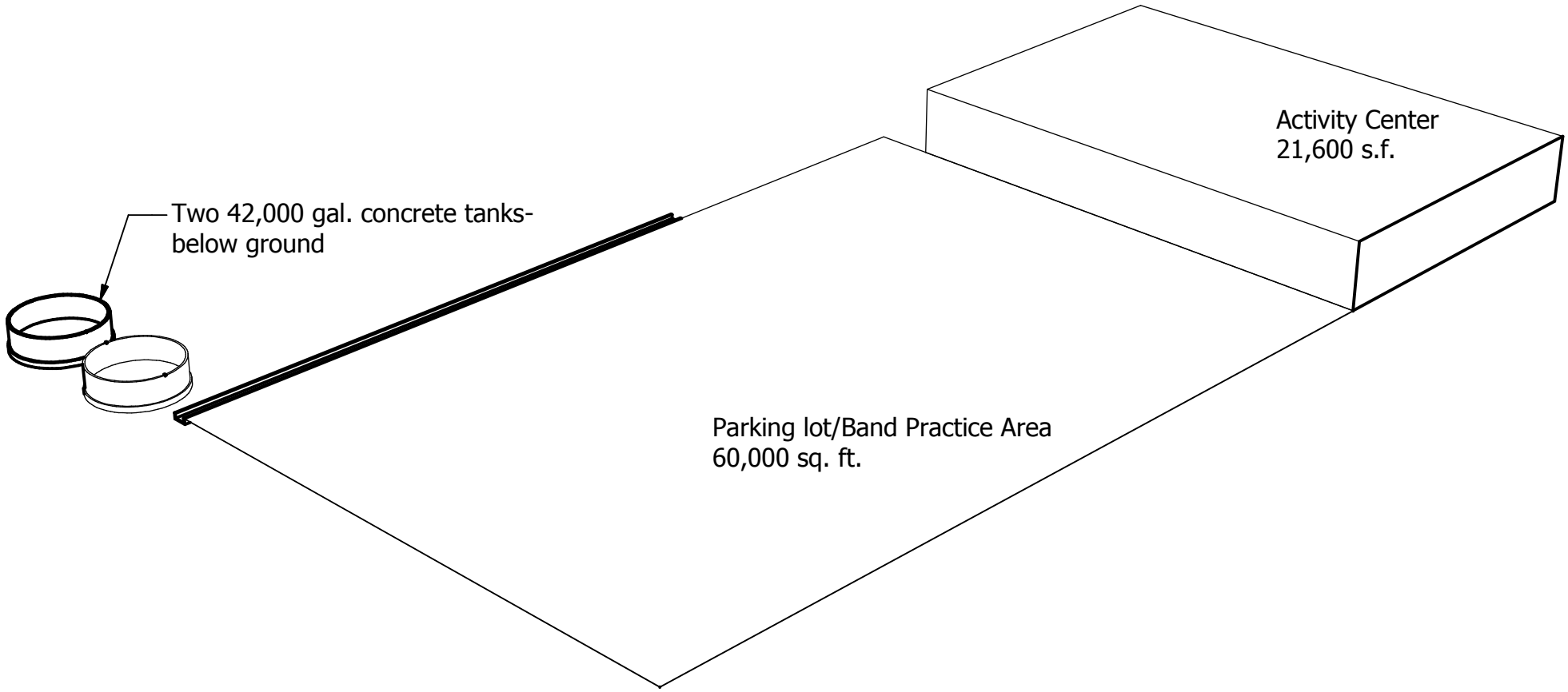
The system we are proposing for Hondo consists of catching water off the roofs and storing the water in two below ground concrete tanks. The untreated water will then be used to irrigate the practice field. This system assumes we will catch 60000 square feet of roof area. A one inch rainfall should produce about 37500 gallons of water./Two tanks would be able to catch and store 65000 gallons.

Hondo receives an average of 26 of rain per year. With 60000 square feet of roof area we could catch 975000 gallons of water per year. A more realistic estimate would be 60 percent of the total possible.. say 585,000 gallons. That equals $3335 worth of water.

Our system would cost about $79,000 for materials only and would take 24 years to pay for it.


Buillding
2
6,243
69,166
3,896
Portable
1
2,375
Tanks and pump house
54,672
Parking
lot
1
102,000
Baseball
Field
Portable
2
16,757
2,556

**Hondo High School**



| | | Hondo High School….estimate | | | | | |
|---|---|---|---|---|---|---|---|
| **amount** | **units** | **Description** | **materials unit cost** | **materials total** | **labor unit cost** | **labor total** | **misc. or subcontractors** |
| | | **1 General Requirements** | | 0 | | | |
| 1 | ea | safety materials | 500 | 500 | | | |
| 1 | ea | permits | 200 | 200 | | | |
| 1 | ea | scaffolds /tools | 1000 | 1000 | | | |
| | | | | 0 | | | |
| | | engineers….civil | | | | | 3000 |
| | | …. Structural | | | | | 1000 |
| | | …..licensed irrigator | | | | | 1000 |
| | | | | | | | |
| | | | | 0 | | | |
| | | **2 Site Work** | | 0 | | | |
| | | excavation for underground tank/ dirt stockpiled on site | | 0 | | | 4500 |
| 200 | lf | fencing | 2 | 400 | | | |
| 100 | lf | silt fence | 0.5 | 50 | | | |
| | | | | | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **3 Tanks** | | 0 | | | |
| 2 | ea | concrete 42,000 gallons with R-panel roof | 22000 | 44000 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **4 Collector boxes and pipes** | | 0 | | | |
| 1 | **ea** | concrete collector box and curb and gutter(150 lf) | 2000 | 2000 | | | |
| 100 | **lf** | 15" dia. Corrugated steel pipe | 12.41 | 1241 | | | |
| | | | | 0 | | | |
| 200 | **lf** | overflow pipe 15" dia. | 12.41 | 2482 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **5 Gutters and downspouts** | | 0 | | | |
| 100 | lf | Gutters | 2 | 200 | | | |
| 5 | ea | down spouts/ roof washer | 100 | 500 | | | |
| 5 | ea | down spout ..funnel/screen/4" SDR 35 | 50 | 250 | | | |
| 50 | lf | 6" SDR35 trunklines.. | 2.89 | 144.5 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **6 Pump house and Pumps** | | 0 | | | |
| 1 | ea | pump house or "hot box" | 5000 | 5000 | | | |
| 1 | ea | pump/controller/pressure tank/ valves | 5500 | 5500 | | | |
| 1 | ea | filter/recirculate valves/timer | 700 | 700 | | | |
| 2 | ea | water meters | 500 | 1000 | | | |
| 1 | ea | RPZ (reduced pressure zone) | 500 | 500 | | | |
| | | plumber…hook up RPZ | | 0 | | | 500 |
| 100 | lf | 3" Sched 40 fill pipes | 3 | 300 | | | |
| 200 | lf | 3" sched. 40 pipes to field | 3 | 600 | | | |
| | | electrician…hook up electrical/ pump | | 0 | | | 1500 |
| 1 | ea | electrical Supply. (poles/transformers/ switchgear | 1000 | 1000 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | Total | | 67567.5 | 0 | 0 | 11500 |

Note….No Labor Included !!!

Chapter 6. Junction High School by Jamison Landolt

Junction High School is located in the city of Junction, Tx.
Currently there are 194 students attending Junction High school. There is no Building Trades program at the school, but there is an Ag. department. The school currently gets its water from the shallow wells in the alluvial sands of the south Llano River. The school has also drilled a well into the Edwards-Trinity aquifer in order to irrigate the athletic fields.

The system we are proposing for Junction is comprised of catching water off of the roofs and storing the water in two above ground concrete tanks. The untreated water could then be used to irrigate the football field. Using this system we assumed we will catch water off of 90,700 square feet of roof area as shown on the site plan. A one inch rainfall should produce about 56,000 gallons of water. Two tanks would be able to catch and store 70,000 gallons per rainfall event.

Junction receives an average of 23" of rain per year. With 90,700 square feet of roof area we could catch 1,288,000 gallons of water per year. A more realistic estimate would be that we would catch 60% of the total possible… around 700,000 gallons. At $ .44/100 gallons, that equals $3080 worth of water.

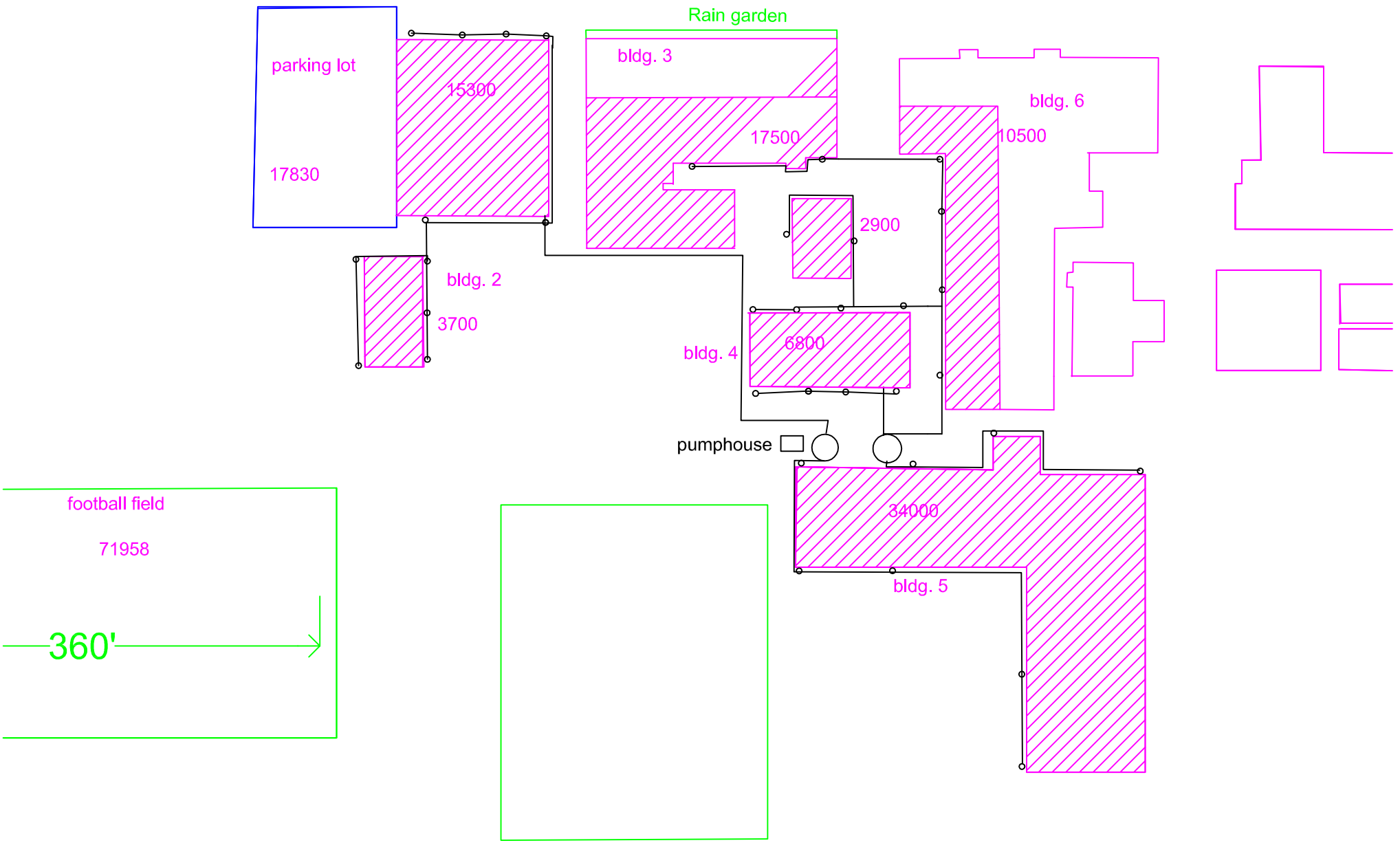
Our system would cost around $77,000 for materials only (this is assuming the students build it.) If we produced $3080 per year it would pay for itself in about

twenty five years. Another way to look at the benefit of catching this amount of water would be that it would provide an extra 16 weeks of irrigation for the football field. Also, since we are catching water off of all the roofs, the possibility of using it for potable uses in the future would be relatively easy to do.

# Schematic Site Plan  Jamison Landolt

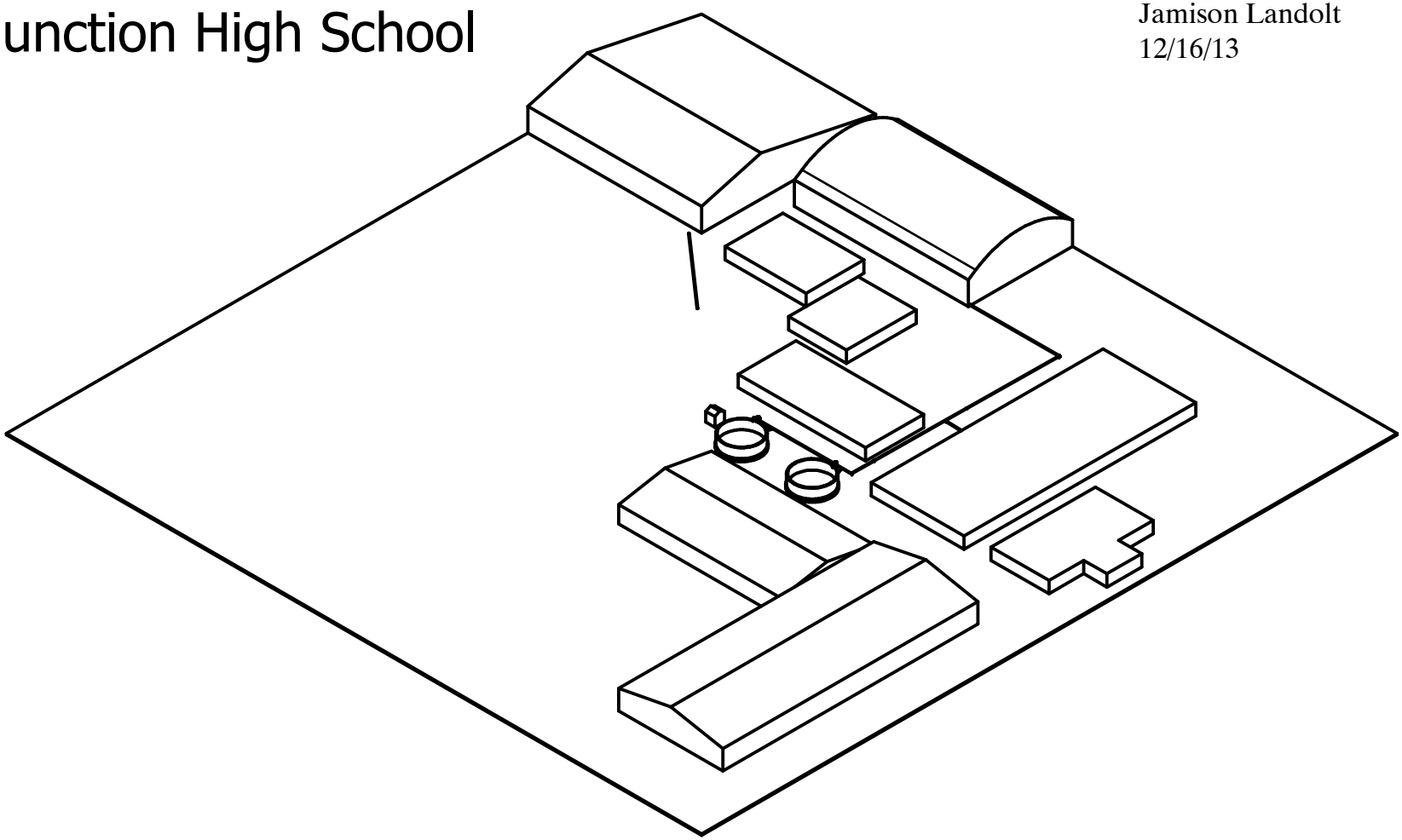
## 9/11/13  Total Area: 163837

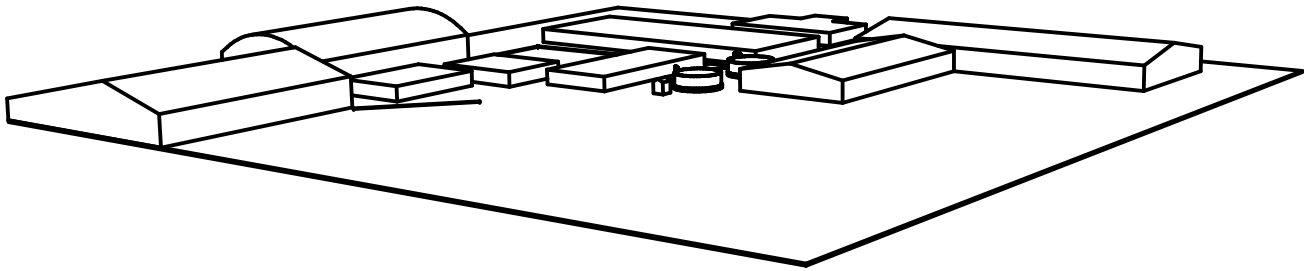
## Scale: 1"=100'



# Junction High School

Jamison Landolt
12/16/13





| | Cost estimate for the construction of rain water collection system at Junction High School | | | | | | |
|---|---|---|---|---|---|---|---|
| Amount | Units | Description | Materials unit cost | Materials total | Labor unit cost | Labor total | Misc. or Subcontact |
| | 1 | **General Requirements** | | 0 | | | |
| | | Permits | 100 | 100 | | | |
| | | Safety equipment | 500 | 500 | | | |
| | | | | 0 | | | |
| | | engineers | | 0 | | | 5000 |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | 2 | **site work** | | 0 | | | |
| 100 | lf | Silt fence | 0.5 | 50 | | | |
| | | | | 0 | | | |
| | | ditching for trunklines | | 0 | | | 2000 |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | 3 | **Tanks** | | 0 | | | |
| | | | | 0 | | | |
| 2 | ea | Concrete tank | 23000 | 46000 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | 5 | **Gutters and downspouts** | | 0 | | | |
| | | | | 0 | | | |
| 200 | ft | Gutters | 3 | 600 | | | |
| 30 | ea | downspouts with funnel and screen | 50 | 1500 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| 800 | lf | 6" SDR35 trunklines.. | 2.89 | 2312 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | 6 | **Pumphouse and pump** | | | | | |
| 1 | ea | pump house or "hot box" | 5000 | 5000 | | | |
| 1 | ea | pump/controller/pressure tank/ valves | 5500 | 5500 | | | |
| 1 | ea | filter/recirculate valves/timer | 700 | 700 | | | |
| 2 | ea | water meters | 500 | 1000 | | | |
| 1 | ea | RPZ (reduced pressure zone) | 500 | 500 | | | |
| | | plumber…hook up RPZ | | 0 | | | 500 |
| 100 | lf | 3" Sched 40 fill pipes | 3 | 300 | | | |
| 1000 | lf | 3" sched. 40 pipes to field | 3 | 3000 | | | |
| | | electrician…hook up electrical/ pump | | 0 | | | 1500 |
| 1 | ea | electrical Supply. (poles/transformers/ switchgear | 1000 | 1000 | | | |
| | | | | | | | |
| | | | | | | | |
| | | Total | | 68062 | | | 9000 |

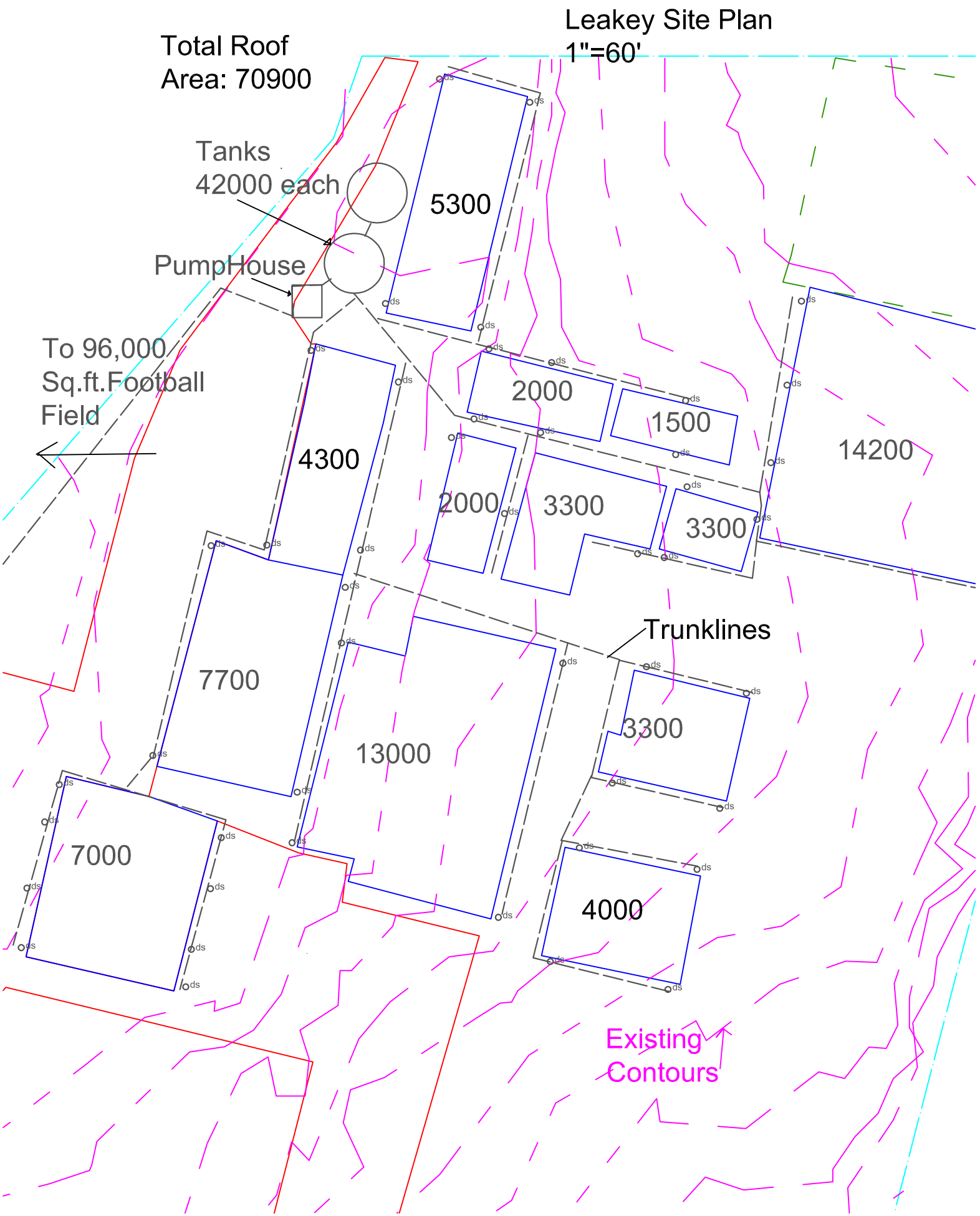
Chapter 7 Rainwater collection system for Leakey High School by Jonathon Skipper

Leakey School (K-12) is located in the City of Leakey, TX in Real County. 268 students attend Leakey and there is not a Building Trades Program at the school, however they have an Ag Department. The school currently buys its water from the city of Leakey which pumps it out of shallow wells in the alluvial sands of the Frio River. Water costs .16/100 gallons, however in the recent droughts; some of the wells are running dry.

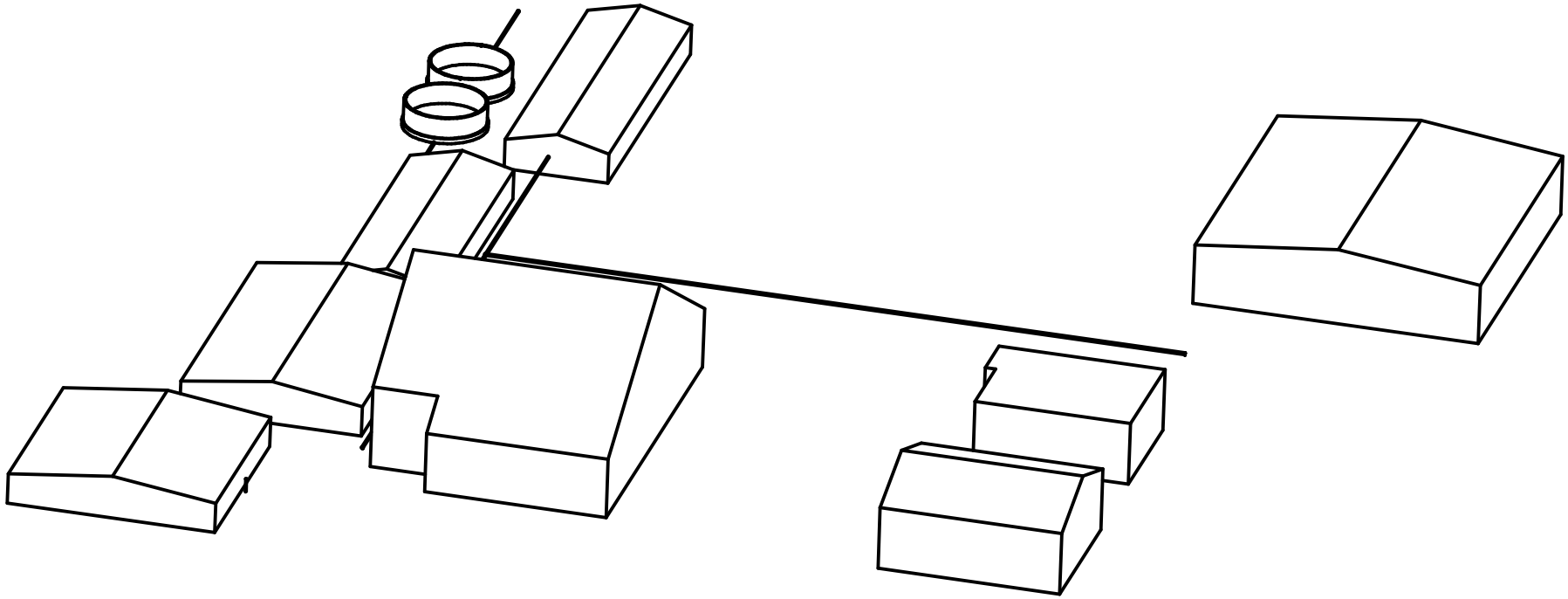
The system we are proposing for Leakey consists of catching water off of the roofs and storing the water in above-ground concrete tanks. The untreated water could then be used to irrigate the football field. Water caught off of roofs can easily be treated up to potable quality, unless lead was used in the old roofing system so in the future this water could be used for potable purposes. This system assumes we will catch water off of 70,000 square feet of roof area. A one inch rainfall should produce about 43,750 gallons of water. Two empty tanks would be able to catch and store 70,000 gallons.

Leakey receives on average 26 inches of rain per year. With 70,000 s.f. of roof area we could catch 1.1 million gallons of water per year. (70000 x .625 gal/s.f. x 26" =1,137,500g). A more realistic estimate would be that we would catch 60% of the total possible… say 680,000 gallons. At .16/100 gallons, that equals $1092 worth of water.

Our system would cost $83,500 for materials only (we are assuming the students would build it). If we Produced $1092 worth of water per year, it would pay for itself in 76 years. Another way to look at the benefit is that in 680,000 gallons of water would be 14 weeks of watering the football field.


Leakey Site Plan
1"=60'
Total Roof
Area: 70900
Tanks
42000 each
PumpHouse
To 96,000
Sq.ft.Football
Field
5300
2000
1500
14200
4300
2000
3300
3300
Trunklines
7700
13000
3300
7000
4000
Existing
Contours

# Leakey Schools



# Cost Estimate For Rainwater Collection System- Leakey High School

| Amount | units | Description | Materials unit Cost | Materials Total | Labor Unit Cost | Labor Total | Misc. or Subcontractor | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **1 General Requirements** | | | | | | | |
| 1 | each | Permits | 100.00 | 100 | | | | | |
| 1 | each | Safety Equipment | 500.00 | 500 | | | | | |
| 1 | each | Scaffold/Tools | | | | | | | |
| | | | | | | | | | |
| | | Engineers… Civil | | | | | 3,000 | | |
| | | … Structural | | | | | 1,000 | | |
| | | … licensed irrigator | | | | | 1,000 | | |
| | | | | | | | | | |
| | 2 | **2 Site Work** | | | | | | | |
| | | fencing | | | | | | | |
| 100 | lf | silk fence | 0.50 | 50 | | | | | |
| | | | | | | | | | |
| | | **3 Tanks** | | | | | | | |
| 2 | ea | Concrete Tank | 22,000.00 | 44,000 | | | | | |
| | | | | | | | | | |
| | | **4 Gutters and Downspouts and Pipes** | | | | | | | |
| 600 | lf | Gutters | 2.65 | 1,590 | | | | | |
| 50 | ea | Downspouts w/ funnel and screen | 30.00 | 1,500 | | | | | |
| 2600 | lf | 6" trunk line | 2.89 | 7,514 | | | | | |
| 2600 | lf | dig ditches | 2.00 | 5,200 | | | | | |
| | | | | | | | | | |
| | | **5 Pump Houses and Pumps** | | | | | | | |
| 1 | ea | Pump, Controller, Pressure tank, and Valves | 5,500.00 | 5,500 | | | 500 | | |
| 1 | ea | Filter/timer/valves | 700.00 | 700 | | | | | |
| 1 | ea | Water Meters | 300.00 | 300 | | | | | |
| 1 | ea | RPZ | 500.00 | 500 | | | | | |
| 800 | lf | 3 In. pipe to field | 3.00 | 2,400 | | | | | |
| 50 | lf | 3 in fill pipe | 3.00 | 150 | | | | | |
| 1 | ea | "Hot Box" or Pump House | 5,000.00 | 5,000 | | | | | |
| 1 | ea | electrical Supply | 2,000.00 | 2,000 | | | 1,000 | | |
| | | | | | | | | | |
| | | **Subtotal** | | 77,004 | | | 6,500 | **Grand Total** | 83,504 |

**Note... No Labor Included**

**Note... No Labor Included**

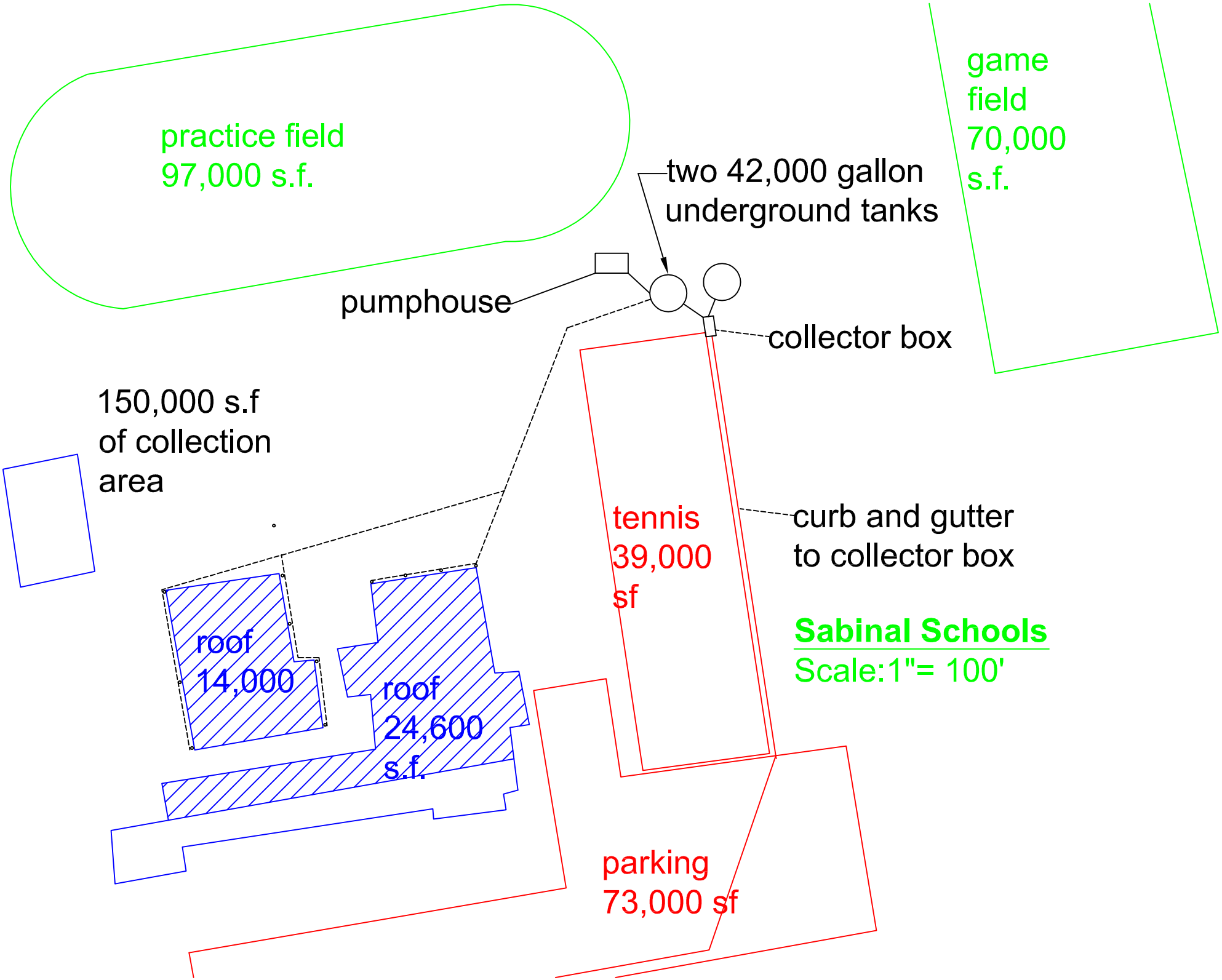
Chapter 8 Sabinal High School by Wyatt Clemenson

Sabinal High School is located in Sabinal Texas on Highway 90 about 50 miles west of San Antonio. Sabinal is a 1A school with about 140 students. There is not a building trades program in Sabinal. The school currently gets its water from the Edwards Aquifer at $.23/100 gallons.

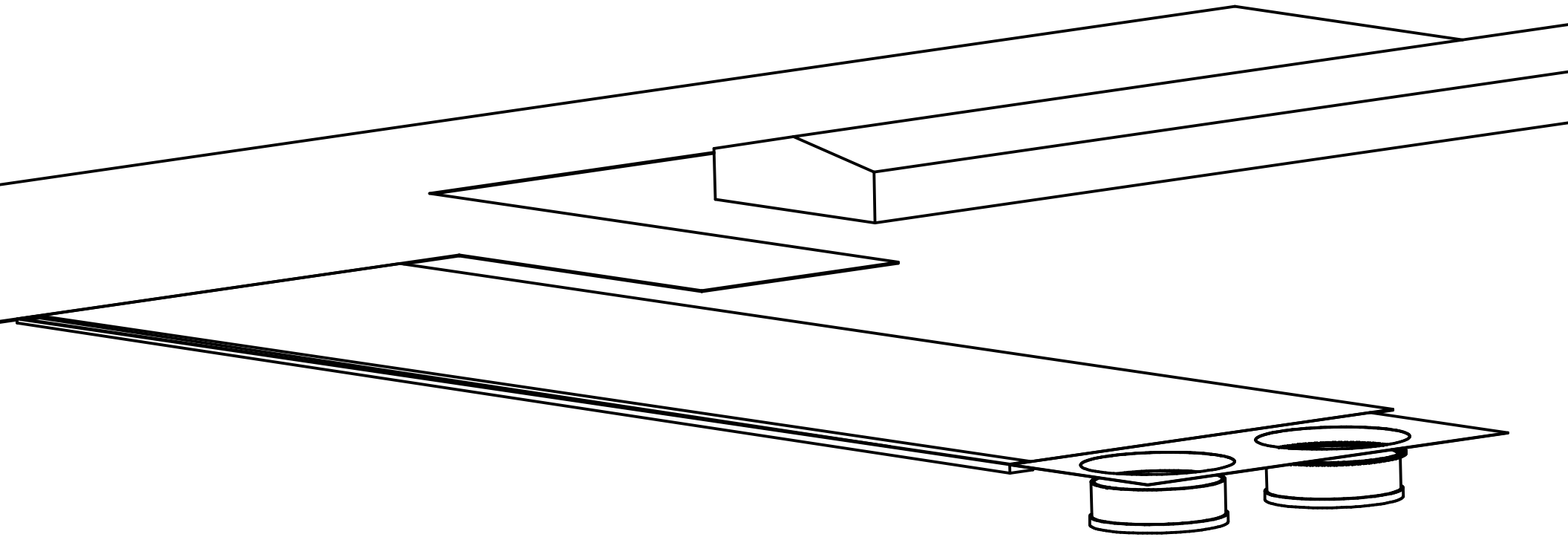
The system we are proposing for Sabinal consists of catching water off of the roofs and parking lots and storing the water in two under-ground tanks. The untreated water will then be used to irrigate the football field. This system assumes we will catch water off of 150,000s.f of impermeable surface. A one inch rainfall would produce 93,750 gallons of rainwater in which 56,000 gallons would probably be caught. Two empty tanks would be able to store 70,000 gallons of water.

Sabinal receives on average 26'' of rain per year. With 150,000s.f. of roof and parking lot we could catch 1,462,500 gallons a year which would equal $3,363 worth of water.

Our system would cost about $85,000. Our system would pay for itself in 25 years.


practice field
97,000 s.f.
game
field
70,000
s.f.
two 42,000 gallon
underground tanks
pumphouse
collector box
150,000 s.f
of collection
area
tennis
39,000
sf
curb and gutter
to collector box
roof
14,000
roof
24,600
s.f.
Sabinal Schools
Scale:1"= 100'
parking
73,000 sf

Sabinal High School



| | | Sabinal High School | | | | | |
|---|---|---|---|---|---|---|---|
| **amount** | **units** | **Description** | **materials unit cost** | **materials total** | **labor unit cost** | **labor total** | **misc. or subcontractors** |
| | | **1 General Requirements** | | 0 | | | |
| 1 | ea | safety materials | 500 | 500 | | | |
| 1 | ea | permits | 200 | 200 | | | |
| 1 | ea | scaffolds /tools | 1000 | 1000 | | | |
| | | | | 0 | | | |
| | | engineers….civil | | | | | 3000 |
| | | …. Structural | | | | | 1000 |
| | | …..licensed irrigator | | | | | 1000 |
| | | | | | | | |
| | | | | 0 | | | |
| | | **2 Site Work** | | 0 | | | |
| | | excavation for underground tank/ dirt stockpiled on site | | 0 | | | 4500 |
| | | excavate for footings. | | | | | 2000 |
| | | fencing | | 0 | | | |
| 100 | lf | silt fence | 0.5 | 50 | | | |
| | | | | 0 | | | |
| | | **3 Tanks** | | 0 | | | |
| 2 | ea | concrete 42,000 gallons with R-panel roof | 22000 | 44000 | | | |
| 225 | lf | retaining walls around tanks | 18 | 4050 | | | |
| | | | | 0 | | | |
| | | **4 Collector boxes and pipes** | | 0 | | | |
| 1 | **ea** | concrete collector box | 500 | 500 | | | |
| 40 | **lf** | 12" PVC pipe to tank | 13.71 | 548.4 | | | |
| 350 | **lf** | curb and gutter | 5 | 1750 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **5 Gutters and downspouts** | | 0 | | | |
| 11 | ea | down spout ..funnel/screen/4" SDR 35 | 50 | 550 | | | |
| 900 | lf | 6" SDR35 trunklines.. | 2.89 | 2601 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **6 Pump house and Pumps** | | 0 | | | |
| 1 | ea | pump house or "hot box" | 5000 | 5000 | | | |
| 1 | ea | pump/controller/pressure tank/ valves | 5500 | 5500 | | | |
| 1 | ea | filter/recirculate valves/timer | 700 | 700 | | | |
| 2 | ea | water meters | 500 | 1000 | | | |
| 1 | ea | RPZ (reduced pressure zone) | 500 | 500 | | | |
| | | plumber…hook up RPZ | | 0 | | | 500 |
| 100 | lf | 3" Sched 40 fill pipes | 3 | 300 | | | |
| 400 | lf | 3" sched. 40 pipes to field | 3 | 1200 | | | |
| | | electrician…hook up electrical/ pump | | 0 | | | 1500 |
| 1 | ea | electrical Supply. (poles/transformers/ switchgear | 1000 | 1000 | | | |
| | | | | 0 | | | |
| | | Total | | 70949.4 | 0 | 0 | 13500 |
| | | grand total | | | | | 84449.4 |

Note....No Labor Included !!!

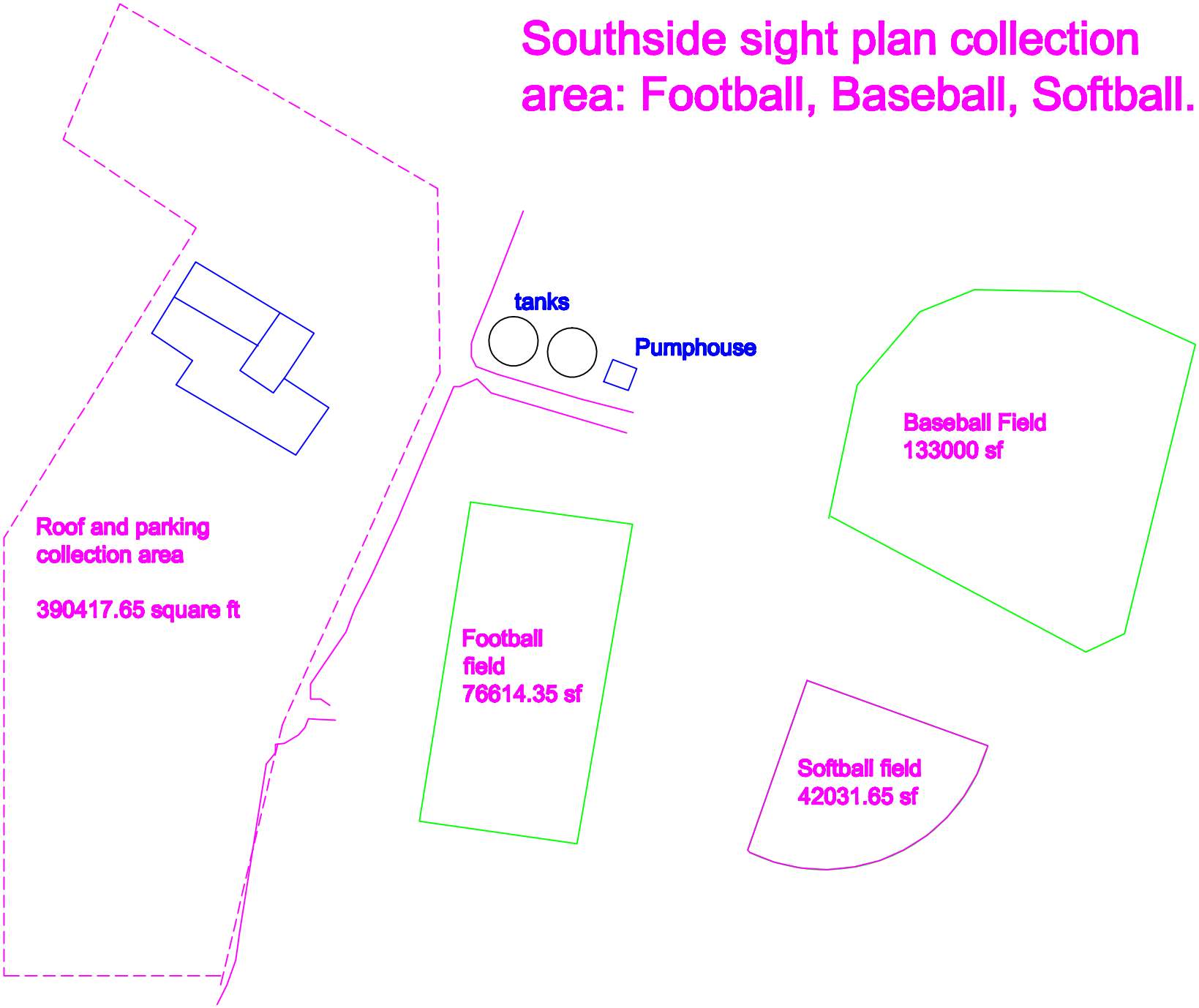
Chapter 10 Rainwater collection system for Southside High School by Greg Macias

Southside High School is located in the city of San Antonio, TX.
Over 1400 students attend Southwest high school and it does have a Building Trades Program at the school.

The school currently gets its water from the city of San Antonio which it pumps out of the Edwards aquifer. Water costs about $.35/100 gallons. Our system will be collecting water off of the roofs and parking. We have approximately 400,000 square feet of collection area. One inch of rain will generate about 200,000 gallons of water. The water will be used to help reduce the costs of watering the football field, baseball field, and softball field. With 28" of rain per year, the school could catch 5 million gallons per year. More realistically, we could catch 1 million gallons a year. At .35/100 gal. , that equals $3,500 worth of water. Our system will cost about $83,000. It would pay for itself in 24 years.

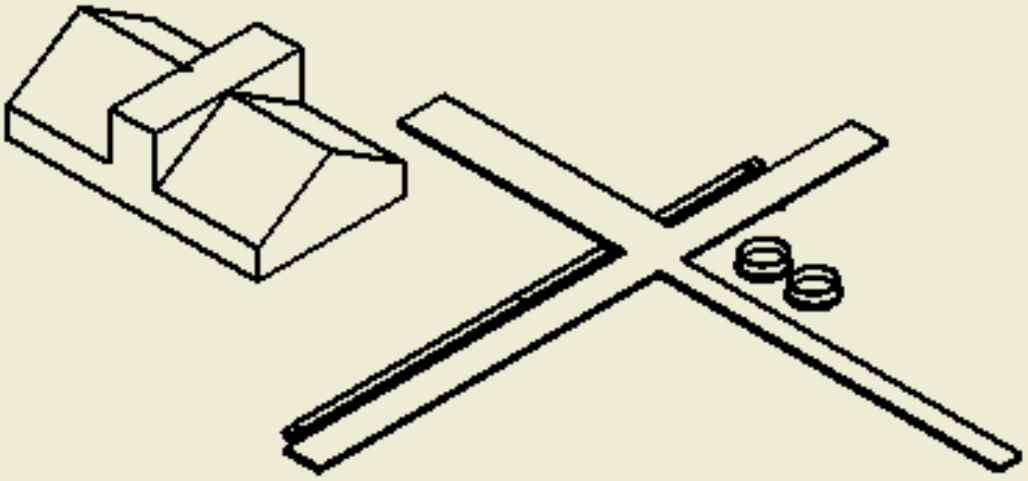
The two tanks will be buried under ground.

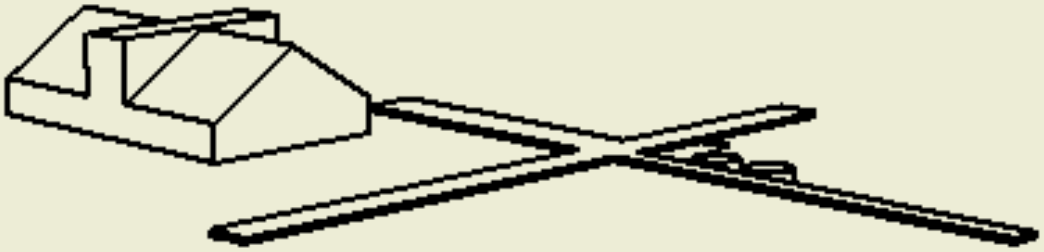
# Southside sight plan collection area: Football, Baseball, Softball.



# Southside High School

Macias... 12-16-13





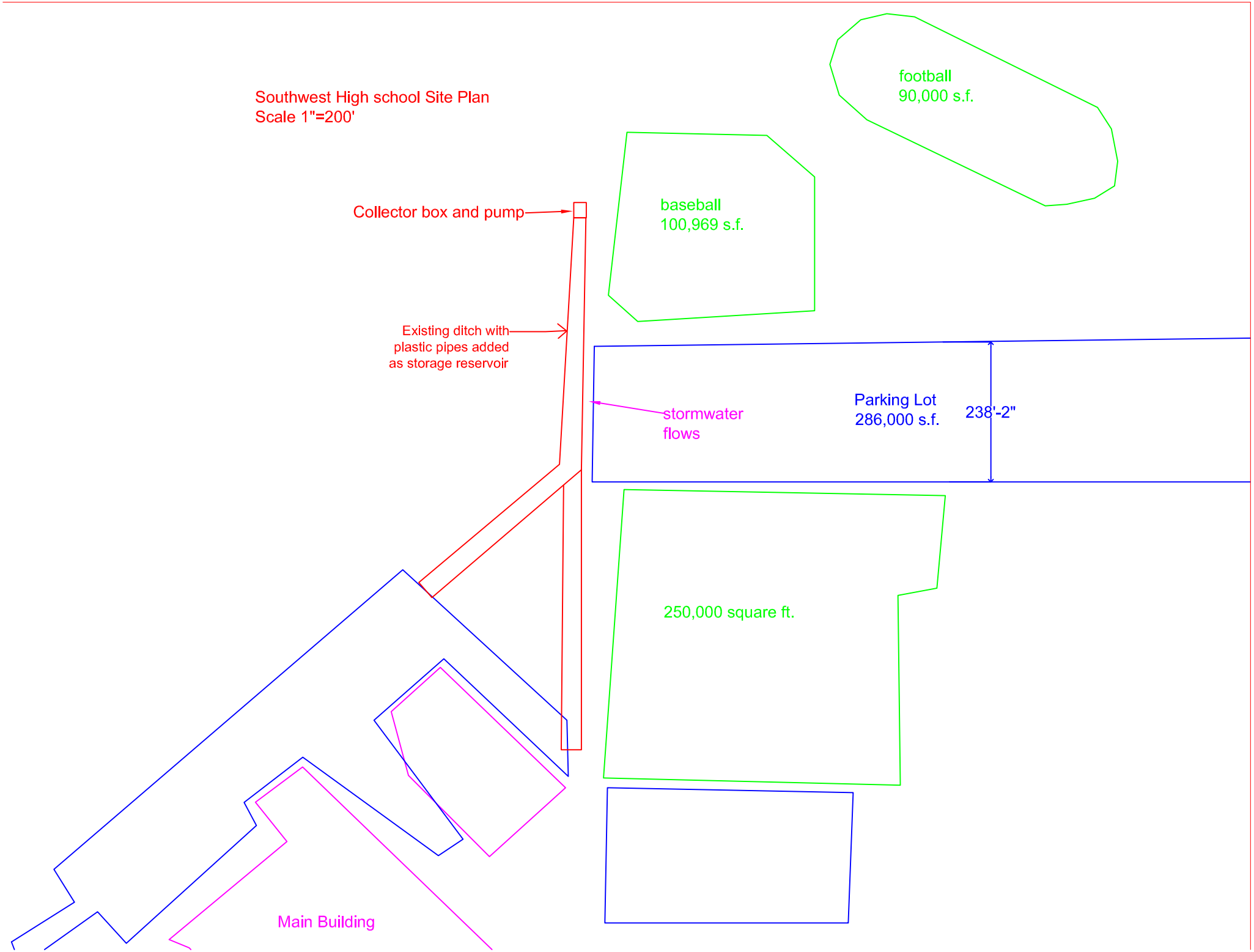
Chapter 10 Rainwater collection system for Southwest High School by Tylor Perry

Southwest High School is located in the city of San Antonio, TX.
Over 3000 students attend Southwest high school and it does have a Building Trades Program at the school.

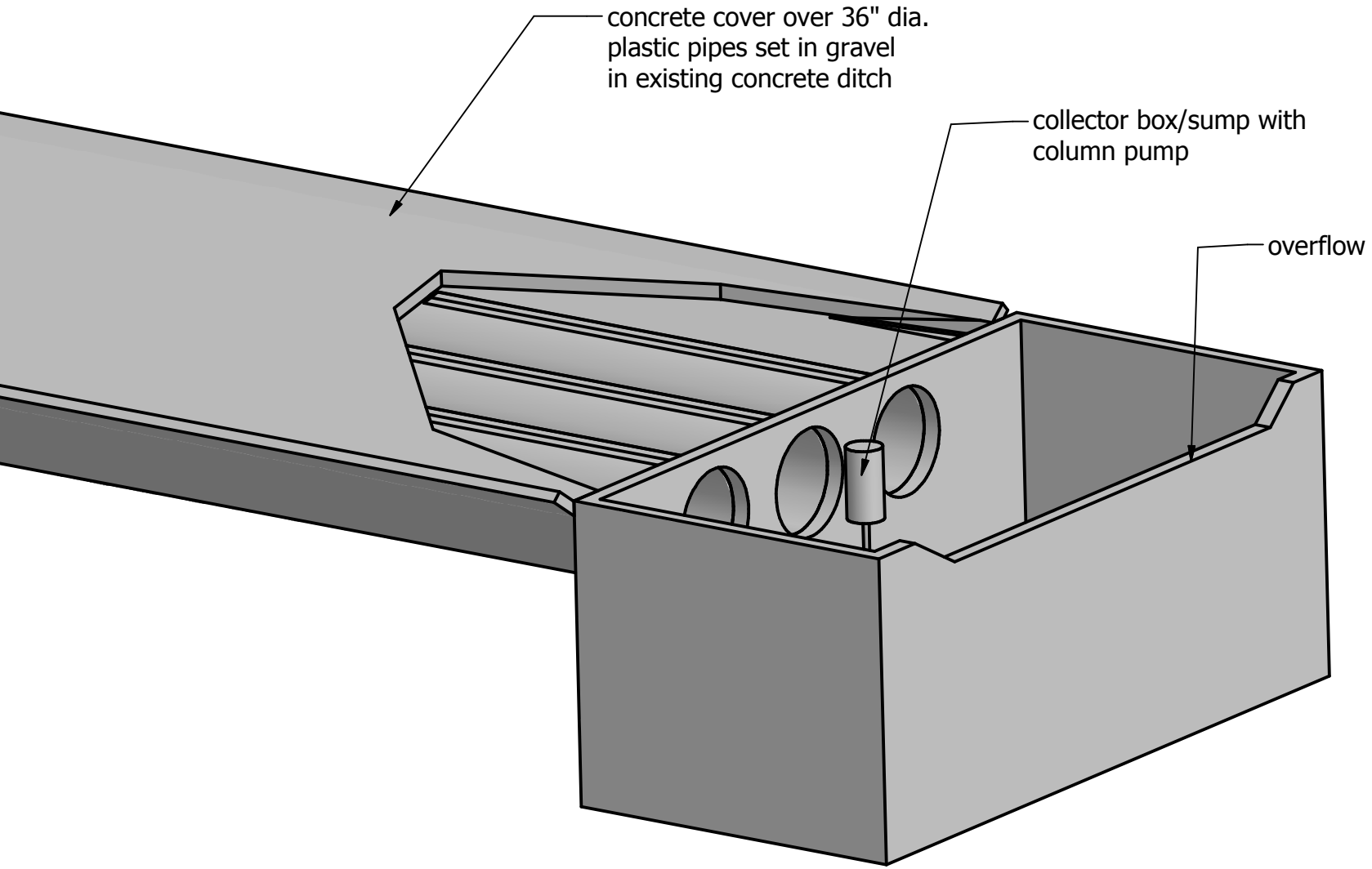
The school currently gets its water from the city of San Antonio which it pumps out of the Edwards aquifer. Water costs about $.35/100 gallons. The system we are proposing for Southwest High School consists of catching water off of the parking lot and storing it in plastic pipes by ADS (64,000 gal.) laid in an existing concrete ditch. The untreated water will be used to water the practice fields. The system will catch water off of a 280,400 square foot segment of a parking lot.

With 28" of rain per year, the school could catch 5 million gallons per year. More realistically we could catch 1 million gallons a year. At .35/100 gal. , that equals $3,500 worth of water. Our system will cost about $83,000. It would pay for itself in 24 years.

Editor's note: We were trying to make use of the existing drainage ditch as the storage reservoir. There may be other ways to make a long concrete ditch leak-proof. Another method would be to construct a dam in the drainage ditch (making it a settling pond) with 15" dia. pipes leading to concrete tanks set below the hill similar to our idea for Warren High School. One problem to consider is the flood plain of the river and the fact that an empty tank would become a boat in a flood.


Southwest High school Site Plan
Scale 1"=200'
football
90,000 s.f.
baseball
100,969 s.f.
Collector box and pump
Existing ditch with
plastic pipes added
as storage reservoir
stormwater
flows
Parking Lot
286,000 s.f.
238'-2"
250,000 square ft.
Main Building

# Southwest High School



| Southwest High School | | | | | | | |
|---|---|---|---|---|---|---|---|
| Amount | Units | **Description** | **materials unit cost** | **materials total** | **labor unit cost** | **labor total** | **misc. or subcontractors** |
| | | **General Requirements** | | 0 | | | |
| 1 | each | safety materials | 500 | 500 | | | |
| 1 | each | permits | 100 | 100 | | | |
| | | | | | | | |
| | | engineers….civil | | | | | 3000 |
| | | …. Structural | | | | | 1000 |
| | | …..licensed irrigator | | | | | 1000 |
| | | | | 0 | | | |
| | | **Site Work** | | 0 | | | |
| 100 | lf | silt fence | 0.5 | 50 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **Tanks** | | 0 | | | |
| 1200 | lf | 36" dia. ADS plastic corrugated PIPE(64000 gal.) | 40 | 48,000 | | | |
| 98 | cy | concrete cover | 85 | 8,330 | | | |
| 186 | cy | gravel fill | 5 | 930 | | | |
| | | | | 0 | | | |
| | | **Collector boxes and pipes** | | 0 | | | |
| **1** | **ea** | concrete collector box at end of ADS Plastic pipes | 1500 | 1,500 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **6 Pump house and Pumps** | | 0 | | | |
| 1 | ea | pump house or "hot box" | 5000 | 5000 | | | |
| 1 | ea | pump/controller/pressure tank/ valves | 5500 | 5500 | | | |
| 1 | ea | filter/recirculate valves/timer | 700 | 700 | | | |
| 2 | ea | water meters | 500 | 1000 | | | |
| 1 | ea | RPZ (reduced pressure zone) | 500 | 500 | | | |
| | | plumber…hook up RPZ | | 0 | | | 500 |
| 100 | lf | 3" Sched 40 fill pipes | 3 | 300 | | | |
| 1000 | lf | 3" sched. 40 pipes to field | 3 | 3000 | | | |
| | | electrician…hook up electrical/ pump | | 0 | | | 1500 |
| 1 | ea | electrical Supply. (poles/transformers/ switchgear | 1000 | 1000 | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | 0 | | | |
| | | Total | | 76410 | 0 | 0 | 7000 |
| | | Grand Total | | | | | 83410 |

Note....No Labor Included !!!

Chapter 11 Rainwater collection system for Tivy High School by Keano Jannell

Tivy High School is located in the city of Kerrville, TX.

1333 students attend Kerrville and there is a Building Trades Program at the school.

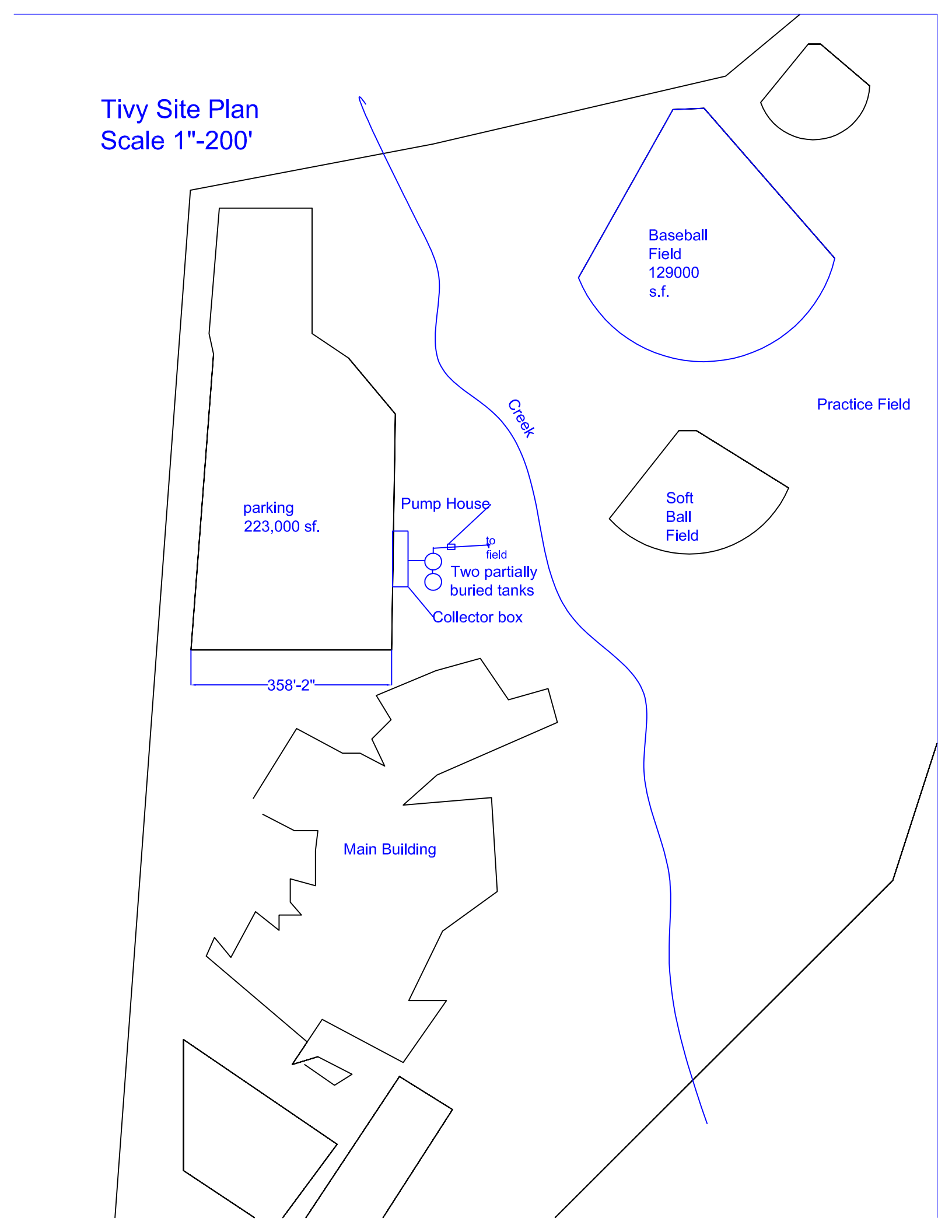
The school currently gets its water from the city of Kerrville which pumps it out of the Guadalupe River and the Trinity aquifer.

Water costs $ .54/100 gallons for 65, 000 g.

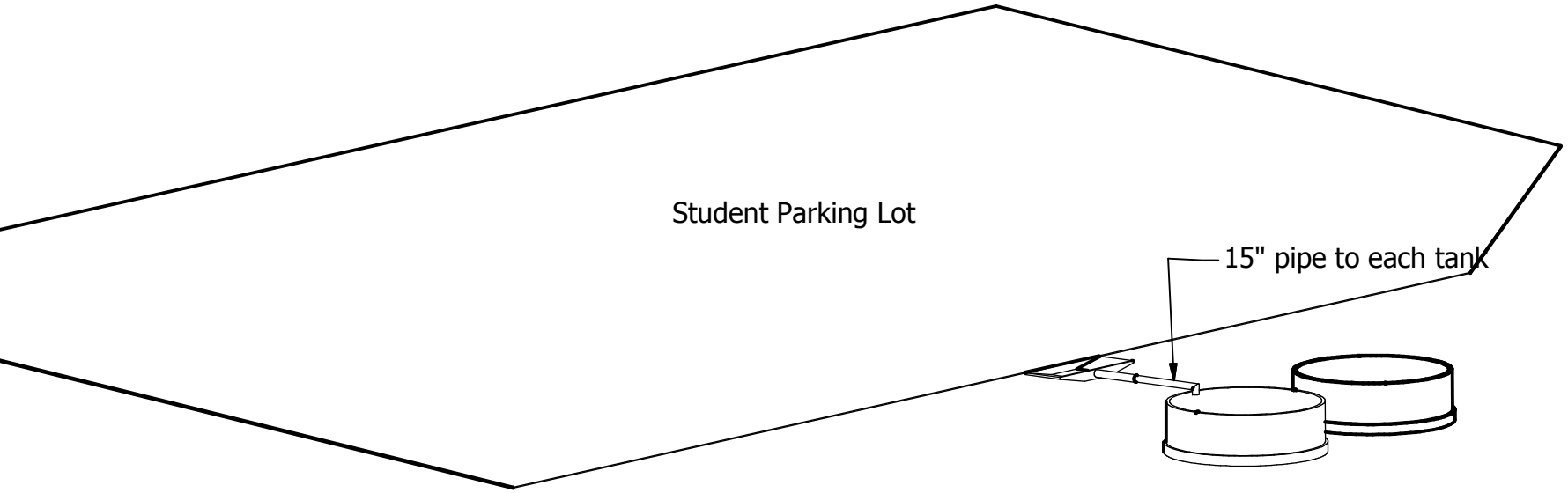
The system we are proposing for Kerrville consists of catching water from the parking lot. The water will be stored in front of the school in two partially dug in concrete tanks. The untreated water will then be used to irrigate the practice field and baseball fields. This system assumes we will catch off a 171, 000 square feet of a parking area. A one inch rainfall should produce about 106, 000 gallons of water. Two tanks would be able to catch and store 70, 000 gallons maximum per rain event.

Kerrville receives on average 32” of rain per year. With 171, 000 square feet of parking lot we could catch 3, 392, 000 gallons of water per year. (171, 000 S.F. x .625 gal/ S.F. x 32”= 3, 392, 000 gallons) A more realistic estimate would be that we would catch 30% of the total possible... 1, 000, 000 gallons. (We will lose some due to a huge collection area). At $ .54/100 gallons, a million gallons equals $5, 400 worth of water.

Our system would cost about $73, 000 for materials only (we are assuming the students would build it.) If we produced $5, 400 worth of water per year it would pay off for itself in 14 years.


Tivy Site Plan
Scale 1"-200'
Baseball
Field
129000
s.f.
Practice Field
Creek
Soft
Ball
Field
parking
223,000 sf.
Pump House
to
field
Two partially
buried tanks
Collector box
358'-2"
Main Building

# Tivy High School



| | | Tivy High School….estimate | | | | | |
|---|---|---|---|---|---|---|---|
| **amount** | **units** | **Description** | **materials unit cost** | **materials total** | **labor unit cost** | **labor total** | **misc. or subcontractors** |
| | | **1 General Requirements** | | 0 | | | |
| 1 | ea | safety materials | 500 | 500 | | | |
| 1 | ea | permits | 200 | 200 | | | |
| 1 | ea | scaffolds /tools | 1000 | 1000 | | | |
| | | | | 0 | | | |
| | | engineers….civil | | | | | 3000 |
| | | …. Structural | | | | | 1000 |
| | | …..licensed irrigator | | | | | 1000 |
| | | | | | | | |
| | | | | 0 | | | |
| | | **2 Site Work** | | 0 | | | |
| | | excavation for underground tank/ dirt stockpiled on site | | 0 | | | 2500 |
| 200 | lf | fencing | 2 | 400 | | | |
| 100 | lf | silt fence | 0.5 | 50 | | | |
| | | | | | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **3 Tanks** | | 0 | | | |
| 2 | ea | concrete 42,000 gallons with R-panel roof | 22000 | 44000 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **4 Collector boxes and pipes** | | 0 | | | |
| 1 | **ea** | concrete collector box and curb and gutter | 2000 | 2000 | | | |
| 50 | **lf** | 15" dia. Corrugated steel pipe | 12.41 | 620.5 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **6 Pump house and Pumps** | | 0 | | | |
| 1 | ea | pump house or "hot box" | 5000 | 5000 | | | |
| 1 | ea | pump/controller/pressure tank/ valves | 5500 | 5500 | | | |
| 1 | ea | filter/recirculate valves/timer | 700 | 700 | | | |
| 2 | ea | water meters | 500 | 1000 | | | |
| 1 | ea | RPZ (reduced pressure zone) | 500 | 500 | | | |
| | | plumber…hook up RPZ | | 0 | | | 500 |
| 100 | lf | 3" Sched 40 fill pipes | 3 | 300 | | | |
| 200 | lf | 3" sched. 40 pipes to field | 3 | 600 | | | |
| | | electrician…hook up electrical/ pump | | 0 | | | 1500 |
| 1 | ea | electrical Supply. (poles/transformers/ switchgear | 1000 | 1000 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | Total | | 63370.5 | 0 | 0 | 9500 |

Note….No Labor Included !!!

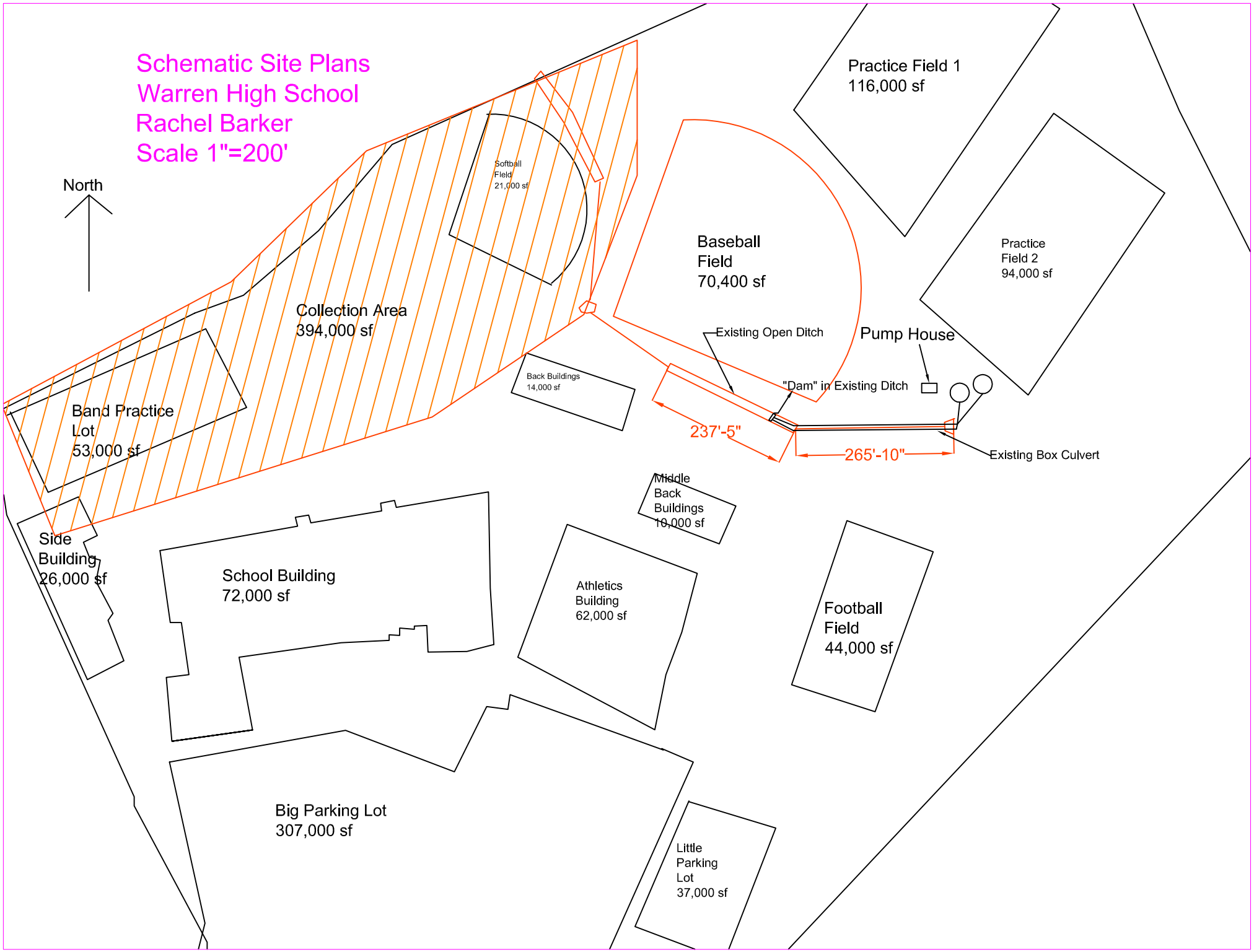
## Chapter 12 Rainwater Collection System for Earl Warren High School by Rachel Barker

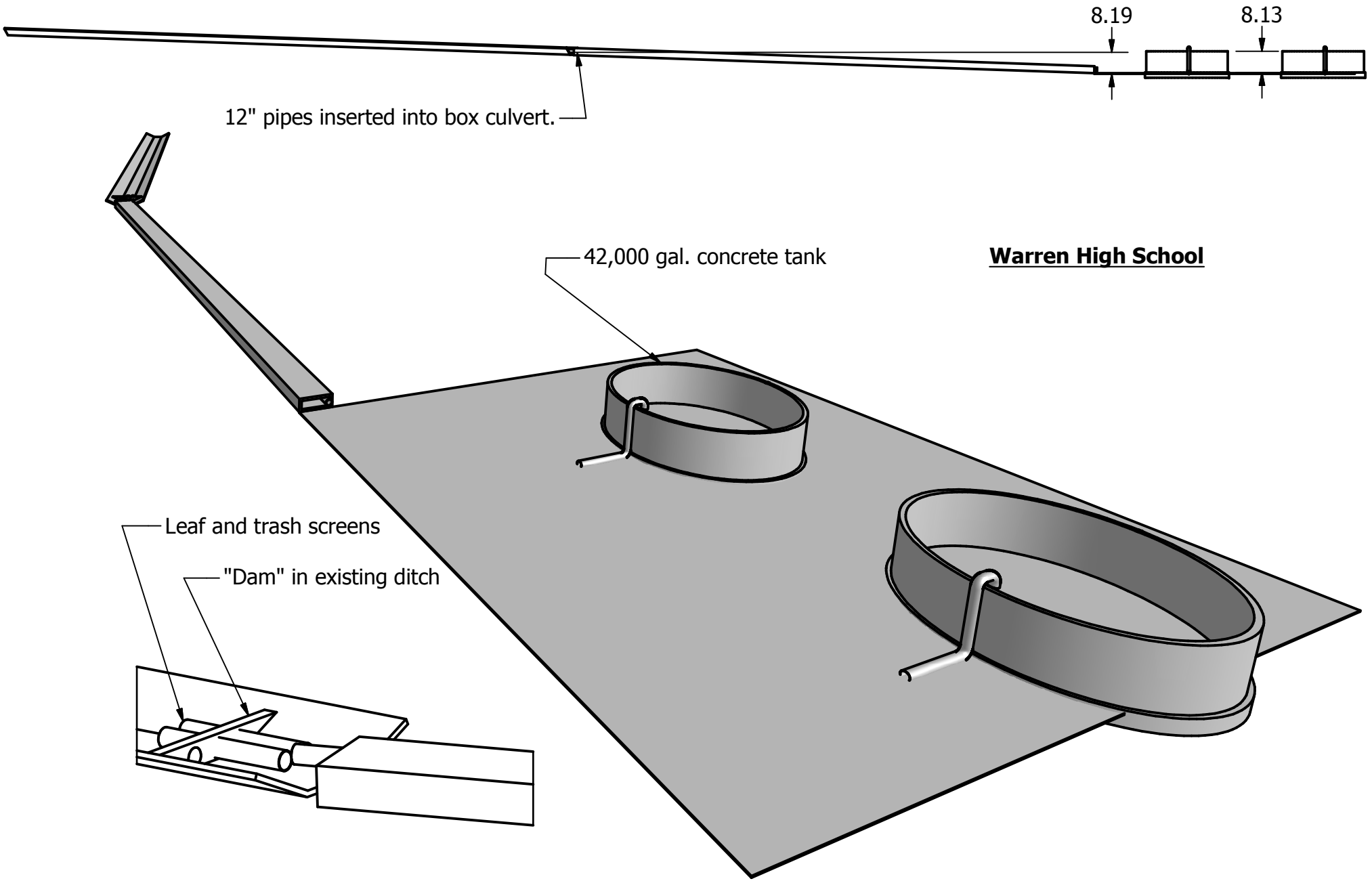
Earl Warren High School is located in the city of San Antonio, TX. 2548 students attend with a focus on Building Trades at the Construction Careers Academy. The school currently gets its water from city of San Antonio which pumps it out of the Edwards Aquifer. Water costs $.35/100 gallons.

The system we are proposing for Earl Warren High School consists of catching water out of the existing storm ditch and storing the water in two above-ground concrete tanks. This ditch appears to be the drainage for about 11 acres of fields, parking and buildings plus the adjacent subdivision. The untreated water will then be used to irrigate the athletic fields. This system assumes we will catch water off of 200,000 square feet of area. A one inch rainfall should produce about 100,000 gallons of water. That would more than fill up two tanks.

Earl Warren receives on average 32" of rain per year. With 200,000 square feet of catchment area we could catch a total of four million gallons of rain per year. A more realistic estimate would be that we would catch a million gallons with 2 tanks. At .35/100 gallons, that equals $3, 500 worth of water.

Our system would cost about $73,000 for materials only (we are assuming the students would build it.) If we produced $3, 500 worth of water per year it would pay for itself in 21 years.


Schematic Site Plans
Warren High School
Rachel Barker
Scale 1"=200'
North
Softball Field 21,000 sf
Practice Field 1 116,000 sf
Baseball Field 70,400 sf
Practice Field 2 94,000 sf
Collection Area 394,000 sf
Existing Open Ditch
Pump House
"Dam" in Existing Ditch
Back Buildings 14,000 sf
237'-5"
265'-10"
Existing Box Culvert
Band Practice Lot 53,000 sf
Middle Back Buildings 10,000 sf
Side Building 26,000 sf
School Building 72,000 sf
Athletics Building 62,000 sf
Football Field 44,000 sf
Big Parking Lot 307,000 sf
Little Parking Lot 37,000 sf


8.19
8.13
12" pipes inserted into box culvert.
42,000 gal. concrete tank
Warren High School
Leaf and trash screens
"Dam" in existing ditch

| | Cost estimate for rainwater collection system….Warren High School | | | | | | |
|---|---|---|---|---|---|---|---|
| Sections or Units | Units | Descripition | Materials unit cost | Materials Total | Labor unit cost | labor total | Misc. or subcontractors |
| | | **1General Requirements** | | 0 | | | |
| 1 | ea | permits | 100 | 100 | | | |
| 1 | ea | Safety equipment | 1500 | 1500 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **2 Site Work** | | 0 | | | |
| | | | | | | | |
| 100 | lin. Ft. | Silt Fence | 0.5 | 50 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **3 Tanks** | | 0 | | | |
| 2 | ea | Concrete Tank | 23000 | 46000 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **4 Collector Boxes and pipes** | | 0 | | | |
| 700 | **ft** | 12" PVC sdr 35 | 13.71 | 9597 | | | |
| 1 | ea | concrete dam | 500 | 500 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | | | 0 | | | |
| | | **6 Pump House and Pumps** | | 0 | | | |
| 1 | ea | pump house or "hot box" | 5000 | 5000 | | | |
| 1 | ea | pump/controller/pressure tank/ valves | 5500 | 5500 | | | |
| 1 | ea | filter/recirculate valves/timer | 700 | 700 | | | |
| 2 | ea | water meters | 500 | 1000 | | | 1200 |
| 1 | ea | RPZ (reduced pressure zone) | 500 | 500 | | | |
| | | plumber…hook up RPZ | | 0 | | | 500 |
| 500 | lf | 3" Sched 40 fill pipes | 3 | 1500 | | | |
| 500 | lf | 3" sched. 40 pipes to field | 3 | 1500 | | | |
| | | electrician…hook up electrical/ pump | | 0 | | | 1500 |
| 1 | ea | electrical Supply. (poles/transformers/ switchgear | 1000 | 1000 | | | |
| | | | | 0 | | | |
| | | Total | | 69947 | | | 3200 |