# Appendix D

# Cost Data Development

MONTGOMERY WATSON

| | | | |
|---|---|---|---|
| BY T. Visosky | DATE 01/09/03 | CLIENT GCWA – Trinity Transfer Study | SHEET 1 of 1 |
| CHKD. BY | DESCRIPTION SH 3 Corridor Evaluation | JOB NO. 1650250 | |

**Goal:** Select pipeline routing for connecting expanded CWA to GCWA Reservoir.
Determine pipeline length, pump station requirements

**Assumptions:**

| | | | | | |
|---|---|---|---|---|---|
| Flow Required | $Q_{total}$ | = | | 175 | MGD |
| Available Head at CWA Connection | $H_{CWA}$ | = | | 15 | ft |
| <u>Reservoir Elevations</u> | | | | | |
| Bottom | $H_{Min}$ | = | | 0 | ft |
| Current Max | $H_{Cur}$ | = | | 15 | ft |
| <u>Pipeline</u> | | | | | |
| Hazen Williams Friction | C | = | | 140 | |
| Minor Losses | | = | | 4% | of calculated headloss |
| 84" TWDB Cost (ENR CCI 6018) | | | | $9.11 | interpolated (50% urban/50% rural) |
| 84" Cost (ENR CCI 6588) | | = | $ | 9.97 | /dia. in./ft |
| 84" Tunneling TWDB Cost (ENR CCI 6018) | | | | $22.00 | /dia in/ft |
| 84" Tunneling (ENR CCI 6588) | | | $ | 24.08 | /dia. in./ft |
| CWA Expansion Construction (from HBR) | | = | $ | 80,000,000 | |
| CWA Expansion Contingency (from HBR) | | = | $ | 12,000,000 | |
| CWA Expansion Engineering (from HBR) | | = | $ | 18,000,000 | |
| <u>Pump Station</u> | | | | | |
| Pump Efficiency | | = | | 80% | |
| Motor Efficiency | | = | | 90% | |
| 4700 hp TWDB Cost (ENR CCI 6018) | | | $ | 13,801,000 | interpolated |
| 4700 hp Cost (ENR CCI 6588) | | | $ | 15,108,173 | |
| <u>Power Costs</u> | | | | | |
| Annual Operation | | | | 80% | (2050 avg vs 2050 peak) |
| Electricity Cost (ENR CCI 6018) | | | $ | 0.06 | /kwH |
| Electricity Cost (ENR CCI 6588) | | | $ | 0.066 | /kwH |
| <u>Other O&M Costs</u> | | | | | |
| Other Pipeline O&M Costs | | | | 1% | of Constuction Cost |
| Other Pump Station O&M Costs | | | | 2.5% | of Constuction Cost |
| CWA | | | $ | 0.10 | /1000 gallons |
| Dept Service | | | | 30 | years |
| Annual Capital Cost (6% ammortized) | | | | 7.26% | annually |
| <u>Other Costs</u> | | | | | |
| Other Costs | | | | 22% | of Constuction Cost |
| <u>Contingency</u> | | | | | |
| Contingency | | | | 20% | of Constuction Cost |

MONTGOMERY WATSON

| | | | | | |
|---|---|---|---|---|---|
| BY T. Visosky | DATE 01/09/03 | CLIENT GCWA – Trinity Transfer Study | | SHEET 1 of 1 |
| CHKD. BY ______ | DESCRIPTION SH 3 Corridor Evaluation | | JOB NO. 1650250 | |

**Calculations:**

| | | Framework Project 175 |
|---|---|---|
| Total Length | mi. | 17.9 |
| - Length of Tunnel | mi. | 0.57 |
| Elevation Head Available | | |
| - H | ft | 0 |
| Pipeline | | |
| - Diameter | in | 84 |
| - Velocity | ft/sec | 7.0 |
| - Friction Loss | ft | 122 |
| Pump Station | | |
| - Total head | ft | 122 |
| - Water Power | hp | 3,738 |
| - Duty Pumps | # | 5 |
| - Standby Pumps | # | 0 |
| - Pump Size | hp | 1,038 |
| | gpm | 24,347 |
| - Total PS Power | hp | 5,192 |
| - Rounded PS | hp | 5,200 |

| Construction Cost (millions) | | | | rounded |
|---|---|---|---|---|
| Pipeline | | $ 82.7 | $ | 74 |
| CWA Expansion | | $ 80.0 | $ | 80 |
| Pump Station | | $ 15.1 | $ | 15 |
| Total | | *$ 177.9* | $ | 178 |
| Contingency | $M | *$ 19.6* | *$* | *18* |
| Contingency CWA | $M | *$ 12.0* | *$* | *12* |
| Contingency Subtotal | $M | *$ 31.6* | *$* | *30* |
| Subtotal | $M | *$ 209.4* | *$* | *208* |
| Other Costs | $M | *$ 25.8* | *$* | *23* |
| Other Costs CWA | $M | *$ 18.0* | *$* | *18* |
| Other Costs Subtotal | $M | *$ 43.8* | *$* | *41* |
| Subtotal | $M | *$ 253.3* | *$* | *249* |

| | | |
|---|---|---|
| Pumping Cost | $M/year | $ 1.8 |
| Other O&M Cost | $M/year | $ 1.2 |
| CWA Cost | $M/year | $ 1.0 |
| Annual Capital Cost | $M/year | $ 18.4 |
| Total O&M Cost | $M/year | $ 22.4 |
| **Total Costs** | **$/TG** | ***$ 0.35*** |

MONTGOMERY WATSON

BY T. Visosky DATE 10/23/02 CLIENT GCWA – Trinity Transfer Study SHEET 1 of 1

CHKD. BY ________ DESCRIPTION Residential Streets to Utility Passageway to Route 3 Evaluation Evaluation JOB NO. 1650250

**Goal:** Select pipeline routing for connecting expanded CWA to GCWA Reservoir.
Determine pipeline length, pump station requirements

**Assumptions:**

| | | | | | |
|---|---|---|---|---|---|
| Flow Required | $Q_{total}$ | = | | 175 | MGD |
| Available Head at CWA Connection | $H_{CWA}$ | = | | 15 | ft |
| Reservoir Elevations | | | | | |
| Bottom | $H_{Min}$ | = | | 0 | ft |
| Current Max | $H_{Cur}$ | = | | 15 | ft |
| Pipeline | | | | | |
| Hazen Williams Friction | C | = | | 140 | |
| Minor Losses | | = | | 4% | of calculated headloss |
| 84" TWDB Cost (ENR CCI 6018) | | | | $9.11 | interpolated (50% urban/50% rural) |
| 84" Cost (ENR CCI 6588) | | = | $ | 9.97 | /dia. in./ft |
| 84" Tunneling TWDB Cost (ENR CCI 6018) | | | | $22.00 | /dia in/ft |
| 84" Tunneling (ENR CCI 6588) | | | $ | 24.08 | /dia. in./ft |
| CWA Expansion Construction (from HBR) | | = | $ | 80,000,000 | |
| CWA Expansion Contingency (from HBR) | | = | $ | 12,000,000 | |
| CWA Expansion Engineering (from HBR) | | = | $ | 18,000,000 | |
| Pump Station | | | | | |
| Pump Efficiency | | = | | 80% | |
| Motor Efficiency | | = | | 90% | |
| 4700 hp TWDB Cost (ENR CCI 6018) | | | $ | 13,801,000 | interpolated |
| 4700 hp Cost (ENR CCI 6588) | | | $ | 15,108,173 | |
| Power Costs | | | | | |
| Annual Operation | | | | 80% | (2050 avg vs 2050 peak) |
| Electricity Cost (ENR CCI 6018) | | | $ | 0.06 | /kwH |
| Electricity Cost (ENR CCI 6588) | | | $ | 0.066 | /kwH |
| Other O&M Costs | | | | | |
| Other Pipeline O&M Costs | | | | 1% | of Constuction Cost |
| Other Pump Station O&M Costs | | | | 2.5% | of Constuction Cost |
| CWA | | | $ | 0.10 | /1000 gallons |
| Dept Service | | | | 30 | years |
| Annual Capital Cost (6% ammortized) | | | | 7.26% | annually |
| Other Costs | | | | | |
| Other Costs | | | | 22% | of Constuction Cost |
| Contingency | | | | | |
| Contingency | | | | 20% | of Constuction Cost |

MONTGOMERY WATSON

BY T. Visosky DATE 10/23/02 CLIENT GCWA – Trinity Transfer Study SHEET 1 of 1

CHKD. BY ________ DESCRIPTION Residential Streets to Utility Passageway to Route 3 Evaluation JOB NO. 1650250

**Calculations:**

| | | Framework Project |
|---|---|---|
| | | 175 |
| Total Length | mi. | 16 |
| - Length of Tunnel | mi. | 0.57 |
| Elevation Head Available | | |
| - H | ft | 0 |
| Pipeline | | |
| - Diameter | in | 84 |
| - Velocity | ft/sec | 7.0 |
| - Friction Loss | ft | 109 |
| Pump Station | | |
| - Total head | ft | 109 |
| - Water Power | hp | 3,341 |
| - Duty Pumps | # | 5 |
| - Standby Pumps | # | 0 |
| - Pump Size | hp | 928 |
| | gpm | 24,347 |
| - Total PS Power | hp | 4,641 |
| - Rounded PS | hp | 4,700 |

| Construction Cost (millions) | | | | rounded | |
|---|---|---|---|---|---|
| Pipeline | | $ | 74.3 | $ | 74 |
| CWA Expansion | | $ | 80.0 | $ | 80 |
| Pump Station | | $ | 15.1 | $ | 15 |
| Total | | $ | 169.4 | $ | 170 |
| Contingency | $M | $ | 17.9 | $ | 18 |
| Contingency CWA | $M | $ | 12.0 | $ | 12 |
| Contingency Subtotal | $M | $ | 29.9 | $ | 30 |
| Subtotal | $M | $ | 199.3 | $ | 200 |
| Other Costs | $M | $ | 23.6 | $ | 23 |
| Other Costs CWA | $M | $ | 18.0 | $ | 18 |
| Other Costs Subtotal | $M | $ | 41.6 | $ | 41 |
| Subtotal | $M | $ | 240.9 | $ | 241 |
| Pumping Cost | $M/year | $ | 1.6 | | |
| Other O&M Cost | $M/year | $ | 1.1 | | |
| CWA Cost | $M/year | $ | 1.0 | | |
| Annual Capital Cost | $M/year | $ | 17.5 | | |
| Total O&M Cost | $M/year | $ | 21.2 | | |
| **Total Costs** | **$/TG** | **$** | **0.40** | | |

features & covers
Buildings
Business & Labor
Education
Environment
Power & Industrial
e-Construction
Transportation
International
Construction Economics



# most recent cost indexes

## Listed in ENR's December 2, 2002 Issue

### Construction Cost Index

Despite a 0.2% decline this month, annual inflation measured by the CCI increased from 2.6 to 2.7%.

| 20-CITY: 1913=100 | Dec. 2002 Index Value | % chg. Month | % chg. Year |
|---|---|---|---|
| **CONSTRUCTION COST** | 6562.73 | -0.2 | +2.7 |
| **COMMON LABOR** | 14021.05 | 0.0 | +4.2 |
| WAGE $/HR. | 26.64 | 0.0 | +4.2 |

### Building Cost Index

Lower material prices offset a 0.1% increase in the BCI's labor component, holding annual inflation to 1.8%.

| 20-CITY: 1913=100 | Dec. 2002 Index Value | % chg. Month | % chg. Year |
|---|---|---|---|
| **BUILDING COST** | 3640.11 | -0.4 | +1.8 |
| **SKILLED LABOR** | 6338.14 | +0.1 | +4.5 |
| WAGE $/HR. | 35.18 | +0.1 | +4.5 |

### Materials Cost Index

Lower lumber prices dragged the MCI down 1.2%, keeping the index 3.2% below a year ago.

| 20-CITY: 1913=100 | Dec. 2002 Index/Price | % chg Month | % chg. Year |
|---|---|---|---|
| **MATERIALS** | 1991.51 | -1.2 | -3.2 |
| **CEMENT** $/TON | 82.70 | 0.0 | +1.1 |
| **STEEL** $/CWT | 26.42 | -0.1 | -4.2 |
| **LUMBER** $/MBF | 442.05 | -3.0 | -2.5 |

Click here to view the ENR Cost Indexes FAQ'S >>

**Job:** Gulf Coast Water Authority Trinity River Conveyance Study
**Client:** Gulf Coast Water Authority

| Comment No. | From | Page No. | Table No. | Figure No. | Paragraph | Comment | Response | Version |
|---|---|---|---|---|---|---|---|---|
| 1 | Robert Istre; GCWA | ES-4 | - | - | 2 | change 'temporary' to 'short-term water' | changed | September 2002 |
| 2 | Robert Istre; GCWA | ES-7 | - | ES-7 | - | First phase change to 30 MGD from 40 MGD | changed | September 2003 |
| 3 | Robert Istre; GCWA | ES-7 | - | - | 1 | change '2010' and '2019' to'2013' and '2025' | changed | September 2002 |
| 4 | Robert Istre; GCWA | 1-3 | - | - | 2 | change 'prior' to 'in' | changed | September 2002 |
| 5 | Robert Istre; GCWA | 2-1 | - | - | 3 | Confirm source of '148 MGD' min. recorded flow of the Brazos River | confirmed | September 2002 |
| 6 | Robert Istre; GCWA | 2-2 | - | - | 2 | change 'field tests indicate that' to 'current' | changed | September 2002 |
| 7 | Robert Istre; GCWA | 2-2 | - | - | 2 | change 'installed' to 'available' | changed | September 2002 |
| 8 | Robert Istre; GCWA | 2-2 | - | - | 2 | delete 'in the range of' | deleted | September 2002 |
| 9 | Robert Istre; GCWA | 2-2 | - | - | 2 | change '260 mgd' to '203 mgd' | changed | September 2002 |
| 10 | Robert Istre; GCWA | 2-2 | - | - | 2 | add 'to' | added | September 2002 |
| 11 | Robert Istre; GCWA | 2-2 | - | - | 3 | delete 'primarily' | deleted | September 2002 |
| 12 | Robert Istre; GCWA | 2-2 | - | - | 3 | add 'not' | added | September 2002 |
| 13 | Robert Istre; GCWA | 2-2 | - | - | 3 | delete 'but the ... American Canal' | deleted | September 2002 |
| 14 | Robert Istre; GCWA | 2-2 | 2-2 | - | - | change 'B-4' to 'Ranch'..add 'Take Point' | incorporated | September 2002 |
| 15 | Robert Istre; GCWA | 2-4 | - | - | 9 | Confirm capacity of Lynchburg Reservoir - 1.5 BG | confirmed | September 2002 |
| 16 | Robert Istre; GCWA | 2-4 | - | 2-3 | | Add CWA system capacities | added | September 2002 |
| 17 | Robert Istre; GCWA | 3-2 | 3-1 | - | - | change 'Reliant Energy' to 'Centerpoint'; add it to municipal demand | incorporated | September 2002 |
| 18 | Robert Istre; GCWA | 3-2 | 3-1 | - | - | change 'Union Carbide' to 'Dow Chemicals' | changed | September 2002 |
| 19 | Robert Istre; GCWA | 3-4 | 3-4 | - | - | Give reference for source of Table | incorporated | September 2002 |
| 20 | Robert Istre; GCWA | 3-5 | 3-6 | | | Chocolate Bayou Water Company', 'Solutia' and 'Oxychem' demands switch to Western Service Area demand | incorporated | September 2002 |
| 21 | Robert Istre; GCWA | 3-7 | 3-7 | - | - | Add 'Oxychem', 'Equistar' and 'Chocolate Bayou Water Company' | added | September 2002 |
| 22 | Robert Istre; GCWA | 3-7 | 3-8 | - | - | Update population data for 'Missouri City' | updated | September 2002 |
| 23 | Robert Istre; GCWA | 3-9 | - | - | 3 | change FBSD's proposed GW reduction rules beyond 2025 to show 60% conversion | incorporated; with the qualifier that the FBSD has not yet planned for 2025 and beyond | September 2002 |
| 24 | Robert Istre; GCWA | 3-11 | 3-12 | - | - | delete Sugar Land's surface water requirement for 2010; and change Missouri City's demand in accordance with reduced population information from Lee Dorger-Dir. of Public Works | incorporated | September 2002 |
| 25 | Robert Istre; GCWA | 3-12 | 3-13 | - | - | Add 'Oxychem', 'Equistar' and 'Chocolate Bayou Water Company' | added | September 2002 |
| 26 | Ralph Rundle; CWA | 3-15 | - | - | - | Mention 'Desalination' as 'Other potential raw water sources' | added | September 2002 |

# COST ESTIMATING PROCEDURES TWDB REGION H

The cost estimates of this study are expressed as one of three main categories that were dictated by TWDB guidelines: capital costs, other project costs, and annual project costs. Capital costs consist of all material, labor, and equipment expenses that are expended in the construction activities of a project. Other project costs include expenses that are not directly associated with the construction activities, such as engineering, land and easement acquisition, environmental studies, mitigation, and construction interest. Annual project costs consist of all costs that are incurred by the project upon implementation, either in repayment of borrowed funds or operating and maintaining the facility. Table 1 illustrates the primary components of the preliminary cost estimate. Cost estimating methods for the technical evaluation of alternatives considered for use in Texas TWDB Region H are explained in the following sections.

TABLE 1 MAJOR ESTIMATING CATEGORIES

**PROJECT COSTS**

| CAPITAL COSTS | OTHER PROJECT COSTS |
|---|---|
| 1. Pump Stations | 1. Engineering, Financial & Legal Services, and Contingencies |
| 2. Pipelines | - Includes Design, Bidding & Construction Phase Services, Geotechnical, and Surveying |
| 3. Water Treatment Plants | 2. Land and Easements |
| 4. Water Storage Tanks | - Land Purchases |
| 5. Off-Channel Reservoirs | - Temporary Easements |
| 6. Well Fields | - Permanent Easements |
| - Injection | - Includes Legal Services, Sales Commisions, & Surveying |
| - Recovery | 3. Environmental - Studies and Mitigation |
| - ASR Wells | - Environmental & Archaeology Studies |
| 7. Dams & Reservoirs | - Permitting |
| 8. Relocations | - Mitigation |
| 9. Water Distribution System Improvements | 4. Interest During Construction |
| 10. Other Items | |

| ANNUAL COSTS |
|---|
| 1. Debt Service |
| 2. Operation & Maintenance (O&M) |
| 3. Pumping Energy Costs |
| 4. Purchase of Water (if applicable) |

# 1 CAPITAL COSTS

Capital costs, generally known as construction costs, have been compiled from a variety of reliable sources and analyzed for trends that can be used for estimating purposes. Once a trend has been identified, a set of representative values is entered into a cost table, from which the user can easily and efficiently locate a cost estimate. Each cost table is explained in the detail in the following sections. All data was adjusted to the Second Quarter of 1999 by using the Engineering News Record's Construction Cost Index (ENR CCI) ratio. The ENR CCI value for the Second Quarter of 1999 is 6018, determined by averaging the index values of April, May, and June of 1999 (6008, 6006, and 6039, respectively). For example, to update a representative cost from January of 1997 (ENR CCI value 5765), the cost from January of 1997 would be multiplied by the ratio of 6018 over 5765. The ENR CCI values are based on representative (steel, cement, and lumber) material and labor construction costs, averaged across 20 cities. The index measures the amount of money it would cost to purchase a theoretical quantity of services and goods in one year, as opposed to another. Monthly index values are reported from 1977 to the present and annual average values are reported back to 1908.

## 1.1 Pump Stations

The cost of a pump station depends upon a wide variety of conditions, including pump discharge, pumping head, pump type, site conditions, desired usage, and structural design. In constructing a preliminary estimate of the cost of a pump station, the intent is not to determine the pump type or details of the station structural design, but rather to estimate the cost of a general station capable of pumping the desired discharge at the necessary head conditions. Regional pump station project cost estimates and construction records were used to adjust published EPA historical pump station cost data. By using a comprehensive and reliable source of pump station cost data, recognizing the trend, and then adjusting that trend to similar projects in the region, a representative set of values for this region was determined. The cost table for this section, shown in Table 2, displays the costs for pump stations at a variety of horsepower requirements, based on peak discharge and design head. Higher horsepower requirements may require multiple pump stations.

[redacted] are generally [redacted] o[redacted], depending on the source of the water coming into the station. [redacted] normally [redacted]ch as a river or reservoir, and [redacted] are permitted. [redacted]tations normally act as [redacted]n a plant or pipeline and d[redacted]s since the inlet pipe flow conditions are fairly constant. The total cost for the intake of a pump station has been estimated as an additional 20 percent of the pump station construction cost. While 10 percent is structural additions, the other 10 percent is trash rack screens and miscellaneous rack cleaning equipment.

**TABLE 2 PUMP STATION COSTS**

| Pump Station Horsepower (HP) | Pump Station Construction Cost ($) |
|---|---|
| 0 | 0 |
| 700 | 6,205,000 |
| 1000 | 7,632,000 |
| 2000 | 10,404,000 |
| 3000 | 12,026,000 |
| 4000 | 13,177,000 |
| 5000 | 14,069,000 |
| 6000 | 14,799,000 |
| 7000 | 15,415,000 |
| 8000 | 15,949,000 |
| 9000 | 16,420,000 |
| 10000 | 16,842,000 |
| 12000 | 17,571,000 |
| 15000 | 18,464,000 |
| 20000 | 19,614,000 |

[1] Values as of Second Quarter 1999.
[2] Add 20 percent for pumps stations with intake structures.
[3] Add 35 percent for pumps stations with standby power.

All electrical costs, with the exception of standby power, are included in the base pump station construction cost. Standby power, normally either a diesel generator or a dual power feed, is necessary to insure that the pump station can remain operational in the event of a power failure. Standby power is an optional feature which has been estimated as an additional 35 percent of the base pump station construction cost.

The costs of pump stations located in water treatment plants are accounted for in the water treatment plant cost table.

## 1.2 Pipelines

Pipeline capital costs are dependent upon a variety of factors, including pipe material used, trenching slopes and depths, fill material quality, frequency of valves/fittings, number of obstruction crossings, necessity of pavement removal and replacement, utility interference, traffic control, geologic conditions, and degree of urbanization. Due to the lack of significant quantities of rock in the primarily sandy clay soil of the region, only one soil type was analyzed. Table 3 shows the unit costs for pipe diameters from 12-inches to 144-inches, based on level of urban development.

TABLE 3 PIPELINE UNIT COSTS

| Pipe Diameter (inches) | Rural Construction ($ / LF) | Urban Construction ($ / LF) |
|---|---|---|
| 12 | 55 | 90 |
| 14 | 65 | 110 |
| 16 | 75 | 130 |
| 18 | 90 | 145 |
| 20 | 100 | 165 |
| 24 | 125 | 210 |
| 27 | 145 | 240 |
| 30 | 170 | 280 |
| 33 | 185 | 305 |
| 36 | 205 | 340 |
| 42 | 245 | 405 |
| 48 | 285 | 475 |
| 54 | 335 | 555 |
| 60 | 380 | 635 |
| 64 | 410 | 685 |
| 66 | 430 | 710 |
| 72 | 485 | 805 |
| 78 | 525 | 870 |
| 84 | 575 | 955 |
| 90 | 625 | 1,040 |
| 96 | 675 | 1,125 |
| 102 | 725 | 1,210 |
| 108 | 780 | 1,295 |
| 114 | 830 | 1,385 |
| 120 | 885 | 1,475 |
| 144 | 1,105 | 1,840 |
| [1] Values as of Second Quarter 1999. | | |

The unit costs are based on open cut construction methods, with the exception of special crossings. Special crossings at railroads, streets, and rivers will likely be accomplished by horizontal boring, also known as pipe jacking. Horizontal boring costs are shown in Table 4.

TABLE 4 PIPELINE CROSSING UNIT COSTS

| Pipe Diameter (inches) | Total Cost ($ / LF) |
|---|---|
| 4 | 560 |
| 6 | 565 |
| 8 | 580 |
| 10 | 610 |
| 12 | 600 |
| 16 | 680 |
| 18 | 745 |
| 20 | 730 |
| 24 | 845 |
| 30 | 940 |
| 36 | 1045 |
| 42 | 1170 |
| 48 | 1295 |
| 54 | 1430 |
| 60 | 1565 |
| 66 | 1650 |
| 72 | 1730 |
| 78 | 1795 |
| 84 | 1850 |

[1] Values as of Second Quarter 1999.
[2] Costs based on Horizontal Boring (Jacking).

## 1.3 Water Treatment Plants

Water treatment plant capital costs are shown in Table 5 for three alternative treatment methods. One process is used almost exclusively on groundwater sources. The other two processes use filtration, mostly for surface water sources, and the quality of the source water normally dictates which one is used.

Groundwater is commonly treated by chlorination only, because the process is relatively inexpensive compared to filtration and the treatment equipment is small enough that each groundwater well can normally have its own. The most common of the surface water treatment methods is conventional filtration treatment. When influent suspended solids concentrations are sufficiently low that they are completely removed by filtration and result in a reasonable backwash cycle on the filtration units, direct filtration can be used. The direct filtration plant is essentially the same as the conventional filtration plant, except the sedimentation process is deleted. Wastewater effluent is sometimes reclaimed for aquifer injection or non-potable use, but this process is discussed later in Section 1.11.

**TABLE 5 WATER TREATMENT PLANT COSTS**

| Plant Capacity (MGD) | Groundwater Chlorination Plant Cost ($) | Direct Filtration Plant Cost ($) | Conventional Filtration Plant Cost ($) |
|---|---|---|---|
| 1 | 385,000 | 2,862,000 | 3,578,000 |
| 10 | 2,246,000 | 16,682,000 | 20,852,000 |
| 50 | 7,000,000 | 52,000,000 | 65,000,000 |
| 75 | 10,500,000 | 78,000,000 | 97,500,000 |
| 100 | 14,000,000 | 104,000,000 | 130,000,000 |
| 150 | 21,000,000 | 156,000,000 | 195,000,000 |
| 200 | 28,000,000 | 208,000,000 | 260,000,000 |

[1] Values as of Second Quarter 1999.

As can be seen in Table 6, the choice of treatment methods is dictated by both the quality of the influent water source and the intended destination of the treated water. Surface waters treated by direct filtration and wastewater reclamation are not intended for conveyance to a public water distribution system. The reason for this is that surface water and wastewater effluent normally has a high suspended solids content and the treatment processes cannot remove enough of the suspended solids to produce a water quality necessary for public water supplies.

**TABLE 6 WATER TREATMENT METHOD DESCRIPTIONS**

| Water Treatment Method | Source | | | Destination | |
|---|---|---|---|---|---|
| | Groundwater | Surface Water | Wastewater | Aquifer or Non-Potable Use | Public Water System Distribution |
| Groundwater Chlorination | • | | | • | • |
| Direct Filtration | • | | | • | • |
| Direct Filtration | | • | | • | |
| Conventional (Filtration) | | • | | • | • |
| Wastewater Reclamation | | | • | • | |

## 1.4 Storage Tanks

Storage tanks are used in a variety of different water supply systems, including pump stations, distribution systems, and pipelines. Several factors influence the cost of storage tanks, including frequency of use, capacity, type of construction materials, location, architectural treatment, and corrosion resistance. Steel tanks are normally constructed in elevated or ground-level locations, while prestressed concrete tanks are normally constructed at or below grade. Concrete does not require cathodic protection or any type of protective exterior coating. Below grade tanks require no architectural treatment, but have higher excavation and backfill costs. The costs of storage tanks are shown in Table 7 are based on ground-level prestressed concrete construction for a range of capacities.

**WATER STORAGE TANK COSTS**

| Storage Capacity (MG) | Cost ($) |
|---|---|
| 0.01 | 161,998 |
| 0.05 | 192,277 |
| 0.10 | 250,864 |
| 0.5 | 494,717 |
| 1.0 | 741,476 |
| 2.0 | 1,105,507 |
| 4.0 | 1,662,686 |
| 6.0 | 2,226,462 |
| 7.5 | 2,691,516 |
| 9.0 | 3,065,107 |
| 10.0 | 3,302,218 |
| 15.0 | 4,709,555 |

[1] Values as of Second Quarter 1999.
[2] Costs based on ground level prestressed concrete construction.

## 1.5 Off-Channel Reservoirs

An off-channel reservoir is a reservoir that receives minimal or no natural inflow. Two methods are normally employed in the construction of off-channel reservoirs. A dam can be constructed along a minor tributary or a ring dike can be constructed. Since little or no natural inflow reaches the reservoir, water is normally supplied by pumping from a nearby river or other location. The cost of the off-channel reservoir is highly dependent on the height of the levees that are constructed and the area of land that is available for use. Land costs will be considerably higher for a shorter ring dike with a much larger circumference that can still hold the same capacity as a taller ring dike with a smaller circumference. Table 8 shows the cost of off-channel reservoirs for a range of capacities.

**OFF-CHANNEL RESERVOIR COSTS**

| Storage Volume (ac-ft) | Ring Dike Cost ($) |
|---|---|
| 500 | 965,000 |
| 1,000 | 1,393,000 |
| 2,500 | 2,313,000 |
| 5,000 | 4,590,000 |
| 7,500 | 5,733,000 |
| 10,000 | 6,733,000 |
| 12,500 | 7,642,000 |
| 15,000 | 10,788,000 |
| 17,500 | 11,732,000 |
| 20,000 | 15,728,000 |
| 22,000 | 16,542,000 |
| 25,000 | 17,705,000 |

[1] Values as of Second Quarter 1999.
[2] Values are based on ring dike construction.
[3] Values also used for cost of dams on minor tributaries.

## 1.6 Well Fields

The costs for public water supply wells are shown in Table 9, as estimated by LBG-Guyton Associates, Inc. The costs include well completion, pumps, and all other necessary facilities. Irrigation wells costs are assumed to amount to 55 percent of public water supply well costs for wells of equivalent depth and capacity.

PUBLIC SUPPLY WELL COSTS

| Well Depth (feet) | Well Capacity (gpm) 200 | 400 | 700 | 1,000 | 1,500 |
|---|---|---|---|---|---|
| **Static Water Level Less Than 200 Feet Below Land Surface** | | | | | |
| 300 | $ 150,000 | $ 229,200 | $ 250,800 | - | - |
| 500 | $ 180,000 | $ 260,400 | $ 285,600 | $ 404,400 | - |
| 700 | $ 235,000 | $ 282,000 | $ 308,400 | $ 430,800 | $ 459,600 |
| 1,000 | $ 270,000 | $ 328,800 | $ 355,200 | $ 469,200 | $ 498,000 |
| 1,500 | $ 310,000 | $ 340,200 | $ 405,600 | $ 520,200 | $ 564,000 |
| **Static Water Levels Between 200 and 300 Feet Below Land Surface** | | | | | |
| 500 | $ 160,000 | $ 221,000 | - | - | - |
| 700 | $ 190,000 | $ 224,400 | $ 315,800 | $ 440,200 | $ 470,600 |
| 1,000 | $ 240,000 | $ 335,400 | $ 365,600 | $ 485,500 | $ 530,100 |
| 1,500 | $ 320,000 | $ 350,900 | $ 415,600 | $ 530,900 | $ 600,500 |
| **Static Water Levels Between 300 and 400 Feet Below Land Surface** | | | | | |
| 500 | $ 170,000 | - | - | - | - |
| 700 | $ 210,000 | $ 238,000 | $ 350,000 | $ 470,000 | $ 500,000 |
| 1,000 | $ 260,000 | $ 414,400 | $ 367,200 | $ 510,000 | $ 550,000 |
| 1,500 | $ 330,000 | $ 415,000 | $ 564,000 | $ 690,000 | $ 750,000 |
| **Static Water Levels Between 400 and 500 Feet Below Land Surface** | | | | | |
| 1,000 | $ 283,000 | $ 400,800 | $ 485,800 | $ 596,400 | - |
| 1,500 | $ 328,000 | $ 434,400 | $ 576,000 | $ 767,000 | - |

[1] Values as of Second Quarter 1999.
[2] Costs based on underreamed, gravel-packed wells, with steel casing and stainless steel screens.
[3] Costs as estimated by LBG-Guyton Associates.
[4] Irrigation well costs assumed to be 55% of above public water supply well cost values.

## 1.7 Dams and Reservoirs

Dam and reservoir construction costs were estimated on an individual case basis due to the unique nature of each project. Most dams and reservoirs that are currently under consideration have been studied in detail in the past and the previous cost estimates normally include both construction cost and other project costs. In most cases, the cost estimates from these previous studies were used, after adjusting the costs with the ENR CCI to the Second Quarter of 1999.

## 1.8 Relocations

In some cases, projects required the use of lands that contain existing facilities or improvements. While relocation of existing utilities, roads, homes, businesses, and other facilities is oftentimes an option, outright purchase cost of the land must be allowed for in cases where it is not deemed acceptable to relocate. Relocation cost estimates are addressed on an individual project basis due to the variation in the cost of the land and facilities which require relocation.

## 1.9 Water Distribution System Improvements

A water distribution system is used to distribute water throughout the service area by means of pump stations, piping, valves, storage tanks, and a variety of other equipment and facilities. When a city or entity requires additional water, improvements to the water distribution system are normally necessary. The cost of the water distribution system improvements varies considerably, based on the extent of the existing and proposed facilities and the wide variety of facilities that make up a water distribution system. Costs are estimated on an individual basis using previous proposed water distribution facility studies and cost estimates.

## 1.10 Stilling Basins

Stilling basins are normally used in water distribution systems to decrease the water flow velocity and allow sediment to settle out prior to discharging into a canal, reservoir, or other body of water. Stilling basin costs are estimated based on a target detention time of two hours and includes all excavation and hauling costs necessary to construct the basin. Optional mechanical sedimentation basin dredging equipment is not included. Stilling basin construction costs, when applicable, are estimated as $2,800 per cfs of discharge.

## 1.11 Wastewater Reclamation Plants

Wastewater effluent can be treated by a variety of methods for aquifer or other non-potable uses. The reverse osmosis membrane treatment method, including denitrification, was used to estimate the wastewater reclamation plant costs that are shown in Table 10. Reclaimed wastewater should not be sent directly to a public water distribution system.

**TABLE 10 WASTEWATER RECLAMATION PLANT COSTS**

| Plant Capacity (MGD) | Wastewater Reclamation Plant Cost ($) |
|---|---|
| 1 | 5,048,000 |
| 10 | 25,301,000 |
| 50 | 51,500,000 |
| 75 | 77,250,000 |
| 100 | 103,000,000 |
| 150 | 154,500,000 |
| 200 | 206,000,000 |

[1] Values as of Second Quarter 1999.

[2] Based on Reverse Osmosis Membrane process, with Denitrification, from Trans-Texas Water Program, Southeast Area, Technical Memorandum entitled "Wastewater Reclamation", March 19, 1998.

# 2 OTHER PROJECT COSTS

## 2.1 Engineering, Financial and Legal Services, and Contingencies

Engineering, financial and legal services, and contingencies are estimated as a lump sum, according to TWDB guidelines, as 30 percent of the total construction cost for pipelines and 35 percent of the total construction cost for all other types of projects.

## 2.2 Land and Easements

Land related costs for a project are typically one of two types: land permanently purchased for construction of a facility, or easement costs. The amount and cost of land purchased for various types of projects is considered on an individual project basis, taking into consideration similar project experience. Easement costs, on the other hand, can vary considerably in a single project, based on the variety of site conditions that a pipeline may encounter along its path. Easements are generally acquired for pipeline projects and can normally be classified as temporary or permanent. Permanent easements are purchased for the land that the pipeline will remain in once it is completed, including a wide enough buffer zone to allow maintenance access and protect the pipeline from other parallel utilities. Temporary easements are "rented" to allow extra room for material and equipment staging, as well as other construction related activities.

Land related costs include legal services, sales commissions, and surveying. Ten percent of the total land and easement costs is added to account for all legal services, sales commisions, and surveying associated with the land related purchases. Land costs can vary considerably throughout the region, based on degree of urbanization and other economic factors. County appraisal district records, previous project estimates, and other land value sources are used to estimate the land related costs.

## 2.3 Environmental and Archaeology Studies, Permitting, and Mitigation

Costs for environmental studies, archaeological studies, permitting, and mitigation are estimated on an individual project basis, taking into consideration previous project estimates, the judgement of qualified professionals, and any other available information. In the case of reservoir projects, mitigation costs were generally equal to the land value of the acreage that would be inundated.

## 2.4 Interest During Construction

Interest during construction is calculated as the cost of the interest on the borrowed funds, less the return on the unspent portion of the borrowed funds that are invested during construction. Interest during construction is calculated, according to TWDB guidelines, as the total interest accrued by a 6 percent annual interest rate on the total borrowed funds at the end of the construction phase, less a 4 percent annual rate of return on investment of unspent funds.

# 3 ANNUAL COSTS

Annual costs are expenses which the owner of the project can expect once the project is completed. Each of these costs is described in detail in the following subsections.

## 3.1 Debt Service

Debt service is the total annual payment that is required to repay borrowed funds. Debt service was calculated according to TWDB Section 1.71 of Exhibit B, assuming an annual interest rate of 6 percent and a repayment period of 40 years for reservoir projects and 30 years for all other projects.

## 3.2 Operation and Maintenance

Operation and maintenance (O&M) costs include all labor and materials required to run the facility and and keep it operational, including periodic repair and/or replacement of facility equipment. In accordance with TWDB guidelines, O&M costs are calculated as 1 percent of the total estimated construction costs for pipelines, distribution facilities, tanks, and wells, 1.5 percent of the total estimated construction costs for dams and reservoirs, and 2.5 percent of the total estimated construction costs for intake structures and pump stations. Water treatment plant cost estimates are shown in Table 10 below.

TABLE 11 OPERATION AND MAINTENANCE COSTS FOR WATER TREATMENT PLANTS

| Plant Capacity (MGD) | Groundwater Chlorination Plant Cost ($) | Direct Filtration Plant Cost ($) | Conventional (Filtration) Plant Cost ($) | Wastewater Reclamation Plant Cost ($) |
|---|---|---|---|---|
| 1 | 146,000 | 156,000 | 195,000 | 211,700 |
| 10 | 1,460,000 | 1,560,000 | 1,950,000 | 2,117,000 |
| 50 | 7,300,000 | 7,800,000 | 9,750,000 | 10,585,000 |
| 75 | 10,950,000 | 11,700,000 | 14,625,000 | 15,877,500 |
| 100 | 14,600,000 | 15,600,000 | 19,500,000 | 21,170,000 |
| 150 | 21,900,000 | 23,400,000 | 29,250,000 | 31,755,000 |
| 200 | 29,200,000 | 31,200,000 | 39,000,000 | 42,340,000 |

[1] Values as of Second Quarter 1999.

## 3.3 Pumping Energy Costs

Power costs are calculated on an annual basis, using calculated horsepower input and a power purchase cost of $0.06 per kWh, per TWDB guidelines.

## 3.4 Purchase of Water

The purchase of water, if applicable to the management strategy being considered, is dependent on the source and type (raw or treated) of water being purchased. The cost is addressed on an individual project basis due to the wide variety of water types and sources.

# Appendix F

# Public Meetings – Powerpoint Presentations

# Trinity Transfer Water Study
# Draft Report Public Hearing

November 21, 2002 – 1:30 pm

Gulf Coast Water Authority Board Room
3630 Highway 1765
Texas City, TX 77591

---

**Agenda**

| | |
|---|---|
| 1:30-1:45 pm | Check in/Look at Exhibits |
| 1:45-2:15 pm | Trinity Transfer Water Study Presentation |
| 2:15-2:45 pm | Questions/Comments |
| 2:45-3:00 pm | Wrap Up/Informal Discussions |

**Primary Contact**

Tom Visosky
MWH Americas
5100 Westheimer, Ste 580
Houston, TX 77056
713-403-1600

**Agency Contact**

Robert Istre
GCWA
3630 Highway 1765
Texas City, TX 77591
409-935-2438

## TRINITY WATER TRANSFER STUDY

## Project Background

- Study Participants:
  - Gulf Coast Water Authority (GCWA)
  - City of Houston (COH)
  - Coastal Water Authority (CWA)
  - Texas Water Development Board (TWDB)
- TWDB - Region H Water Management Plan:
  - GCWA and COH "Major Water Providers" for the region.
  - Transfer of Trinity River Water from COH to GCWA.

## Study Parameters

- Review of existing regional water facilities
- Review previous TWDB/GCWA Reports; update water demand projections
- Raw water transmission analysis
- Cost estimate

## Regional Service Areas

### Eastern Service Area

**Municipal Demand**
- Galveston
- Texas City
- Dickinson
- La Marque
- Santa Fe
- Hitchcock
- Centerpoint (Receives treated water)

**Industrial Demand**
- British Petroleum
- Dow Chemical Company
- Sterling Chemicals
- Valero Energy
- Marathon Petroleum
- Eagle Concrete

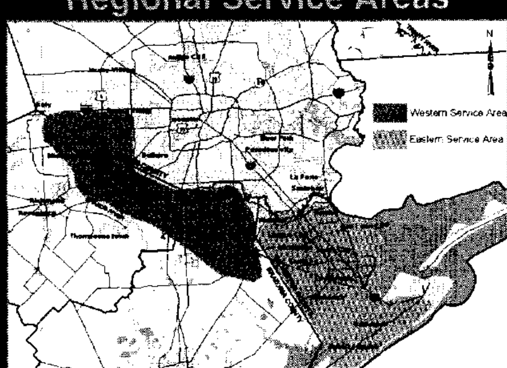
## Regional Service Areas

### Western Service Area

**Municipal Demand**
- Southwest Harris County
- Sugar Land
- Missouri City
- Pearland
- Alvin
- FBWCID #2
- Manvel
- Arcola

**Industrial Demand**
- Chocolate Bayou Water Company
- Solutia
- Oxychem
- Texas Brine
- Texas Department of Corrections
- Fluor Daniel

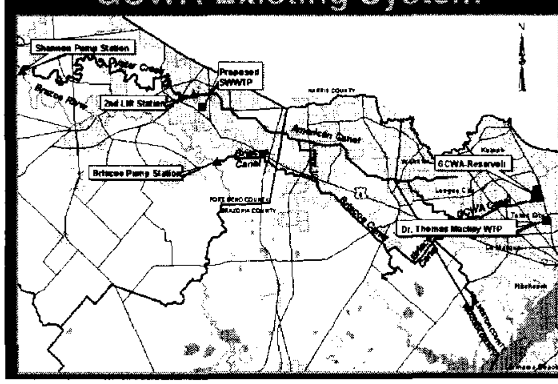
## Regional Service Areas



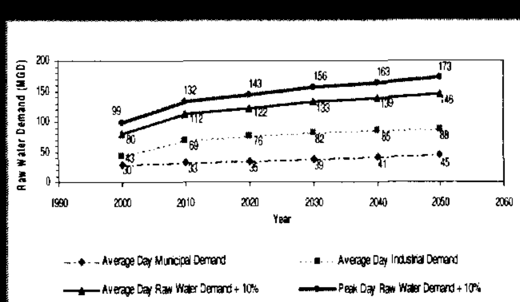
## GCWA Existing System

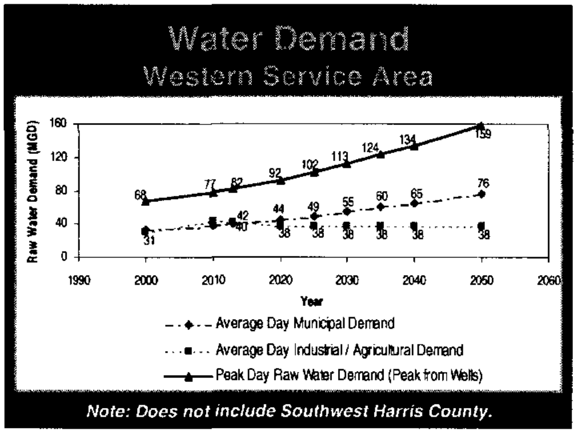
- Canal System A
  - Shannon Pump Station
  - 2nd Lift Station
  - American Canal
- Canal System B
  - Briscoe Pump Station
  - Briscoe Canal
- GCWA Canal
- GCWA Reservoir
- Dr. Thomas Mackey Water Treatment Plant

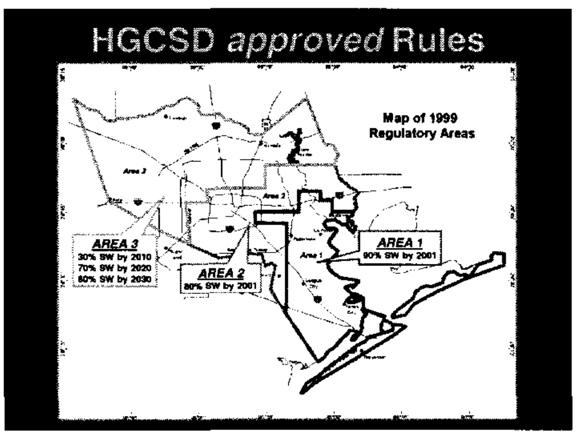
## GCWA Existing System

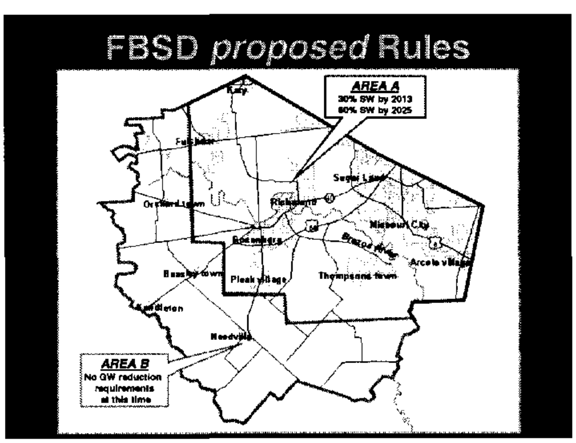



## Water Demand
### Eastern Service Area

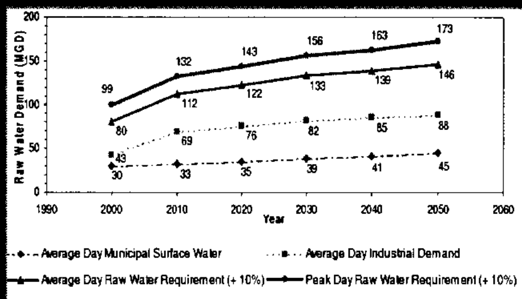



Water Demand
Western Service Area
Raw Water Demand (MGD)
160
120
80
40
0
1990
2000
2010
2020
2030
2040
2050
2060
Year
68
77
82
92
102
113
124
134
159
76
42
44
49
55
60
65
31
40
38
38
38
38
38
38
Average Day Municipal Demand
Average Day Industrial / Agricultural Demand
Peak Day Raw Water Demand (Peak from Wells)
Note: Does not include Southwest Harris County.

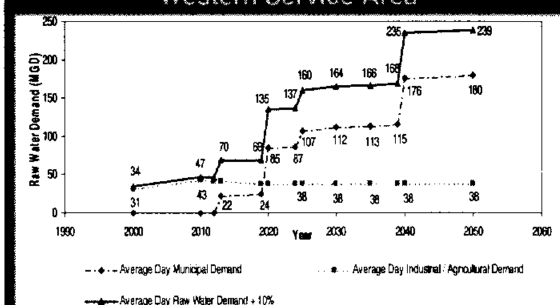

HGCSD approved Rules
Map of 1999
Regulatory Areas
AREA 3
30% SW by 2010
70% SW by 2020
80% SW by 2030
AREA 2
80% SW by 2001
AREA 1
90% SW by 2001
Area 3
Area 2
Area 1


FBSD proposed Rules
AREA A
30% SW by 2013
60% SW by 2025
AREA B
No GW reduction
requirements
at this time
Katy
Sugar Land
Richmond
Missouri City
Rosenberg
Arcola village
Pleak village
Thompsons town
Needville

## Surface Water Requirements
### Eastern Service Area




## Surface Water Requirements
### Western Service Area




*Note: Includes Southwest Harris County.*

## Regional Water Supply Scenario
### (MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| Existing GCWA Water Rights | 212 | 212 | 212 | 212 | 212 | 212 | 212 | 212 | 212 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 166 | [illegible] | [illegible] |
| [illegible] | [illegible] | 112 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 146 |
| [illegible] | [illegible] | 41 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| [illegible] | | | | | | [illegible] | 139 | [illegible] | [illegible] |
| [illegible] | | | | | | | | 30 | 30 |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

## Regional Water Supply Scenario
(MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Western Service Area Raw Water Demand** | **34** | **58** | **70** | **135** | **160** | **164** | **166** | **235** | **239** |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | | | | | | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

## Regional Water Supply Scenario
(MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Eastern Service Area Raw Water Demand** | **80** | **112** | **115** | **122** | **128** | **133** | **139** | **139** | **146** |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | | | | | [illegible] | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

## Regional Water Supply Scenario
(MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Existing Raw Water Deficit or Surplus** | **98** | **41** | **27** | **-45** | **-75** | **-86** | **-93** | **-162** | **-174** |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | | | | | [illegible] | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

# Regional Water Supply Scenario
(MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Temporary Supplies On-Line | | | | 50 | 75 | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | | | | | [illegible] | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

# Regional Water Supply Scenario
(MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 133 | 139 | 139 | 146 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| Trinity River Water (CWA) | | | | | | 133 | 139 | 139 | 146 |
| [illegible] | | | | | | | | [illegible] | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

# Regional Water Supply Scenario
(MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 212 | 212 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 235 | 239 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| Permanent Supplies On-Line (Western Service Area) | | | | | | | | 30 | 30 |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

## Regional Water Supply Scenario (MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 174 |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | | | | | [illegible] | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

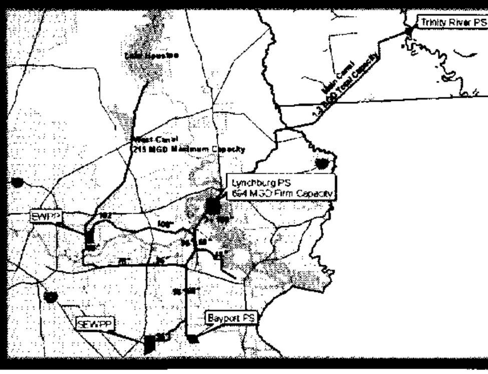
## Regional Supply Overview

- Trinity River Water to transfer Eastern Service Area
- Brazos River Water available to Western Service Area

## CWA Existing System

- Trinity River Pump Station
- Lynchburg Pump Station
- East Water Purification Plant
- Southeast Water Purification Plant
- Bayport Pump Station

## CWA Raw Water System




## Trinity Transfer Facilities

- Take points
- Pump station
- Pipeline
- Delivery points

## Pipeline Design Assumptions

- Pipeline materials :
  - Welded Steel Pipe (AWWA C200) or
  - Reinforced Concrete Cylinder Pipe (AWWA C300)
- Capacity : 175 MGD
- Maximum velocity : 8 ft/s
- Diameter : 84 in

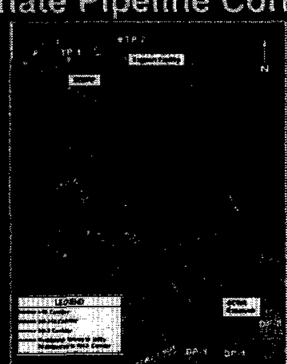
## Pump Station Design Assumptions

- Pipeline losses : C = 140
- Minor losses : 4% of Pipeline losses
- Total Dynamic Head = 109 ft
- Pump type : Vertical Turbine
- Number of pumps : 5 duty VFD + 1 spare VFD
- Pump horsepower : 4.700 hp

## Alternate Pipeline Corridors

- Pipeline corridors:
  - I-45
  - SH-3
  - Residential streets to utility passageway to SH-3
  - SH-146

## Alternate Pipeline Corridors

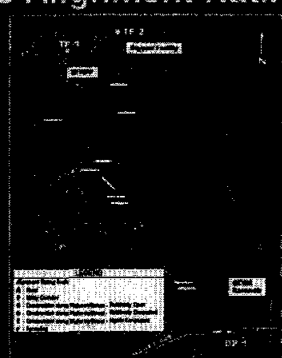


## Corridor Selection Criteria

Construction difficulty rating:

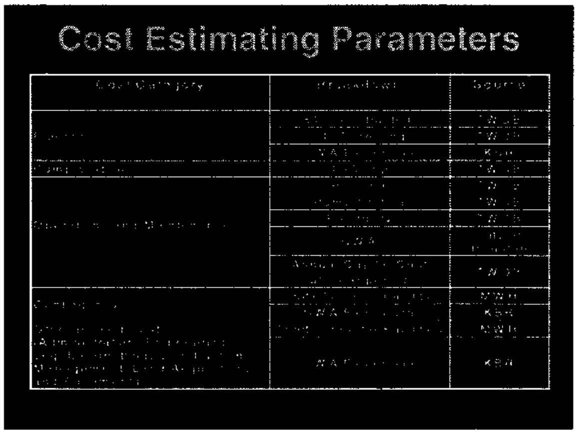
- A: Rural
- B: Utility Corridor
- C: Construction along Highway/Street
  - Relatively Open
- D: Construction along Highway/Street
  - Relatively Congested
- E: Construction along Highway/Street
  - Highly Congested
- F: Tunneling

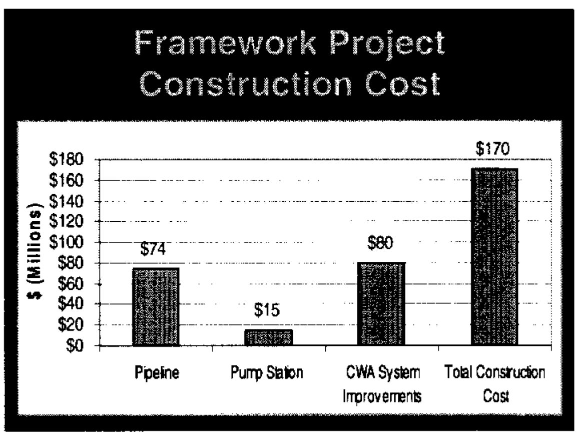
## Pipeline Alignment Rating Scale

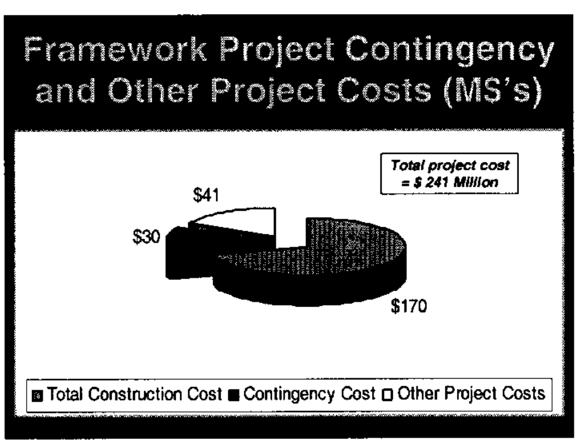


## Framework Project

| Take Point | Delivery Point | Length (miles) | Capacity (MGD) | Pipeline Diameter (inches) | Pump Station (total installed hp) |
|---|---|---|---|---|---|
| TP-2 | DP-1 | 16 | 175 | 84 | 4,700 |


Cost Estimating Parameters


Framework Project
Construction Cost
$ (Millions)
$180
$160
$140
$120
$100
$80
$60
$40
$20
$0
$74
$15
$80
$170
Pipeline
Pump Station
CWA System Improvements
Total Construction Cost


Framework Project Contingency and Other Project Costs (MS's)
Total project cost = $ 241 Million
$41
$30
$170
Total Construction Cost
Contingency Cost
Other Project Costs

## Framework Project O & M Unit Cost for New Deliveries

| Pipeline and Pump Station (Millions per Year) | Electricity (Millions per Year) | CWA (Millions per Year) | Annual Capital Costs (Millions per Year) | Total O&M Cost (Millions per Year) | Unit Cost for Deliveries ($/1,000 gallons) |
|---|---|---|---|---|---|
| $ 1.1 | $ 1.6 | $ 1.0 | $ 17.5 | $ 21.2 | **$ 0.33** |

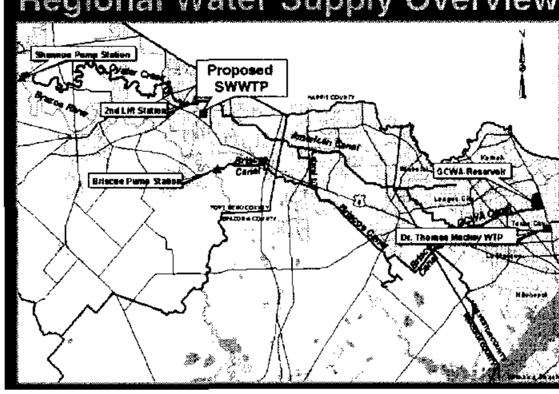
$0.33/1000 gallons = $107/acre feet

*Note: Cost of water purchase not included. All water is assumed transferred.*

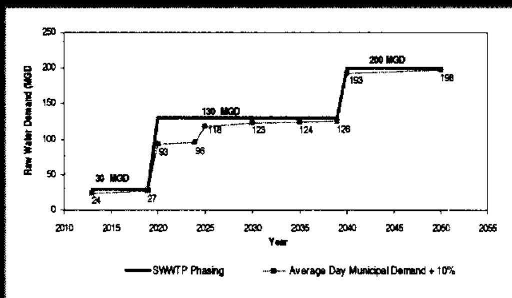
## Cost Comparison

| Water Management Strategy | Yield (MGD) | Total Capital Cost (M$) | Total Annual Cost (M$) | $/AF |
|---|---|---|---|---|
| **Trinity Transfer (MWH)** | **175** | **241** | **21** | **107** |
| Bedias Reservoir (TWDB Region H) | 81 | 132 | 10 | 112 |
| Allens Creek Reservoir (TWDB Region H) | 85 | 147 | 12 | 121 |
| Little River Reservoir (TWDB Region H) | 115 | 341 | 25 | 197 |
| Trinity Transfer (TWDB Region H) | 25 | 43 | 5 | 230 |

## Regional Water Supply Overview



## Southwest Water Treatment Plant Phasing




## Conclusions

- Trinity Transfer
  - 2030 - 175 MGD constructed capacity
- Temporary Water Supplies
  - 2020 to 2030 - 75 MGD
- Permanent Water Supplies for Western Service Area
  - 2040 and beyond - 30+ MGD
- Southwest Water Treatment Plant
  - Phase 1: 2013 - 30 MGD
  - Phase 2: 2020 - 130 MGD
  - Phase 3: 2040 - 200 MGD

## TRINITY WATER TRANSFER STUDY

# Trinity Transfer Water Study
# Public Presentation of Report

December 20, 2002 – 10:00 am

**Location**
Greater Fort Bend Economic Development Council Auditorium
One Flour Daniel Drive
Lakepoint Plaza, Building D
Sugarland, TX 77478

---

**Agenda**

| | |
|---|---|
| 10:00-10:15 am | Check in/Look at Exhibits |
| 10:15-11:15 am | Trinity Transfer Water Study Presentation |
| 11:15-11:45 am | Questions/Comments/Wrap-Up |

**Primary Contact**
Tom Visosky
MWH Americas
5100 Westheimer, Ste 580
Houston, TX 77056
713-403-1600

**Agency Contact**
Robert Istre
GCWA
3630 Highway 1765
Texas City, TX 77591
409-935-2438

***Notice:***
*All interested parties are welcome. Please pass information along as appropriate. Please RSVP to Tom Visosky at 713-403-1625 by 12/17.*

Registration required at visitors desk.

# TRINITY WATER TRANSFER STUDY

## Study Participants

- Gulf Coast Water Authority (GCWA)
- City of Houston (COH)
- Coastal Water Authority (CWA)
- Texas Water Development Board (TWDB)

## Project Background

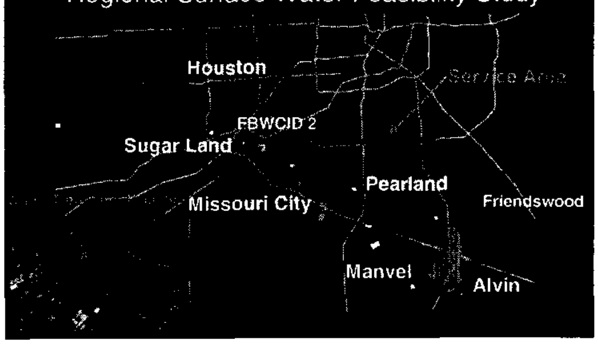
- TWDB - Region H Water Management Plan Identified:
- GCWA and COH "Major Water Providers" for the region.
- Transfer of Trinity River Water from COH to GCWA.
  - Trinity River Water to transfer Eastern Service Area
  - Brazos River Water available to Western Service Area

## Study Parameters

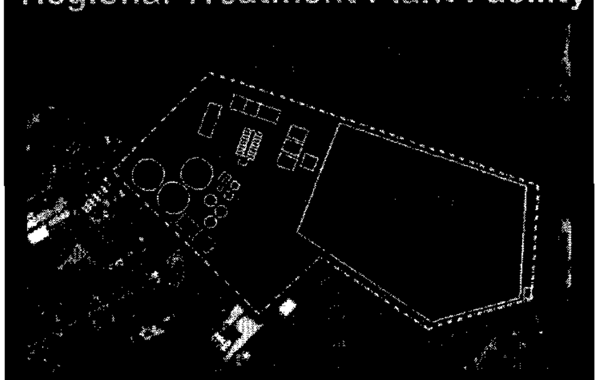
- Review previous TWDB/GCWA Studies; update water demand projections
- Review of existing regional water facilities
  - Assume surface water compatibility with Western Service Area groundwater
- Raw water transmission analysis
- Cost estimate

## Previous Study

- Regional Surface Water Feasibility Study




## Regional Treatment Plant Facility



## Regional Service Areas

### Eastern Service Area

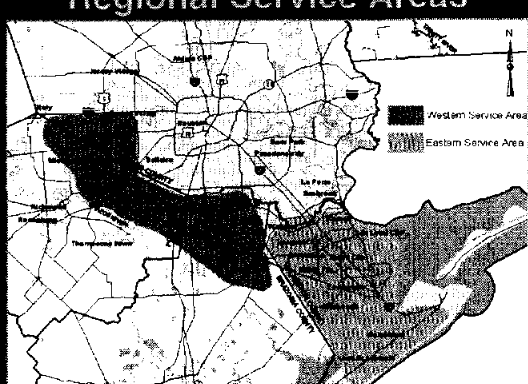
- Municipal Demand
  - Galveston
  - Texas City
  - Dickinson
  - La Marque
  - Santa Fe
  - Hitchcock
  - Centerpoint
    (Receives treated water)
- Industrial Demand
  - British Petroleum
  - Dow Chemical Company
  - Sterling Chemicals
  - Valero Energy
  - Marathon Petroleum
  - Eagle Concrete

## Regional Service Areas

### Western Service Area

- Municipal Demand
  - Southwest Harris County
  - Sugar Land
  - Missouri City
  - Pearland
  - Alvin
  - FBWCID #2
  - Manvel
  - Arcola
- Industrial Demand
  - Chocolate Bayou Water Company
  - Solutia
  - Oxychem
  - Texas Brine
  - Texas Department of Corrections
  - Fluor Daniel

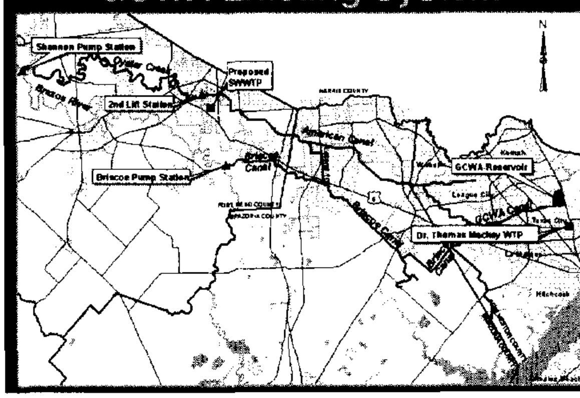
## Regional Service Areas



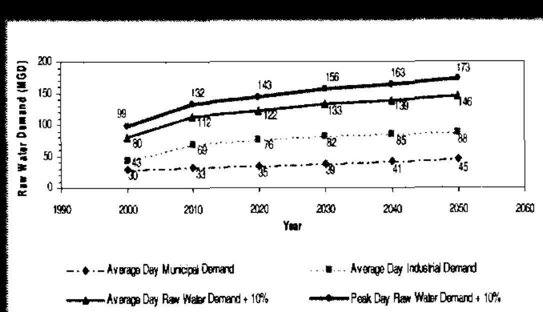
## GCWA Existing System

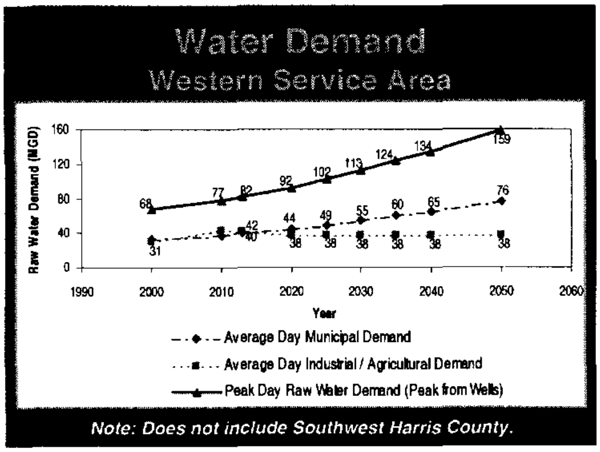
- Canal System A
  - Shannon Pump Station/2nd Lift Station
  - American Canal
- Canal System B
  - Briscoe Pump Station
  - Briscoe Canal
- GCWA Canal
- GCWA Reservoir
- Dr. Thomas Mackey Water Treatment Plant
  - 50 MGD Capacity

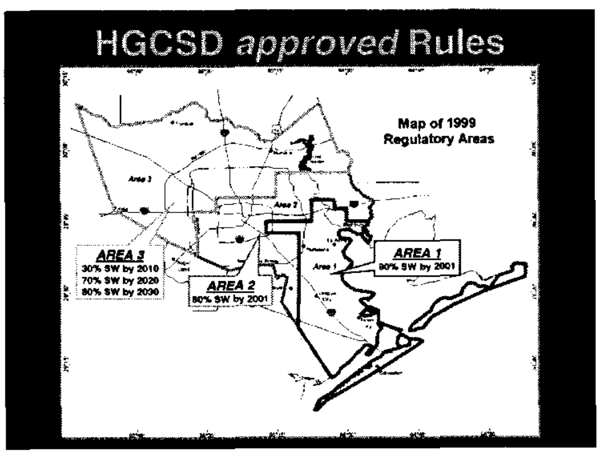
## GCWA Existing System

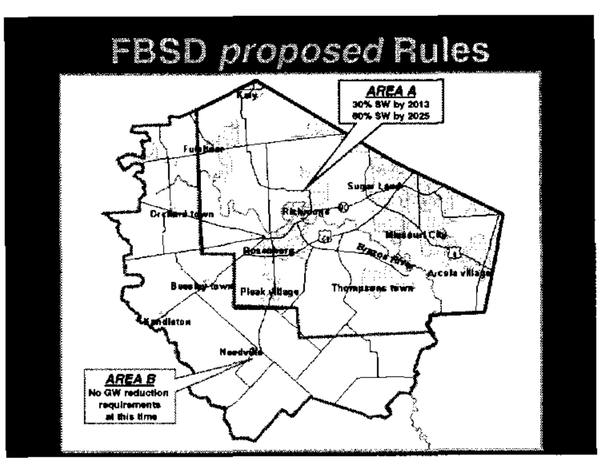



## Water Demand
### Eastern Service Area

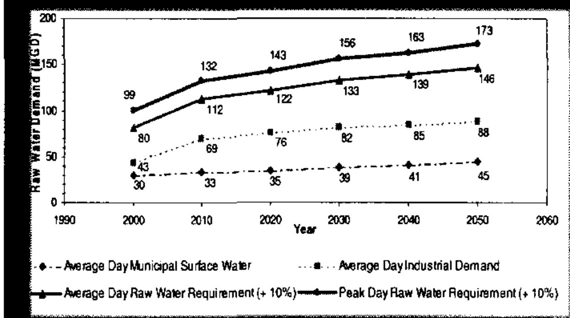



Water Demand
Western Service Area
Raw Water Demand (MGD)
Year
Average Day Municipal Demand
Average Day Industrial / Agricultural Demand
Peak Day Raw Water Demand (Peak from Wells)
Note: Does not include Southwest Harris County.

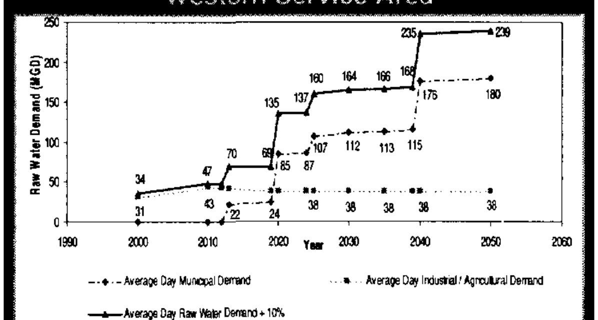

HGCSD approved Rules
Map of 1999 Regulatory Areas
AREA 1
80% SW by 2001
AREA 2
80% SW by 2001
AREA 3
30% SW by 2010
70% SW by 2020
80% SW by 2030


FBSD proposed Rules
AREA A
30% SW by 2013
60% SW by 2025
AREA B
No GW reduction requirements at this time

## Surface Water Requirements
### Eastern Service Area




## Surface Water Requirements
### Western Service Area




*Note: Includes Southwest Harris County.*

## Regional Water Supply Scenario
### (MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| Existing GCWA Water Rights | 212 | 212 | 212 | 212 | 212 | 212 | 212 | 212 | 212 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 133 | [illegible] | [illegible] | 146 |
| [illegible] | [illegible] | 11 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | | | | | [illegible] | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

# Regional Water Supply Scenario (MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Western Service Area Raw Water Demand** | **34** | **58** | **70** | **135** | **160** | **164** | **166** | **235** | **239** |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | | | | | [illegible] | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

# Regional Water Supply Scenario (MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Eastern Service Area Raw Water Demand** | **80** | **112** | **115** | **122** | **128** | **133** | **139** | **139** | **146** |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | | | | | [illegible] | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

# Regional Water Supply Scenario (MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Existing Raw Water Deficit or Surplus** | **98** | **41** | **27** | **-45** | **-75** | **-86** | **-93** | **-162** | **-174** |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | | | | | [illegible] | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

## Regional Water Supply Scenario
(MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| **Temporary Supplies On-Line** | | | | 50 | 75 | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | | | | | [illegible] | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

## Regional Water Supply Scenario
(MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | **133** | **139** | **139** | **146** |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| **Trinity River Water (CWA)** | | | | | | **133** | **139** | **139** | **146** |
| [illegible] | | | | | | | | [illegible] | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

## Regional Water Supply Scenario
(MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | **212** | **212** |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | **235** | **239** |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| **Permanent Supplies On-Line (Western Service Area)** | | | | | | | | **30** | **30** |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

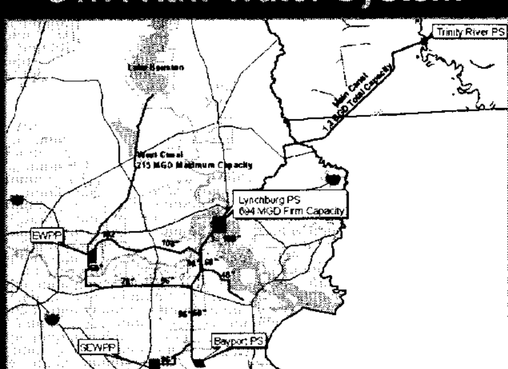
## Regional Water Supply Scenario (MGD)

| Regional Water Needs | 2000 | 2010 | 2013 | 2020 | 2025 | 2030 | 2035 | 2040 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 174 |
| [illegible] | | | | [illegible] | [illegible] | | | | |
| [illegible] | | | | | | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | | | | | | | [illegible] | [illegible] |
| Surplus Raw Water | 98 | 41 | 27 | 5 | 0 | 47 | 46 | 7 | 2 |

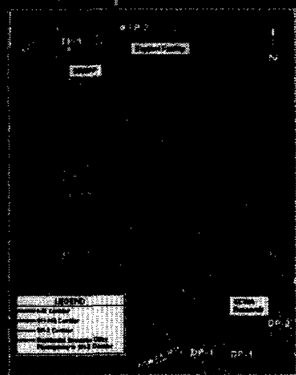
## Trinity Transfer Facilities

- CWA Improvements
  - Additional capacity at Lynchburg PS
  - Additional conveyance capacity from Lynchburg PS to Take point
- Take points
- Pump station
- Pipeline
- Delivery points

## CWA Raw Water System



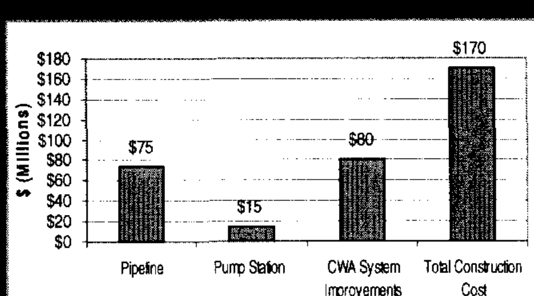
## Alternate Pipeline Corridors



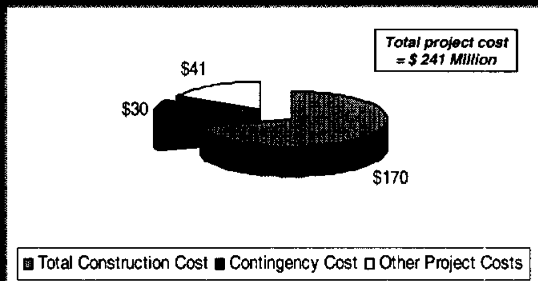
## Framework Project

| Length (miles) | Capacity (MGD) | Pipeline Diameter (inches) | Pump Station (total installed hp) |
|---|---|---|---|
| 16 | 175 | 84 | 4,700 |

## Framework Project Construction Cost



## Framework Project Contingency and Other Project Costs (MS's)




## Framework Project O & M Unit Cost for New Deliveries

| Pipeline and Pump Station (Millions per Year) | Electricity (Millions per Year) | CWA (Millions per Year) | Annual Capital Costs (Millions per Year) | Total O&M Cost (Millions per Year) | Unit Cost for Deliveries ($/1,000 gallons) |
|---|---|---|---|---|---|
| $ 1.1 | $ 1.6 | $ 1.0 | $ 17.5 | $ 21.2 | **$ 0.33** |

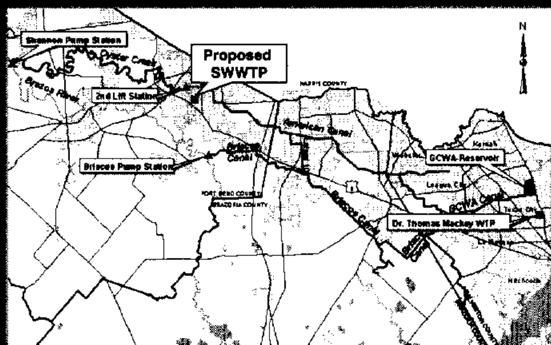
$0.33/1000 gallons = $107/acre feet

*Note: Cost of water purchase not included. All water is assumed transferred.*

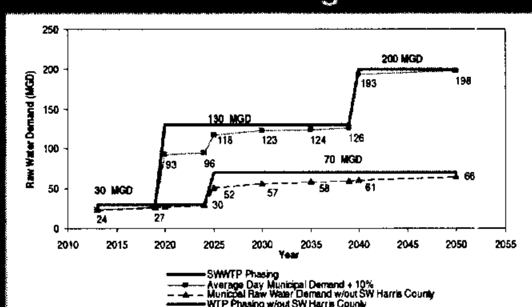
## Cost Comparison

| Water Management Strategy | Yield (MGD) | Total Capital Cost (MS) | Total Annual Cost (MS) | $/AF |
|---|---|---|---|---|
| **Trinity Transfer (MWH)** | **175** | **241** | **21** | **107** |
| Bedias Reservoir (TWDB Region H) | 81 | 132 | 10 | 112 |
| Allens Creek Reservoir (TWDB Region H) | 89 | 157 | 12 | 121 |
| Little River Reservoir (TWDB Region H) | 115 | 351 | 25 | 197 |
| Trinity Transfer (TWDB Region H) | 25 | 63 | 5 | 230 |

## Regional Water Supply Overview




## Southwest Water Treatment Plant Phasing




## Summary

- Trinity Transfer
  - 2030 - 175 MGD constructed capacity
- Temporary Water Supplies
  - 2020 to 2030 - 75 MGD
- Permanent Water Supplies for Western Service Area
  - 2040 and beyond - 30+ MGD
- Southwest Water Treatment Plant
  - Phase 1: 2013 - 30 MGD
  - Phase 2: 2020 - 130 MGD
  - Phase 3: 2040 - 200 MGD

## Next Steps

- Identify Interested Parties
- Perform Alignment Study and Right of Water Acquisition for Trinity Transfer Facilities
- Perform Siting Study for SWWTP and Distribution System including Right of Way Determination and Acquisition
- Develop Temporary Raw Water Supplies
- Perform Blending Study of Surface Water and Western Service Area Groundwater

## Study Contacts

- **Primary Contact**

  Tom Visosky
  MWH Americas
  5100 Westheimer, Ste 580
  Houston, TX 77056
  713-403-1600

- **Agency Contact**

  Robert Istre
  GCWA
  3630 Highway 1765
  Texas City, TX 77591
  409-935-2438

## TRINITY WATER TRANSFER STUDY

# Appendix G
# Comments

**Job:** Gulf Coast Water Authority Trinity River Conveyance Study
**Client:** Gulf Coast Water Authority

| Comment No. | From | Page No. | Table No. | Figure No. | Paragraph | Comment | Response | Version |
|---|---|---|---|---|---|---|---|---|
| 1 | Robert Istre; GCWA | ES-4 | - | - | 2 | change 'temporary' to 'short-term water' | changed | September 2002 |
| 2 | Robert Istre; GCWA | ES-7 | - | ES-7 | - | First phase change to 30 MGD from 40 MGD | changed | September 2003 |
| 3 | Robert Istre; GCWA | ES-7 | - | - | 1 | change '2010' and '2019' to'2013' and '2025' | changed | September 2002 |
| 4 | Robert Istre; GCWA | 1-3 | - | - | 2 | change 'prior' to 'in' | changed | September 2002 |
| 5 | Robert Istre; GCWA | 2-1 | - | - | 3 | Confirm source of '148 MGD' min. recorded flow of the Brazos River | confirmed | September 2002 |
| 6 | Robert Istre; GCWA | 2-2 | - | - | 2 | change 'field tests indicate that' to 'current' | changed | September 2002 |
| 7 | Robert Istre; GCWA | 2-2 | - | - | 2 | change 'installed' to 'available' | changed | September 2002 |
| 8 | Robert Istre; GCWA | 2-2 | - | - | 2 | delete 'in the range of' | deleted | September 2002 |
| 9 | Robert Istre; GCWA | 2-2 | - | - | 2 | change '260 mgd' to '203 mgd' | changed | September 2002 |
| 10 | Robert Istre; GCWA | 2-2 | - | - | 2 | add 'to' | added | September 2002 |
| 11 | Robert Istre; GCWA | 2-2 | - | - | 3 | delete 'primarily' | deleted | September 2002 |
| 12 | Robert Istre; GCWA | 2-2 | - | - | 3 | add 'not' | added | September 2002 |
| 13 | Robert Istre; GCWA | 2-2 | - | - | 3 | delete 'but the ... American Canal' | deleted | September 2002 |
| 14 | Robert Istre; GCWA | 2-2 | 2-2 | - | - | change 'B-4' to 'Ranch'..add 'Take Point' | incorporated | September 2002 |
| 15 | Robert Istre; GCWA | 2-4 | - | - | 9 | Confirm capacity of Lynchburg Reservoir - 1.5 BG | confirmed | September 2002 |
| 16 | Robert Istre; GCWA | 2-4 | - | 2-3 | | Add CWA system capacities | added | September 2002 |
| 17 | Robert Istre; GCWA | 3-2 | 3-1 | - | - | change 'Reliant Energy' to 'Centerpoint'; add it to municipal demand | incorporated | September 2002 |
| 18 | Robert Istre; GCWA | 3-2 | 3-1 | - | - | change 'Union Carbide' to 'Dow Chemicals' | changed | September 2002 |
| 19 | Robert Istre; GCWA | 3-4 | 3-4 | - | - | Give reference for source of Table | incorporated | September 2002 |
| 20 | Robert Istre; GCWA | 3-5 | 3-6 | | | Chocolate Bayou Water Company', 'Solutia' and 'Oxychem' demands switch to Western Service Area demand | incorporated | September 2002 |
| 21 | Robert Istre; GCWA | 3-7 | 3-7 | - | - | Add 'Oxychem', 'Equistar' and 'Chocolate Bayou Water Company' | added | September 2002 |
| 22 | Robert Istre; GCWA | 3-7 | 3-8 | - | - | Update population data for 'Missouri City' | updated | September 2002 |
| 23 | Robert Istre; GCWA | 3-9 | - | - | 3 | change FBSD's proposed GW reduction rules beyond 2025 to show 60% conversion | incorporated; with the qualifier that the FBSD has not yet planned for 2025 and beyond | September 2002 |
| 24 | Robert Istre; GCWA | 3-11 | 3-12 | - | - | delete Sugar Land's surface water requirement for 2010; and change Missouri City's demand in accordance with reduced population information from Lee Dorger-Dir. of Public Works | incorporated | September 2002 |
| 25 | Robert Istre; GCWA | 3-12 | 3-13 | - | - | Add 'Oxychem', 'Equistar' and 'Chocolate Bayou Water Company' | added | September 2002 |
| 26 | Ralph Rundle; CWA | 3-15 | - | - | - | Mention 'Desalination' as 'Other potential raw water sources' | added | September 2002 |

| Comment No. | From | Page No. | Table No. | Figure No. | Paragraph | Comment | Response | Version |
|---|---|---|---|---|---|---|---|---|
| COMMENTS DURING THE PUBLIC MEETING HELD ON NOVEMBER 21, 2002 : | | | | | | | | |
| 27 | Carlton Getty (Asst. Secretary/Treasurer; GCWA) | - | - | - | - | Industrial demand for the Western Service Area was thought to be higher than expected. | A consensus was reached within the GCWA Board members that these numbers can be used since the corresponding industrial entities gave them. | October 2002 (Public Hearing - November 21, 2002) |
| 28 | Carlton Getty (Asst. Secretary/Treasurer; GCWA) | - | - | - | - | What type of Legislature would have to be initiated to make this transfer a reality | David Meesey from the TWDB said that this may or may not be an Interbasin Transfer. MWH to coordinate with TWDB to further investigate this. | October 2002 (Public Hearing - November 21, 2002) |
| 29 | W. W. Latimer (President, GCWA) | - | - | - | - | Why do we need the transfer? | Robert Istre informed the purpose of this study was to put a price tag on the transfer | October 2002 (Public Hearing - November 21, 2002) |
| 30 | Domenic Di Censo | - | - | - | - | There is no argument on the need of the Southwest Water Treatment Plant | - | October 2002 (Public Hearing - November 21, 2002) |
| 31 | W. W. Latimer (President, GCWA) | - | - | - | - | What is the source of water for the Allen's Creek Reservoir ? Is it the Brazos? | Bob Higggins: Yes | October 2002 (Public Hearing - November 21, 2002) |
| 32 | W. W. Latimer (President, GCWA) | - | - | - | - | How does the Allen's Creek Reservoir operate? | David Meesey explained that this is a "scalping reservoir"; and it is usually 1/2 full to full. | October 2002 (Public Hearing - November 21, 2002) |
| 33 | Jo Trahan | - | - | - | - | This study is more important for the people in the Western Service Area. Is this presentation goin to be presented to them? | Bob Higggins: We are more than willing to present this to them. | October 2002 (Public Hearing - November 21, 2002) |
| 34 | Jo Trahan | - | - | - | - | Since this study is more pertinent for the Western Service Area, is the City of Houston serious about this? Do you really want this? | Jun Chang, City of Houston: Yes, it is just a matter of time, we have to decide when this would happen. | October 2002 (Public Hearing - November 21, 2002) |
| 35 | Jo Trahan | - | - | - | - | This study gives us a good idea of future problems. Even if we say that the water demands are overly optimistic, we know what the future water supply will look like. | - | October 2002 (Public Hearing - November 21, 2002) |

| Comment No. | From | Page No. | Table No. | Figure No. | Paragraph | Comment | Response | Version |
|---|---|---|---|---|---|---|---|---|
| COMMENTS FROM TEXAS WATER DEVELOPMENT BOARD, ref.: LETTER DATED DECEMBER 27, 2002. | | | | | | | | |
| 36 | | - | - | - | - | Add list of references of reports reviewed and cited in the report | incorporated | January 2003 |
| 37 | | - | - | - | - | Report does not explain why residential streets to utility passageway to SH-3 is the more promising alignment, and the conclusion isn't obvious from Table 4-7. | New Appendix giving cost details of SH-3 corridor added, and the text was modified accordingly. | January 2003 |
| 38 | | TOC-i | - | - | - | Page no. ES-4 for Raw Water Demand Overview and Trinity Transfer Timing, Page no. ES-5 for Framework Project & Probable Costs and page no. ES-7 should be ES-5, ES-6 and ES-8 respectively | incorporated | January 2003 |
| 39 | | TOC-ii | - | - | - | Listing for page 3-11 should be Industrial and Agricultural Water Demand Projections | incorporated | January 2003 |
| 40 | | TOC-ii | - | - | - | Listing for page 3-13 should be Southwest Water Treatment Plant | incorporated | January 2003 |
| 41 | | TOC-ii | - | - | - | Page no. 3-14 for Other Potential Raw Water Sources should be 3-15 | incorporated | January 2003 |
| 42 | | TOC-iii | - | - | - | The last word in the listing for Appendix A should be Projections instead of Forecasts. | incorporated | January 2003 |
| 43 | | TOC-iv | - | - | - | Page no. ES-5 for Framework Project should be ES-6 | incorporated | January 2003 |
| 44 | | TOC-iv | - | - | - | Listing for Table 3-5 should be Projected Peak Day Municipal Water Demand in Eastern Service Area (MGD) | incorporated | January 2003 |
| 45 | | TOC-iv | - | - | - | Listing for Table 3-9 should be Municipal Average Day Average Water Projection Demand for Western Service Area (MGD) | incorporated | January 2003 |
| 46 | | TOC-iv | - | - | - | Listing for Table 3-12 should be Projected Municipal Surface Water Requirements in the Western Service Area (MGD) | incorporated | January 2003 |
| 47 | | TOC-v | - | - | - | Page no. 4-4 for Pipeline Feasibility Criteria Assumptions should be 4-5 | no change | January 2003 |
| 48 | | - | - | - | - | List of figures should be added | incorporated | January 2003 |
| 49 | | ES-1 | - | - | - | Define acronym CDM | incorporated | January 2003 |
| 50 | | ES-3 | - | ES-2 | - | The municipal demand is shown as 30 MGD, but the demand, as presented in Table 3-1, is 32 MGD | The municipal demand should be 32 MGD. The text was altered accordingly. | January 2003 |
| 51 | | ES-8 | - | - | - | Possibly change to "Currently surface water treatment capacity does not exist..." | incorporated | January 2003 |
| 52 | | ES-8 | - | ES-7 | - | The huge jumps in demand should be explained, i.e. from 38 to 95 MGD about 2020 and from 126 to 193 MGD about 2040 | These jumps reflect the changes in the subsidence district's groundwater reduction rules - an explanation to this effect is added in the report. | January 2003 |
| 53 | | - | - | - | - | Some of the graphics could be presented in a more easy-to-read fashion | incorporated | January 2003 |
| 54 | | 1-1 | - | - | Line 3 | The first time Senate Bill 1 is used, it should be referred to as Senate Bill 1 of the 75th Texas Legislature. | incorporated | January 2003 |
| 55 | | 2-1 | - | - | Last line, Gulf Coast Water Authority | For clarity the sentence might include the name of the facility, i.e. the Dr. Thomas Mackey plant. | incorporated | January 2003 |

| Comment No. | From | Page No. | Table No. | Figure No. | Paragraph | Comment | Response | Version |
|---|---|---|---|---|---|---|---|---|
| 56 | | 2-1 | - | - | 2nd sentence under Surface Water Source and Supply | State that the Brazos flows through Waco and Richmond, instead of through Waco to Richmond. | incorporated | January 2003 |
| 57 | | 2-1 | 2-1 | - | | Does 212 MGD total reflect water rights under drought of record conditions? | No. GCWA has entered into a contract with the Brazos River Authority (BRA) for water stored in the BRA reservoirs. When flow in the Brazos decreases, GCWA can request of the stored BRA water. This explanation is mentioned in text. | January 2003 |
| 58 | | 2-2 and 2-3 | - | - | | These pages discuss the silting of canals from the Brazos and what could be accomplished to increase delivery. What is effect of silting on the Texas City Reservoir, which supplies the Dr. Thomas Mackey Water Treatment Plant? | Majority of the sedimentation would occur in lakes in Fort Bend County, and in the approximately 50 miles of GCWA canals. Over a long period, silting would reduce capacity of the reservoir and, reservoir dredging may be required. | January 2003 |
| 59 | | 2-2 | - | - | 2, line 5 | Should be capacity of 203 MG. | The amount in question is the capacity of the Shanon Pump Station, and so it should be 'MGD' | January 2003 |
| 60 | | 2-2, 2-3 and 2-4 | - | - | - | Titles at top of page should be Planning Area Existing Infrastructure instead of Planning Area Existing Envirostructure. | incorporated | January 2003 |
| 61 | | 2-3 | - | - | City of Houston, 2nd sentence | Report should state that the City currently operates two surface water treatment plants. | incorporated | January 2003 |
| 62 | | 2-3 | - | - | Water Treatment Facilities | Tiki Island is listed twice | deleted repeated word | January 2003 |
| 63 | | - | 2-3 and 2-4 | - | - | Missing these tables | Tables have been deleted. | January 2003 |
| 64 | | 2-4 | - | - | - | Title: Coastal Water Authority should be all caps | incorporated | January 2003 |
| 65 | | 2-4 | - | - | 1, sentence 1 | The Lynchburg Reservoir and Cedar Point Lateral System either aren't included or aren't labeled in Figure 2-3. | incorporated | January 2003 |
| 66 | | 2-4 | - | - | - | Last sentence on page needs a verb | incorporated | January 2003 |
| 67 | | 3-1 and 3-2 | - | - | - | Exclude the TWDB in references to the Region H Regional Water Plan. | incorporated | January 2003 |

| Comment No. | From | Page No. | Table No. | Figure No. | Paragraph | Comment | Response | Version |
|---|---|---|---|---|---|---|---|---|
| 68 | | 3-2 | - | - | - | Population subtotal in Table 3-1 should be 181,000 to correspond to the total given in Table 3-2 | incorporated | January 2003 |
| 69 | | 3-3 | - | - | - | The first line should refer to the Region H Regional Water Plan municipal water use projections instead of the TWDB municipal water use projections | incorporated | January 2003 |
| 70 | | 3-5 | 3-6 | - | - | Table based on information supplied by GCWA. The assumptions and basis for that data would be helpful especially since the demand is projected to more than double and the amount for industrial customers is so much greater than that for municipal customers | GCWA conducts annual surveys and these demand projections are results of the survey. This explanation is mentioned in the text. | January 2003 |
| 71 | | 3-6 | - | - | Current Population and Water Usage, line 2 | The statement should be as reported in the Region H Plan instead of as reported by the TWDB through the Region H Plan. | incorporated | January 2003 |
| 72 | | 3-6 | - | - | Current Population and Water Usage, line 3 | The current western demand is given as 200 MGD rather than the 64 MGD as shown in Table 3-7. | The demand should be 64 MGD. Text changed. | January 2003 |
| 73 | | 3-6 | 3-7 | - | - | Population subtotal in Table 3-7 should be 222,600 to correspond to the total given in Table 3-8. | incorporated | January 2003 |
| 74 | | 3-7 | 3-8 | - | - | Table contains the same population projections as the Region H Regional Water Plan, except for Missouri City. Although the numbers for Missouri City are reasonably close, the report might explain why the City of Missouri City's data were used. | Population data from 2010 through 2050 reduced by 10% of Region H values after consultations with City of Missouri City's Dir. of Public Works, Lee Dorger. This explanation also added in the footnote to Table 3-8. Also please refer requesting comment number 24. | January 2003 |
| 75 | | 3-7 and 3 8 | 3-9 and 3-11 | - | - | Comparing the two tables, it is an apparent increase in total peaking factor from 2.03 in years 2000 and 2010 to 2.08 in years 2020 through 2050. What is the basis for this increase? | Due to rounding of water projection numbers. Also, the peaking factor for each 'Municipal Utility' is constant for the entire planning period. | January 2003 |
| 76 | | 3-9 | - | - | Line 3 | Delete District after Harris and Galveston Coastal Subsidence District, since the ends in Districts. | incorporated | January 2003 |
| 77 | | 3-9 | - | - | Next to last paragraph | Clarify that the City of Houston's consultant is CDM. Spell out CDM when it is first used in the report. | incorporated | January 2003 |

| Comment No. | From | Page No. | Table No. | Figure No. | Paragraph | Comment | Response | Version |
|---|---|---|---|---|---|---|---|---|
| 78 | | 3-10 | - | - | - | An explanation of how CDM arrived at their demand figures for Southwest Harris County would be helpful, especially since it more than doubles the surface water demands starting in 2020. | CDM arrived at these demand figues by analysis census data and using a per capita water generation factor. This process was explained in a meeting with CDM, and the results were presented to MWH. Data presented in Appendix C. | January 2003 |
| 79 | | 3-10 | - | - | - | The first sentence under Figure 3-2 appears erroneous. Should the statement be surface water rather than groundwater? | The statement should be surface water. Change incorporated. | January 2003 |
| 80 | | 3-10 | 3-12 | - | - | Table shows a jump in surface water requirements from 60 MGD in year 2035 to 120 MGD in year 2040 in Southwest Harris County. Please explain, since allowable groundwater pumping remains constant in that interval. | As per information from report by CDM. See Appendix C. | January 2003 |
| 81 | | 3-11 | 3-13 | - | - | Please explain the unusual fluctuations in water demand for the farmers on A & B Systems | Data relies on estimates provided by customers to GCWA. | January 2003 |
| 82 | | 3-12 | - | - | - | Will groundwater be used to meet peak water demands? Is a 10% total loss for filter backwash and for conveyance reasonable? Was a 10 % loss also included for projected average day water demands as stated on page ES-8? | Yes, groundwater will be used to meet peak water demands. The 10% total loss for filter backwash and conveyance is based on the Regional Surface Water Plant Feasibility Study for Mid-Brazoria County Planning Group Report, dated September 2001. Also, the Eastern Service Area will convey water through pipelines thus reducing water losses, and the Western Service Area canal system will be reduced thus reducing the water losses. Due to this, a 10% total loss is believed to be appropriate. A 10% loss was included as stated on page ES-8. | January 2003 |
| 83 | | 3-14 | 3-14 | - | - | Why are the supplies shaded in Table? | Shading was done to highlight them. Shading removed from table | January 2003 |

| Comment No. | From | Page No. | Table No. | Figure No. | Paragraph | Comment | Response | Version |
|---|---|---|---|---|---|---|---|---|
| 84 | | 3-15 | - | - | - | Another potential source of raw water would be scalping a portion of flood flows into off-channel reservoirs. | incorporated | January 2003 |
| 85 | | 4-2 | 4-1 | - | - | Table states as an initial screening issue, that the I-45 corridor has a narrow construction within right-of-way. It would be informative if the right-of-way were defined. Is this right-of-way allowed along public roads by the Texas Department of Transportation or for an existing water line along I-45? | Texas Department of Transportation was recontacted, and they reconveyed the limited availability of the right-of-way along the I-45 corridor. | January 2003 |
| 86 | | 4-3 | - | - | - | Plural verb should'nt be used with a singular subject | incorporated | January 2003 |
| 87 | | 4-3 | - | - | - | The rating scale is from A to F rather than A to G. Also, A is the least difficult instead of the most difficult | incorporated | January 2003 |
| 88 | | 5-1 | 5-1 | - | - | Provide additional reference information on the sources used for the cost estimate parameters | New Appendix giving Region H Construction Cost development procedures included. | January 2003 |
| 89 | | 5-2 | - | 5-2 | - | Does $74 million pipeline construction cost consider any dewatering due to possible high water table conditions? | Cost includes standard construction cost for the region. | January 2003 |
| 90 | | 5-2 | 5-2 | - | - | What fraction of 175 MGD ultimate demand was used to determine the $.33 cost per 1,000 gallons? | The $.33/1,000 gallons cost was based on the year 2050 GCWA peak raw water requirement of 175 MGD (design capacity). | January 2003 |
| 91 | | - | - | - | | Appendix A: Title should be Region H Water Plan not TWDB Population and Consumptive Water Demand Projections | incorporated | January 2003 |
| 92 | | - | - | - | - | Appendix A: Population and Consumptive Water Demand Forecasts are not included for Brazoria County | incorporated | January 2003 |