Stormwater Reuse Through Aquifer Storage & Recovery

CITY OF NAPLES, FLORIDA
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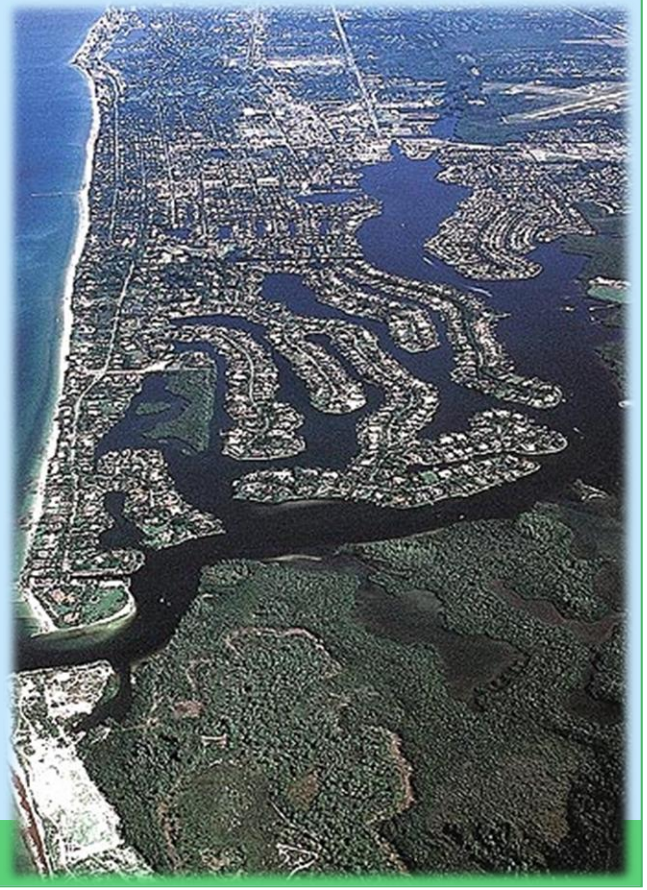
DIRECTOR-STREETS & STORMWATER DEPT.

APRIL 7, 2015

City of Naples, Florida

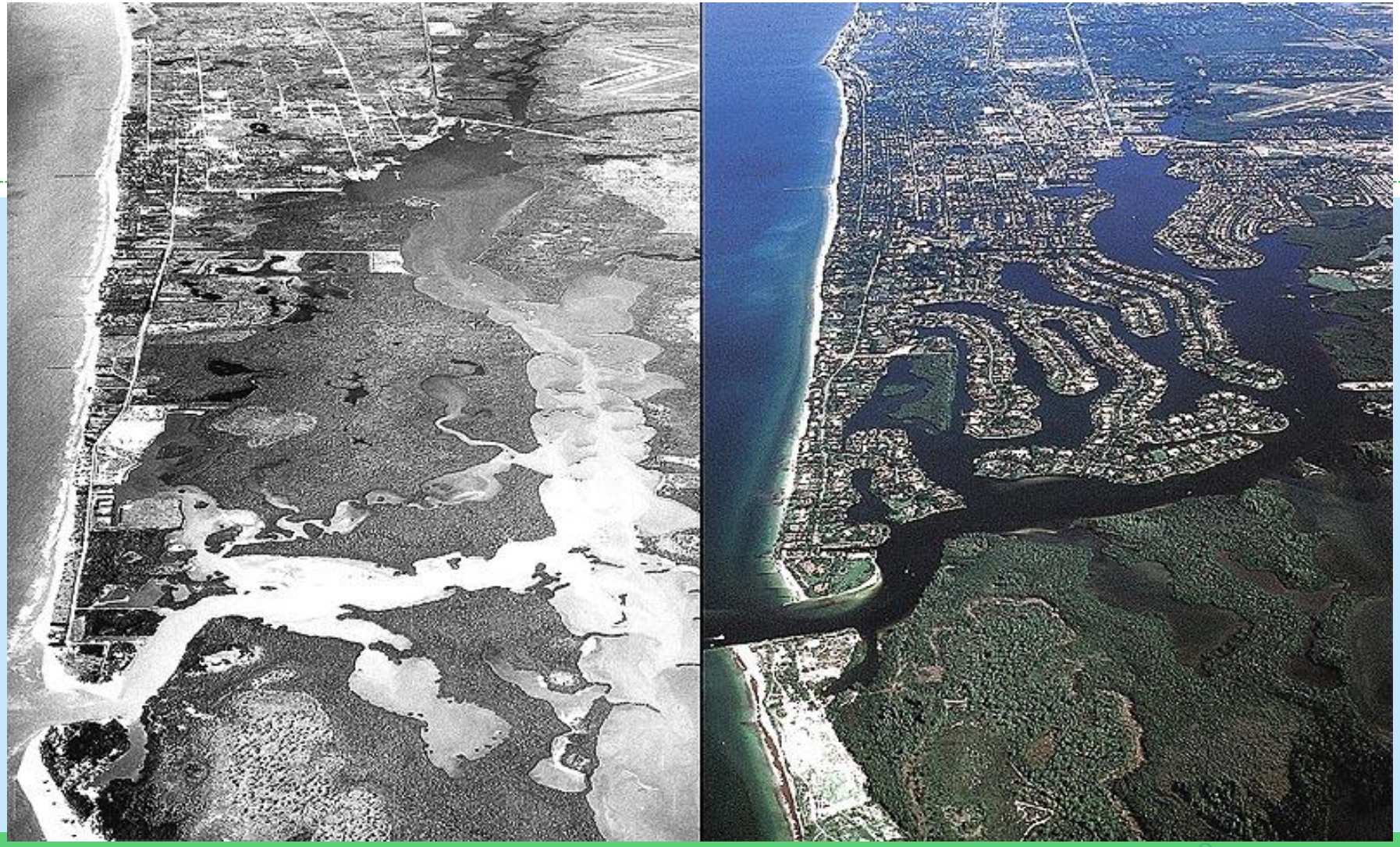
- Population: 20,537 (triples in-season with visitors)
- Stormwater Utility (Fee is $13.05 /ARU)
  - $4.8 M per year
- Water Demand (17.33 MGD total)
  - Irrigation: 10.4 MGD (60%)
- Water Supply
  - Potable: 14.3 MGD
  - Treated Effluent 6.72 MGD
  - Golden Gate Main Canal
  - Stormwater Pump Station

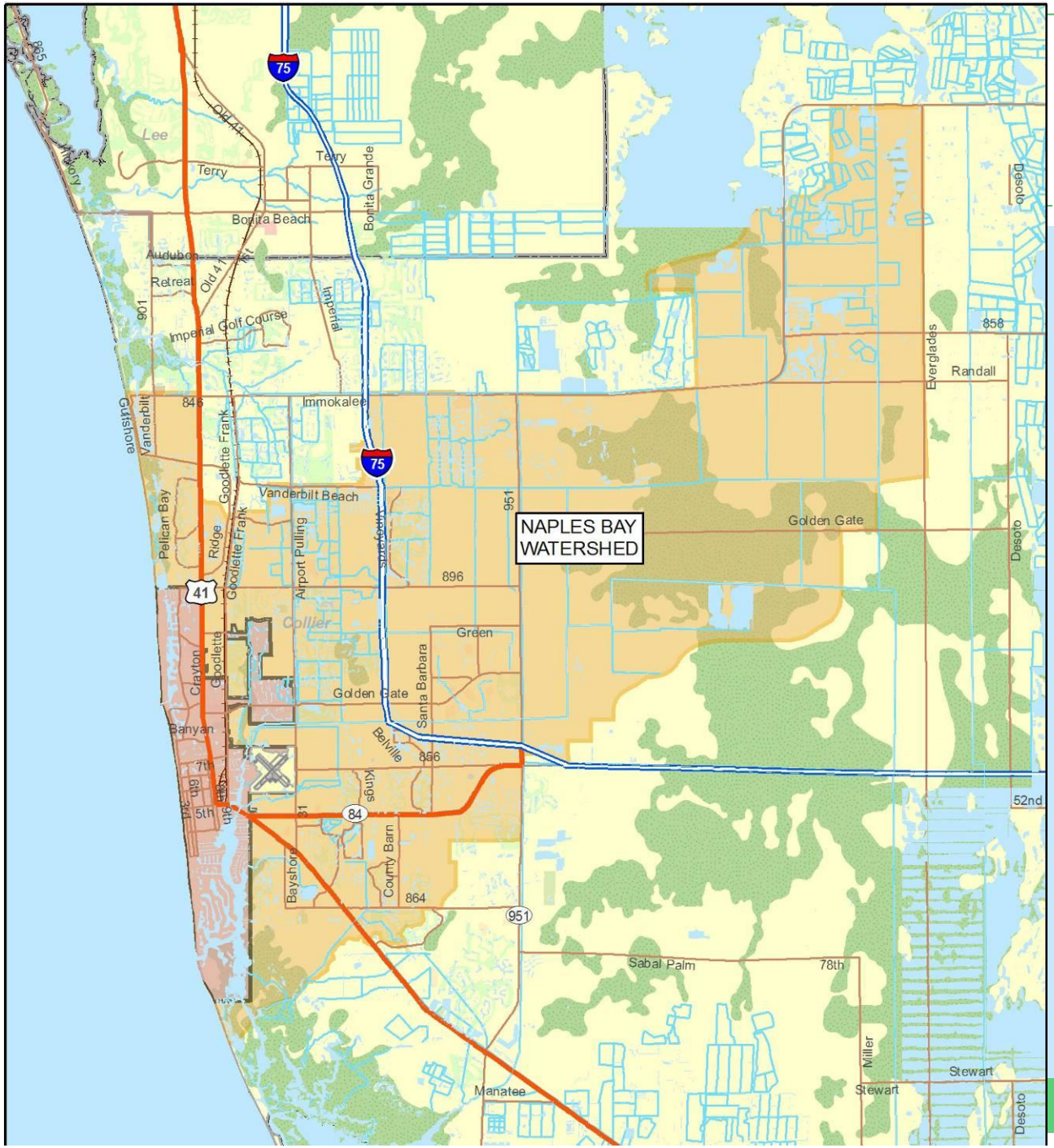
} Stormwater



Naples Bay

Before – (1950) **After – (2000)**





Watershed

- 120 sq. mi. Area
  - City 6.8%
- Impairments
  - Fresh Water
  - Nutrients (NAA)
  - Iron
  - Copper
  - Bacteria

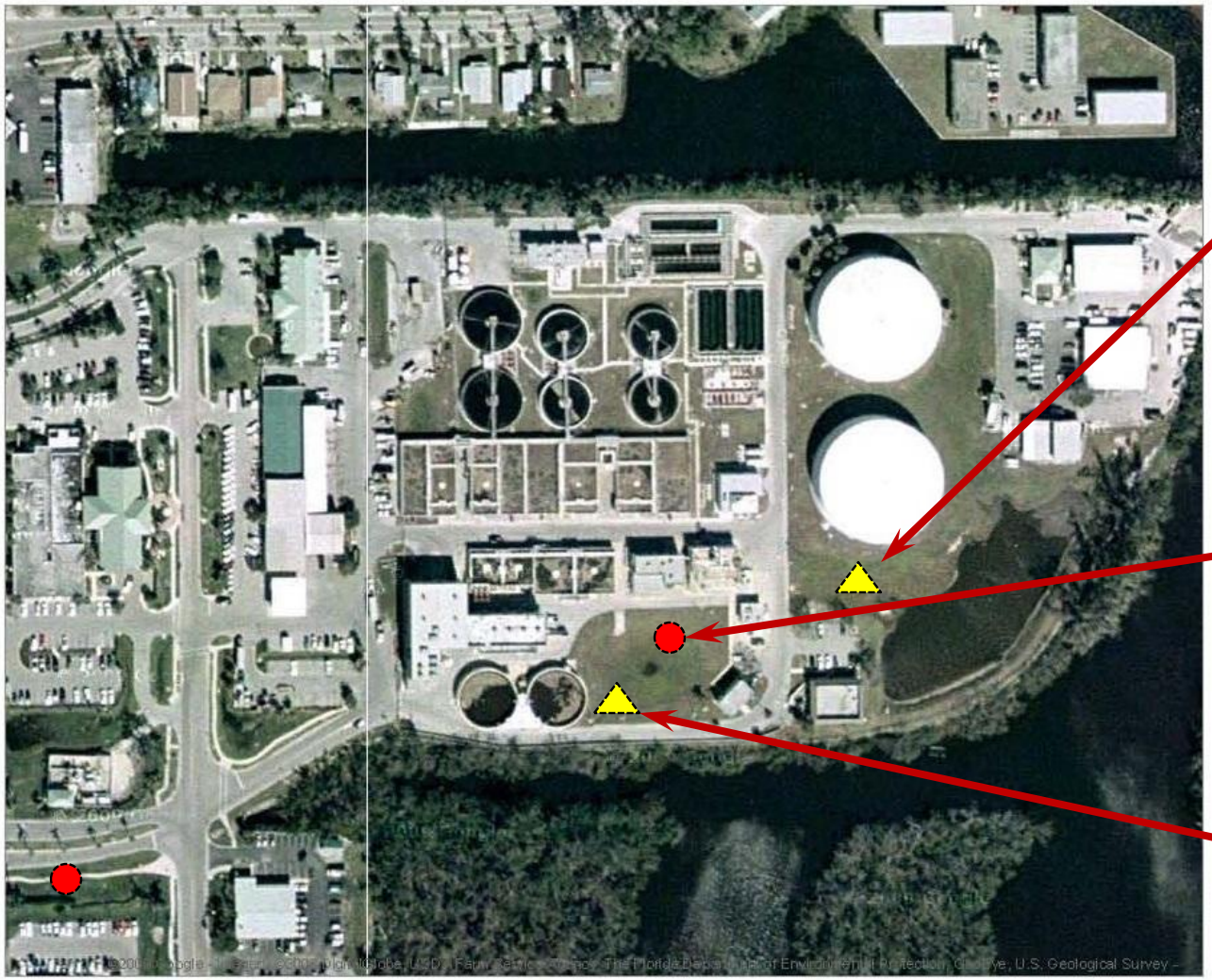
Background of overall program

- To develop up to 5 MGD of additional water sources
- To reduce consumption of potable water from 270 gallons per capita per day (GPCD) to below 200 GPCD
- To conserve existing potable water supply from the Lower Tamiami Aquifer
- To increase supply of supplemental water for irrigation
- To reduce reliance on expanded water treatment facilities
- To meet conditions of renewed water use permit, 100% reclaimed status

Water Availability

- Critical period is March through May
- Assume 30% recovery
- Volume to meet irrigation during critical period ~ 1,000,000,000 gallons (6.24 mgd for 90 days)
- One ASR well can deliver 1 to 2 MGD

Reclamation Plant Site Layout



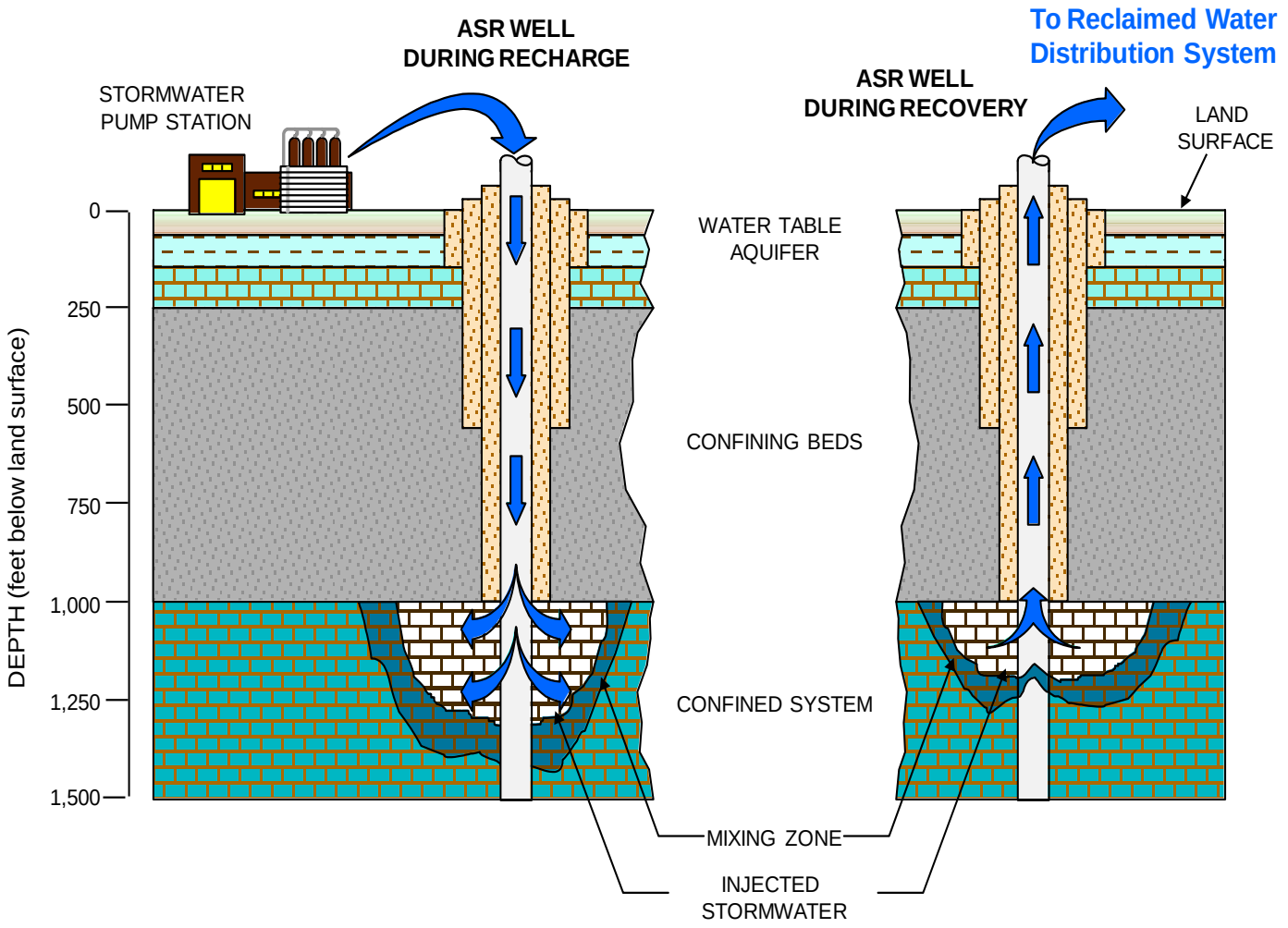
ASR Well (ASR-1)

Convert Exploratory Well to Monitor Well

Construct ASR Well (ASR-2)

ASR Well

Naples ASR Well Design



REGULATORY

Underground Source of Drinking Water (USDW)

An aquifer which supplies drinking water for human consumption and contains water with a total dissolved solids (TDS) concentration of less than **10,000** mg/L or less

Confining Layers

To prevent upward migration into USDW

Exploratory Well Construction Permit

ASR Well Construction Permit

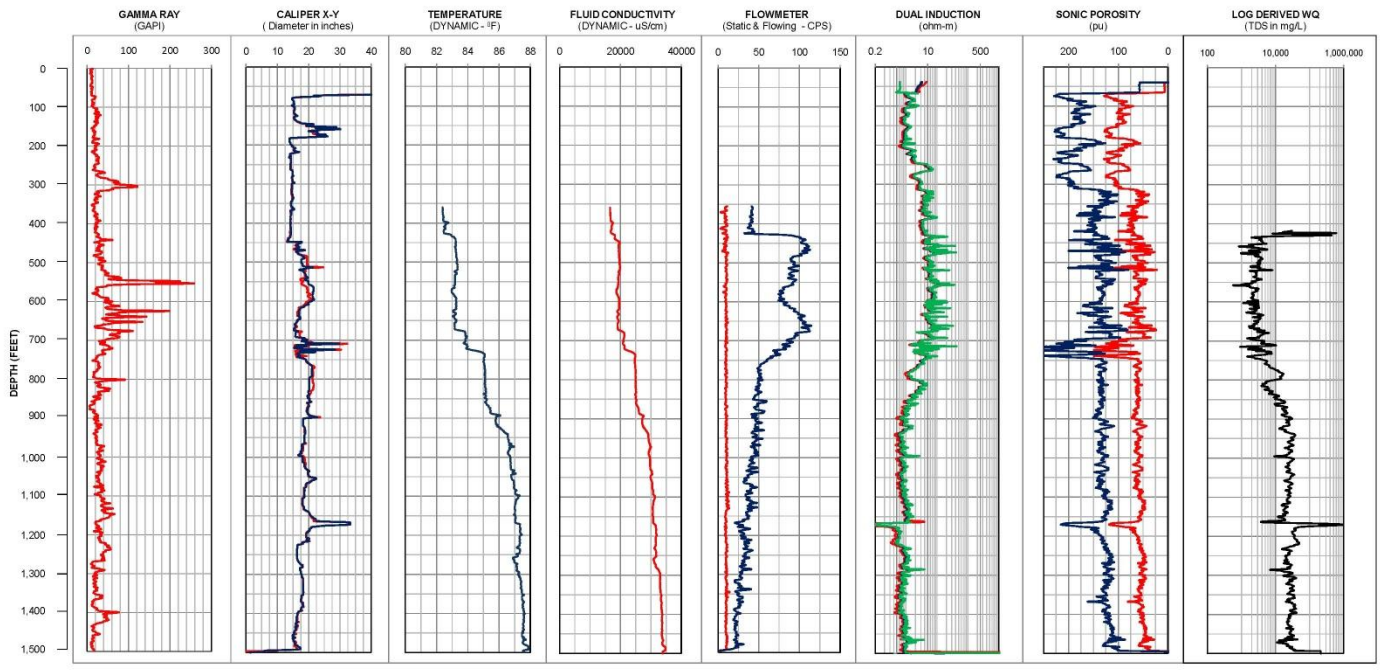
Cycle Testing the Storage Zone Permit

Operating Permit

UNDERGROUND CONDITIONS

- Geophysical logging used to collect information of sub-surface conditions

Geophysical logs

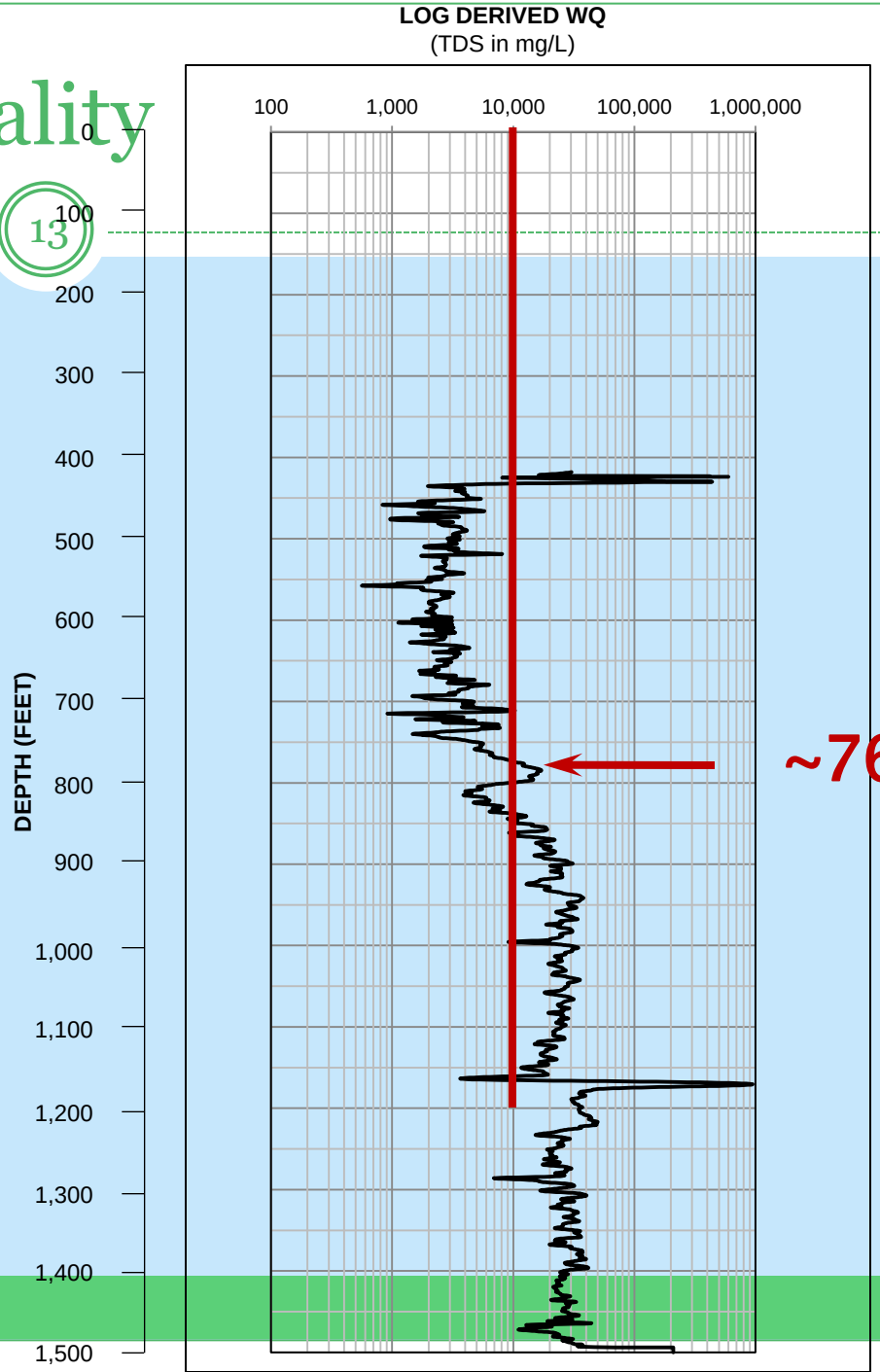


Log derived water quality

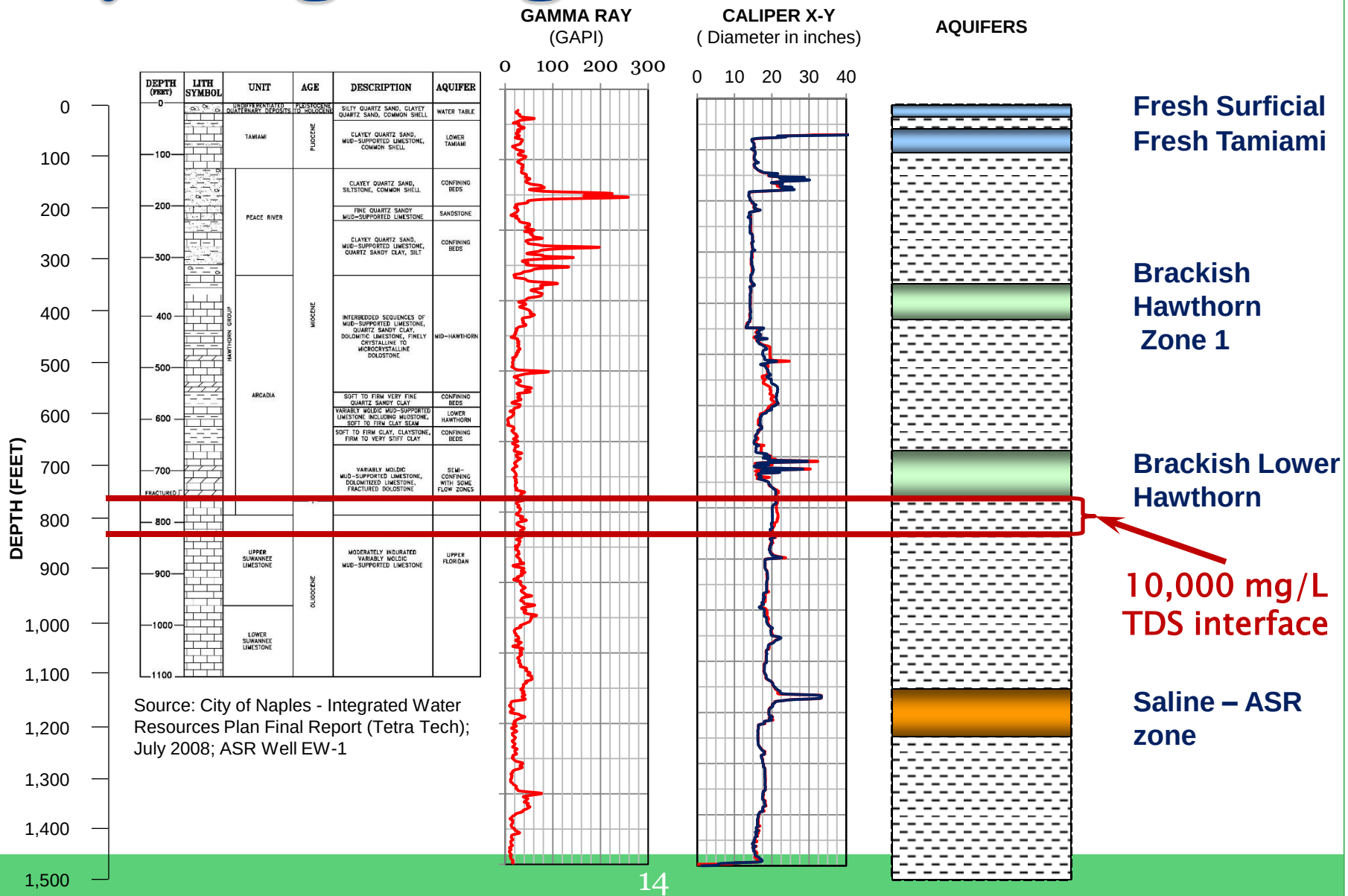
Use information related to water quality and porosity to calculate down-hole water quality

Note: packer test 785-805' showed TDS of 12,000 mg/L

10,000 mg/L TDS interface estimated at 760 feet

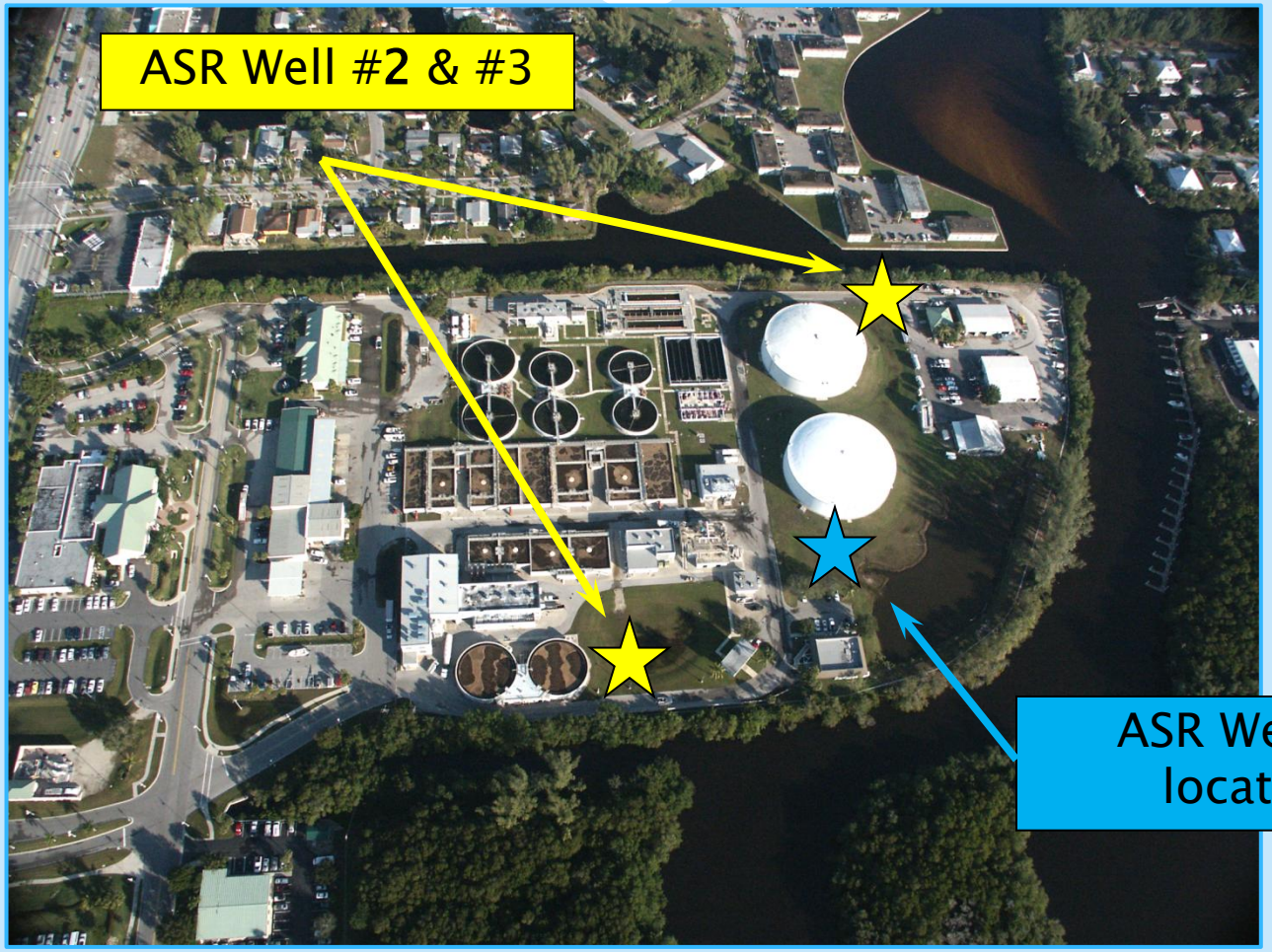


Hydrogeologic column



Source: City of Naples - Integrated Water Resources Plan Final Report (Tetra Tech); July 2008; ASR Well EW-1

Schedule (cont'd.)



Large Rig (85'+)

Drilling

Construction began in Aug-09

Drill to 1,500 feet

Casing Requirements

ASR Well No. 1
Completion diagram
24-inch casing to 1,080'
Storage zone 1,080' to 1,350'
Plug pilot hole

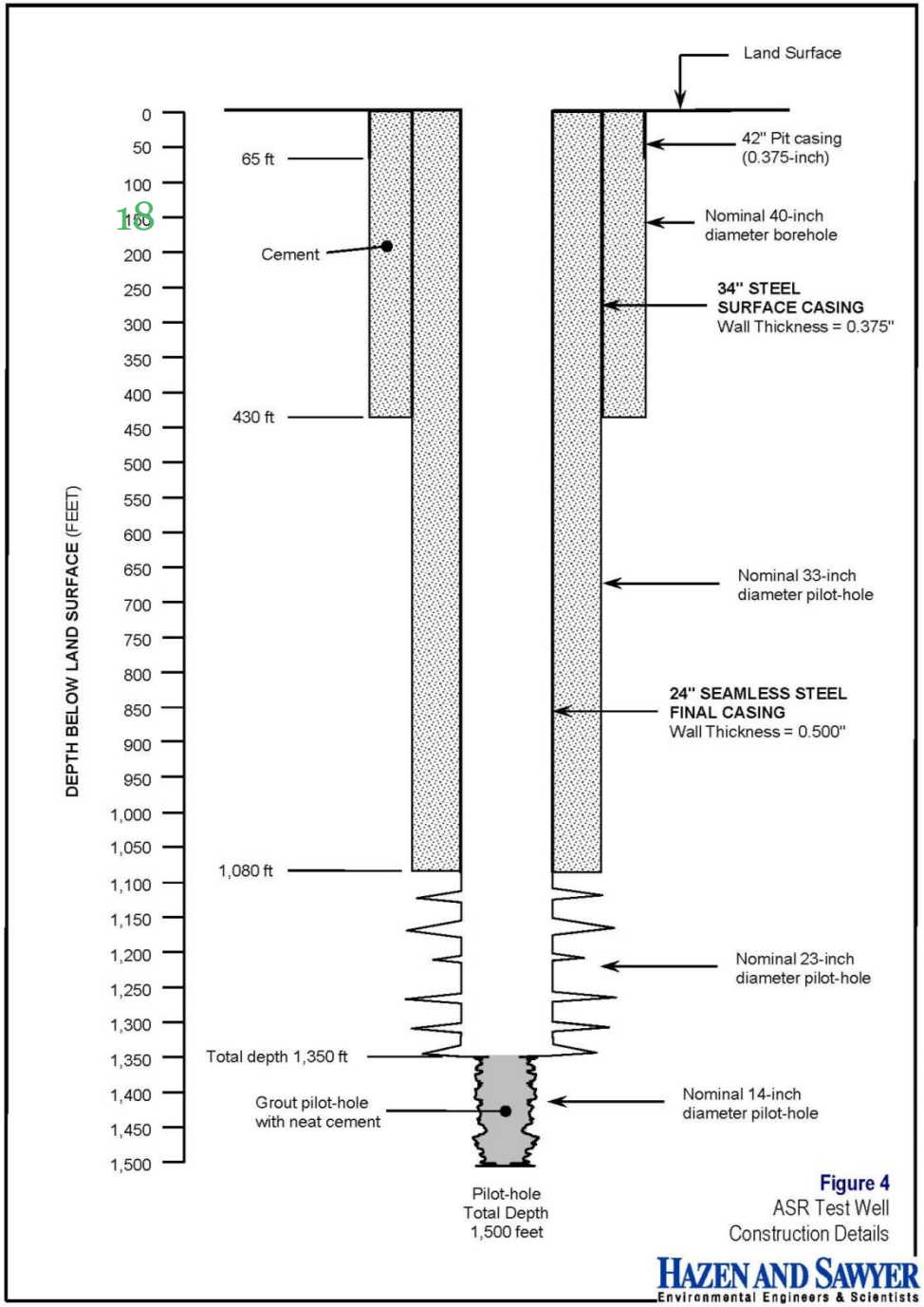


Figure 4
ASR Test Well
Construction Details

HAZEN AND SAWYER
Environmental Engineers & Scientists

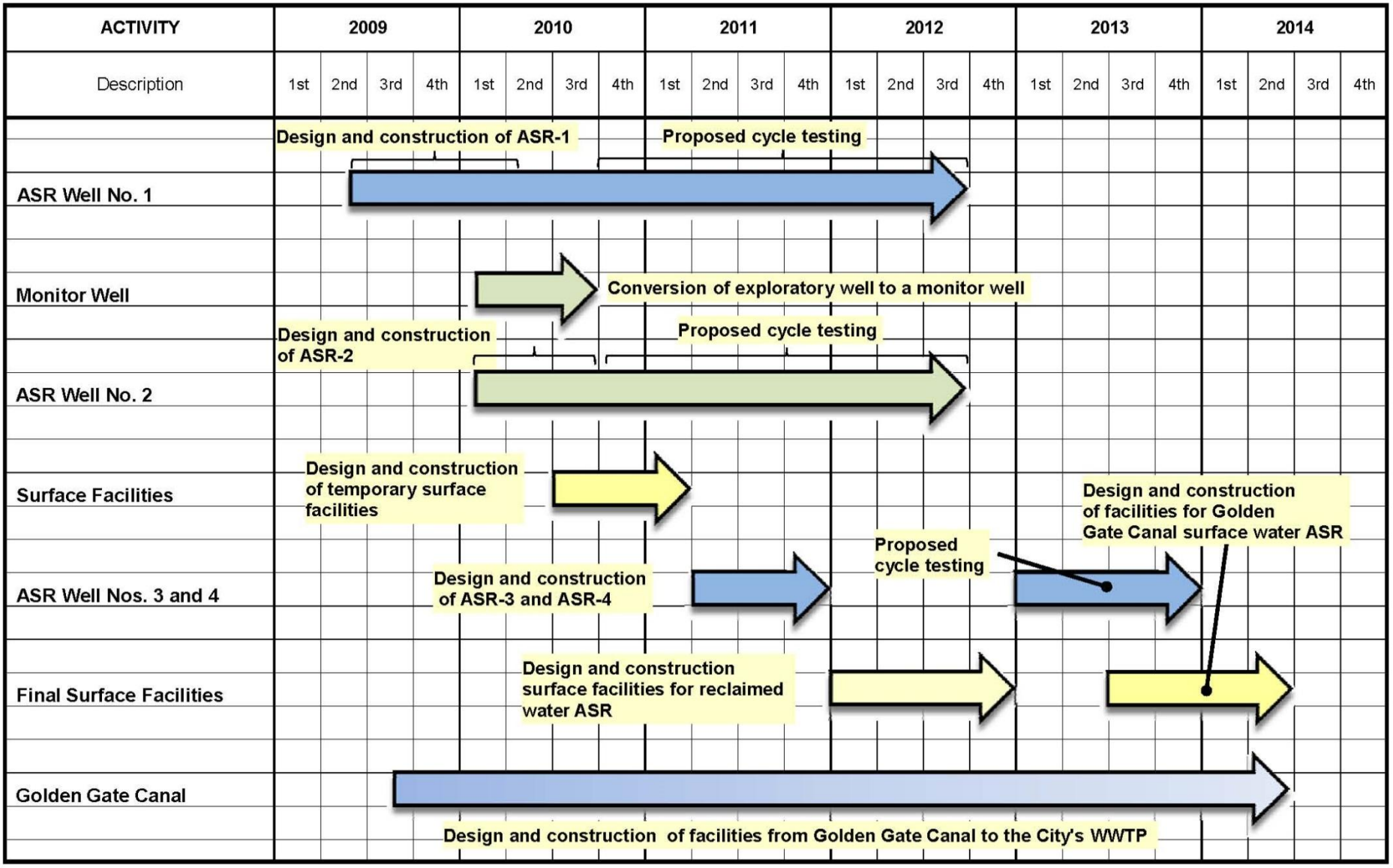
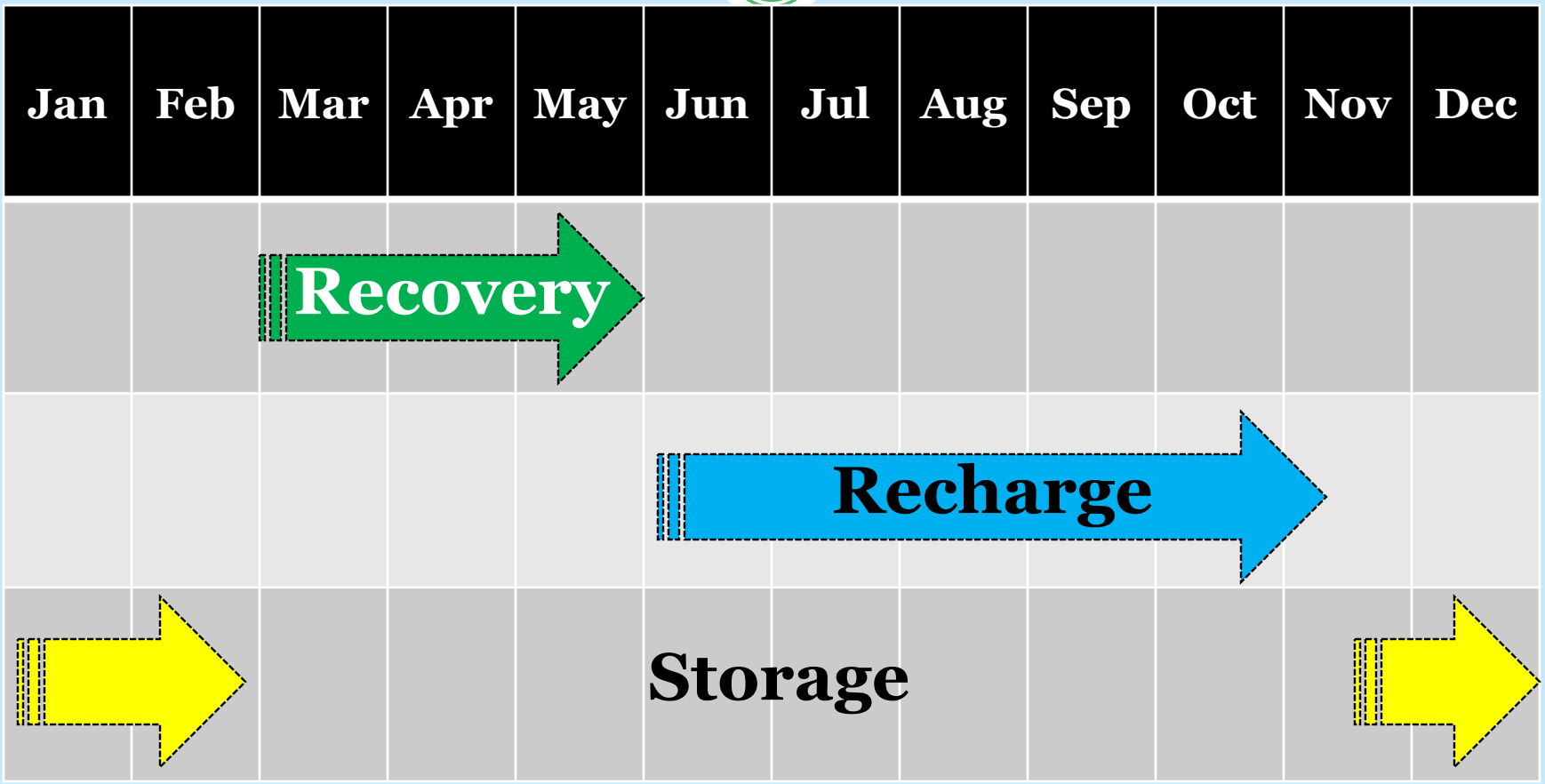


Figure 11
Implementation Schedule

HAZEN AND SAWYER
Environmental Engineers & Scientists

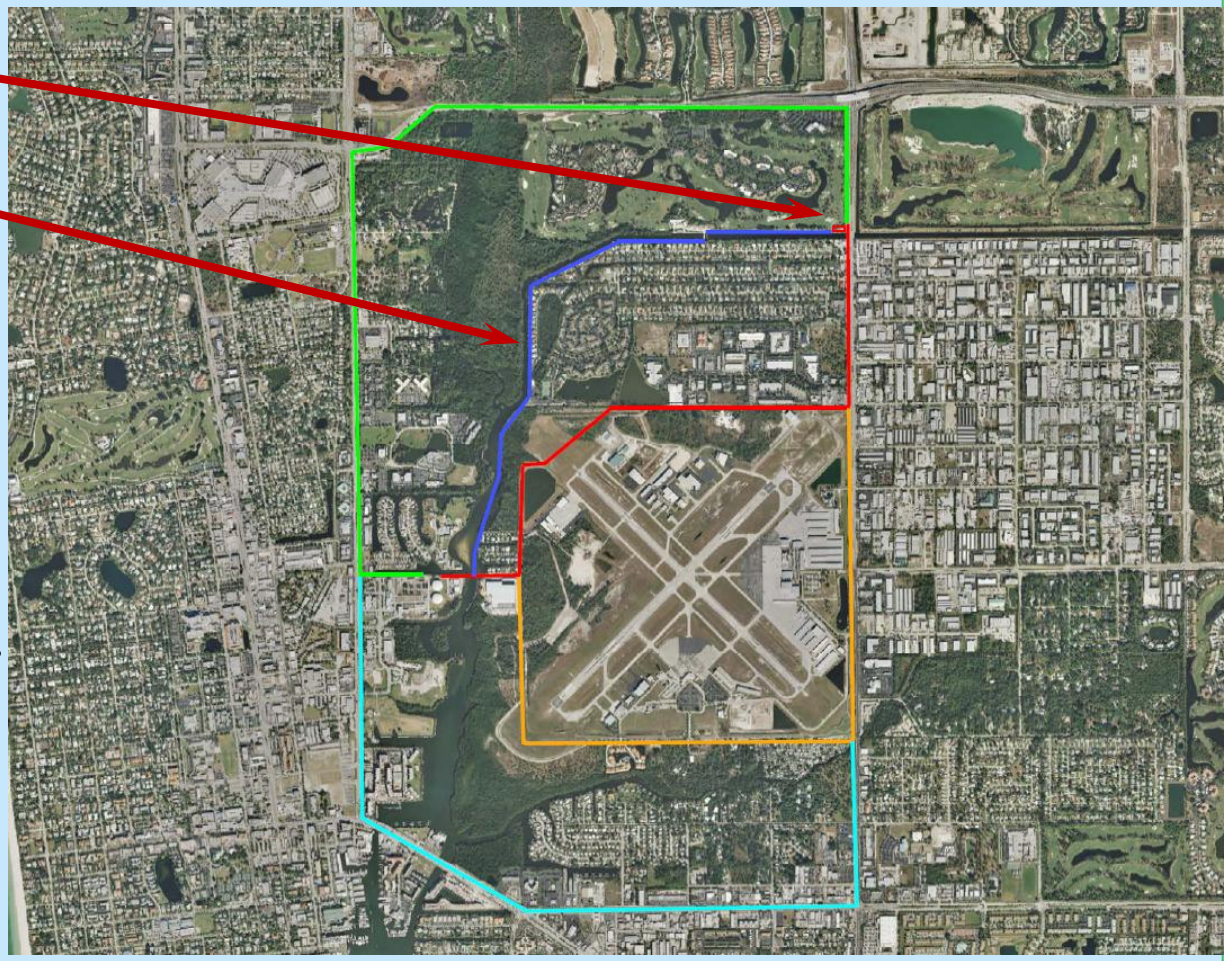
Design criteria



Water Budget

- Average potable demand = 17.33 mgd
- Irrigation demand (60%) = 10.40 mgd
- Available reuse = 6.72 mgd
- Deficit = 3.68 mgd
- Critical period is March through May
- Assume 30% recovery
- Volume to meet irrigation during critical period ~ 1,000,000,000 gallons (6.24 mgd for 90 days)

Golden Gate Canal Stormwater Transmission



Designer: CDM Smith, Inc.
Design & CEI Cost: $500,000

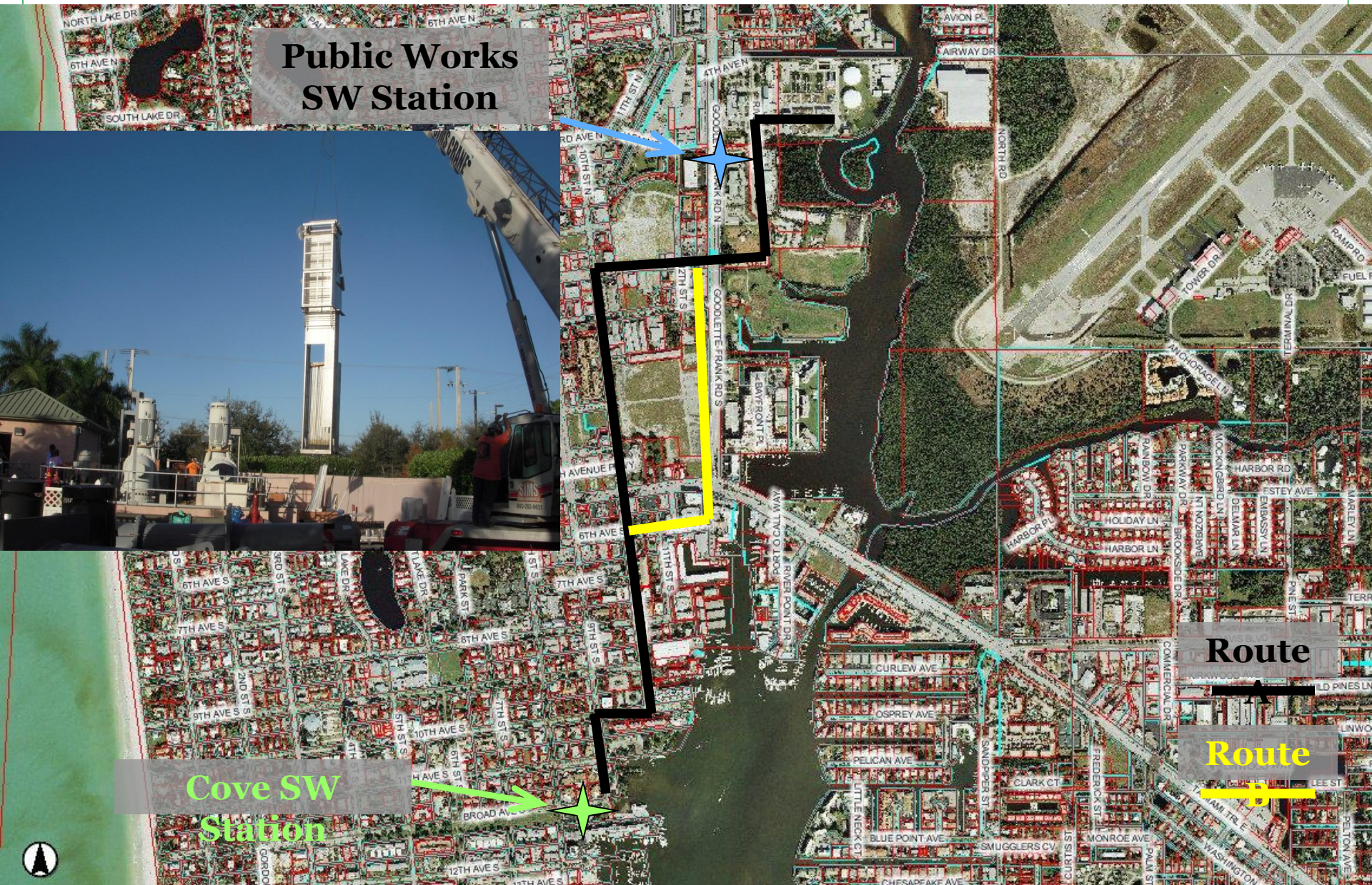
Builder: Stevens & Layton, Inc.
$4.8 Million

Max Availability: 10 MGD
Limited to Canal Depth in Dry Season
Max Delivery: 2 MGD per Well


18/10/2012 11:49


GOLDEN GATE MAIN CANAL
BIG CYPRESS BASIN
SOUTH FLORIDA WATER MANAGEMENT DISTRICT
ADOPT-A-CANAL
11/10/2012 15:18

Stormwater Transmission Mains



Cost Benefit – Net Cost After Sales

Transmission Route Alternative	Amortized Cost (25-years) WITHOUT WELL COST	Recoverable Volume Available for Sale (20% Recovery Rate)	Annual Revenue from Sales ($0.66 per Thou. Gal.)	NET Cost Per Thousand Gallons Diverted
Cove To ASR Via GFR (149 MG)	$126,000	29.8 MG	$19,668	**$0.71**
Cove To ASR Via 10th St. (149 MG)	$126,400	29.8 MG	$19,668	**$0.72**
PW To ASR (76 MG)	$32,700	15.2 MG	$10,032	**$0.30**

- 2013 Reuse Rate Per 1,000 Gallons: $0.66
- Assumes 20% Recovery Rate from ASR (100% injected, 20% extracted)

Stormwater Availability

	COVE	PUBLIC WORS
Total Flow 2012	686 MGY	369 MGY
Avg. Monthly Wet Season Flow	106 MG	53 MG
Ave. Monthly Dry Season Flow	22 MG	15 MG
Available ASR Capture for 2012 Based On Pump Run Time	**149 MG**	**76 MG**

- Does not consider adjustments to the pump controls to allow for more storage in wet well.
- Only assumes one available ASR well at 1,400 GPM max injection rate.

Cost Benefit Pollutant Reduction

Parameter	Pollutants of Concern					
	Cove Pump Station			Public Works Pump Station		
	TN	TP	Cu	TN	TP	Cu
Average Concentration – mg/l	1.6	0.275	0.0025	0.9725	0.084	0.01595
Stormwater Diverted Annually	149 MG	149 MG	149 MG	76 MG	76 MG	76 MG
Pollutant Load Reduction Per Million Gallons	13.3 lbs.	2.3 lbs.	.021 lbs.	8.1 lbs.	0.7 lbs.	.133 lbs.
Annual Pollutant Load Reduction	**1,982 lbs.**	**341 lbs.**	**3.1 lbs.**	**616 lbs.**	**53 lbs.**	**10.1 lbs.**

- Other stormwater pollutants removed: suspended solids and bacteria.

Public Works SW Pump Station

Supply To ASR

	Est. Capital Cost
• Design Transmission Main	$ 50,000
• Construct Transmission Main	$250,000
• Annual O&M Costs:	$ 5,000

Designer: AECOM
Design & CEI Cost: $60,000

Builder: TLC Diversified, Inc.
$250,000 Million

Max Availability: Depends on Rainfall
Dry Season: Under 0.5 MGD
Wet Season:
Limited to Canal Depth in Dry Season

CITY OF NAPLES STORMWATER QUALITY PROJECTS	POLLUTANTS OF CONCERN (TN, TP, Cu) REMOVED IN POUNDS PER YEAR	COST PER POUND DIVERTED	WITH $1.3M ASR WELL CONSTRUCTION
PUBLIC WORKS Pump Station Transmission Main to WRF	**679 lbs. (based on 75 MG treated per Year)**	**$ 39.76**	**$ 116.35**
COVE Pump Station Transmission Main to WRF	**2326 lbs. (based on 149 MG treated per Year)**	**$ 56.32**	**$ 78.68**
Broad Avenue Detention System-1	88 lbs. (based on 34 MG treated per Year)	$ 121.11	
Riverside Circle Filter Marsh-1	107 lbs. (based on 52 MG treated per Year)	$ 176.01	
One Mile of Roadside Swale-1	14.5 lbs. (based on 12 MG treated per Year)	$ 430.18	
Floating Island (200 square-feet)-2	6.6 lbs. (based on plant mass increase)	$ 370.12	

NOTE #1: Pollutant removal is based on standard removal efficiencies as determined by Dr. Harvey Harper.

NOTE #2: Plant pollutant removal data based on Lee County study, "The Effectiveness of Vegetated Floating Mats in Sequesering Nutrients", 2010.

WATER QUALITY COMPARISON			
	Golden Gate Main Canal (ppm, ppb) 2007 Data	Public Works Pump Station (ppm, ppb) 2013 Data	Multiplier
Total N	0.18	1.1	6.1 X
Total P	0.027	0.173	6.4 X
Copper	0.57	10	17.5 X

Placing a Value on Naples Bay

- **Naples Bay = 1,184 acres**
  - $7 Million – $59 Million
- 4-acres of Seagrass
  - $80,000
- 533 acres of Mangroves
  - $2 Million - $10 Million
- 38 acres of Oyster Reefs
  - $380,000

Stormwater Reuse Through Aquifer Storage & Recovery

THANK YOU FOR THE OPPORTUNITY TO PRESENT!

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