

# Monroe County Residential Canal Water Quality Improvement Program



Environmental Permitting Summer School  
July 2015



## Canal Construction in the Florida Keys

- Dredge and fill activities created 170 miles of canals, with 312 miles of waterfront property to accommodate the increasing population
- Many canals dug 10 - 20 feet to maximize fill material
- Most canals are long dead-end networks with little or no tidal flushing
- Canal development initiated before ecologists and resource managers were aware of the implications



# Impacts of Canal Development

- Increased population growth in a sensitive area without storm water and waste water systems
- Added excessive nutrients, turbidity and sediment to canal waters causing long-term water quality degradation
- Destroyed shoreline habitat especially mangroves
- The canals discharge directly to nearshore **Outstanding Florida Waters** in the FKNMS which may not receive direct or indirect discharges that would significantly degrade these waters





# Why is Canal Restoration Needed?



Key Colony Beach

Only 1/3  
of the  
canals  
have  
“Good”  
Water  
Quality



Duck Key



Key Haven



Conch Key



Sugar Loaf



# This is Why Restoration is Needed



Upper Keys – accumulated seaweed



Middle Keys – trapped seaweed



Summerland – trapped seaweed



Lack of flushing

2/3 of the canals have either “Poor” or “Fair” Water Quality

# Regulatory Drivers and Will the New Sewer System be Enough to Improve Water Quality?

## 1. Impaired Water Quality in the Canals

- Class III marine surface water quality standards for nutrients and dissolved oxygen are not being met per DEP Chapter 62-302, F.A.C.



## 2. Florida Keys Reasonable Assurance Document (FKRAD)

- Developed in 2008 by DEP in cooperation with local governments to address water bodies that do not meet the State's water quality standards
- Outlined extensive waste water and storm water restoration activities to address the nutrient impairments as an alternative to the establishment of Total Maximum Daily Loads
- The FKRAD 2011 Update recognized that additional canal restorations would be needed, in addition to the wastewater and stormwater pollutant reductions, to achieve the Class III Dissolved Oxygen Standard

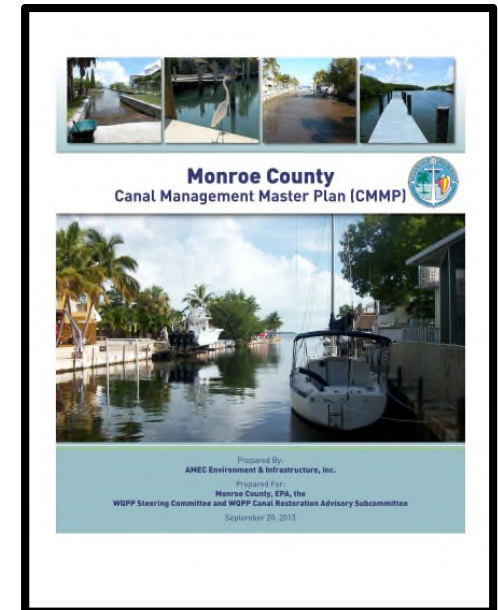


Photos courtesy of cudjoewastewater.com



# Monroe County Canal Management Master Plan for Residential Canals(CMMP)

- Defined **goals** agreed upon by all stakeholders
- Developed a **framework** for canal **restoration**
- Completed a comprehensive County-wide **mapping** of residential canals
- Completed a County-wide **field study of water quality** in the canals
- Developed a **ranking system** for categorizing canals based on observed characteristics
- **Prioritized** canals based on need for water quality improvement
- Proposed potential **corrective actions** to improve water quality in canals focused on dissolved oxygen:
  - Weed Barriers and Organic Removal of decayed seaweed
  - Culverts and Pumping Systems
  - Backfilling



# Where Do We Start?

- The FKNMS Water Quality Protection Program Steering Committee created a Canal Restoration Advisory Subcommittee which recommended that the first step to implement the CMMP was a **Canal Restoration Demonstration Program**
- The purpose is to:
  - Implement CMMP technologies
  - Evaluate the effectiveness of the technologies
  - Obtain realistic permitting, scheduling, and cost information
- Monroe County funded **\$5 Million** for canal demonstration projects in Unincorporated Monroe County





# Monroe County Demonstration Projects

Weed Barriers	Organic Removal	Culvert Installation	Backfilling	Pumping
<p>#266 Big Pine Doctor's Arm between Witters &amp; Bailey Lanes</p> <p><i>Same Canal – 2 categories</i></p> <p><b>#1</b></p>		<p>#459 Geiger Key Boca Chica Ocean Shores between Boca Chica Rd &amp; Jay Lane</p> <p><b>#2</b></p>	<p>#29 Key Largo Sexton Cove between Bunting &amp; Pigeon Drives</p> <p><b>#3</b></p>	<p>#278 Big Pine Eden Pines Colony Pine Ave</p> <p><b>#7</b></p>
<p>#287 Big Pine Atlantic Estates between Hollerich and Atlantis Drs</p> <p><b>#4</b></p>	<p>#290 Big Pine between Ave I and J</p> <p>Canal already has an existing effective weed gate</p> <p><b>#5</b></p>	<p>#277 Big Pine Tropical Bay between Watson Blvd and Sunrise Drive</p> <p><b>#6</b></p>		
		<p>#472 Geiger Key Geiger Mobile Homes</p> <p>DEP Grant Project</p>		

# Update on Canal #29 Backfilling Demonstration Project Sexton Cove, Key Largo

**Cause of Impairment:** Extremely deep (>20 feet deep) stagnant pockets with low dissolved oxygen and high hydrogen sulfide which can flush into nearshore waters during storm events

**Restoration Goals:** Promote flushing, reduce/eliminate stratification, increase dissolved oxygen, and create a conducive habitat for marine life

**Logistical Limitations:** Turbidity caused by placement of backfill material, canal access for staging and emplacement of backfill, high cost



**1. Restoration - 25,000 cubic yards of clean fill to raise canal bottom elevation to -7.7 ft MLW from -35 ft**

## **2. Permitting Process**

- a) SFWMD ERP
- b) USACE 404 Permit with Federal Consultation for T&E Species
- c) FKNMS Permit
- d) Monroe County Permits



# Canal #29 Backfilling Demonstration Project - Sexton Cove, Key Largo (continued)

## 3. Construction Process

- a) Clean fill transported by trucks from Florida City – 25 per day
- b) Vacant lot at canal end used for staging backfill
- c) Excavator loaded fill onto a conveyor belt in order not to disturb a mangrove fringe along the canal
- d) Fill moved onto a 60' x 24' barge for uniform emplacement throughout the canal
- e) Turbidity curtains maintained at canal mouth
- f) Manatee and crocodile observations required



## 4. Project Schedule and Cost

- a) Construction Initiated March 4, Substantial Completion June 3, 2015, Project Completion July 3, 2015
- b) Construction Cost \$1,360,000





# Update on Organic Removal Projects

## Canal #266 Drs. Arm & #290 Avenue J, Big Pine Key

**Cause of Impairment:** Buildup of decomposing weed wrack on canal bottom depleting the dissolved oxygen and adding nutrients

**Restoration Goals:** Increase dissolved oxygen and reduce nutrient loading to the water

**Logistical Limitations:** Large volume of suspended sediment and extracted water that requires stabilization, space requirements for dewatering equipment, high cost

**1. Restoration - removal of up to 5 feet of decayed seaweed and muck from the canal bottoms**

**2. Permitting**

- a) SFWMD ERP
- b) USACE 404 Permit with Federal Consultation for T&E Species
- c) FKNMS Permit
- d) Monroe County Building Permits



# Construction and Schedule for Organic Removal – Canal #266 Drs. Arm & #290 Avenue J (continued)

## 3. Construction Process

- a) Barge operated hydraulic vacuum dredge
- b) Estimated volumes: #266 8,300 cy; #290 4,700 cy
- c) Dredge spoils piped to land side staging areas
- d) Spoils dewatered using a mix tank, hydro-cyclone, clarifier, and belt presses
- e) Water discharged back into canal
- f) Turbidity curtains maintained at canal mouth
- g) Polymer addition monitoring on-going
- h) Reuse of dredge spoils at a local facility

## 4. Project Schedule and Cost

- a) Construction Initiated May 18, 2015 Substantial Completion estimated September 2015 or sooner for #266 and November 2015 #290
- b) Both canals \$1,839,905 (Canal #266 alone \$1,202,163 and Canal #290 alone \$849,840)



# Culvert Installation Projects

Canal #472 Geiger Key Boca Chica Rd, Canal #277 Big Pine,  
Canal #459 Geiger Key

**Cause of Impairment:** Lack of tidal flushing/stagnant water

**Restoration Goals:** Increase natural tidal flushing, increase dissolved oxygen and clarity, and create a conducive habitat for marine life

**Logistical Limitations:** Need reasonable location for a connection between canals or between canals and thin strips of land; subsurface utilities; restoration of properties

**1. Restoration Canal #472- concrete culvert underneath Boca Chica Road to create tidal connection between two dead end canals (#472 and #470)**

## 2. Permitting

- SFWMD – General Permit for work in County ROW
- USACE Permit – Nationwide 7 - Outfall Structures
- FKNMS Permit
- Monroe County Building Permits





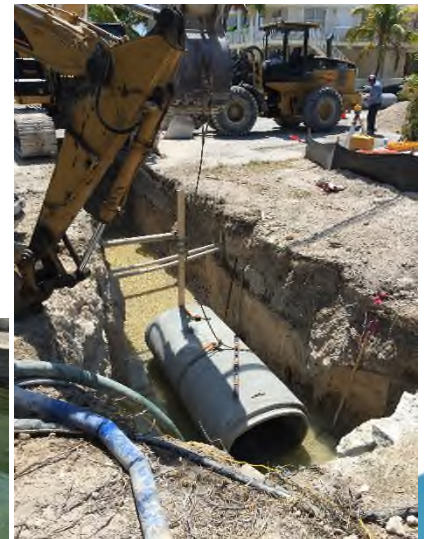
# Geiger Key #472 Culvert Installation

## 3. Construction Process

- a) 112 foot 24-inch by 38-inch submerged elliptical concrete culvert at a depth of approximately 4.5 feet below ground surface
- b) Placed above existing sewer pipe
- c) Removed and replaced a portion of two concrete seawalls
- d) Cofferdams, dewatering pumps, and turbidity barriers used around the in-water work areas
- e) Manatee grates installed
- f) All impacted areas restored to pre-construction conditions
- g) Immediate tidal flushing once installed.

## 4. Project Schedule and Cost

- a) Construction initiated March 9, 2015 completed March 27, 2015
- b) Construction cost \$200,000



# Update on Demonstration Projects for Air Curtains Canals #266 & #287 Big Pine Key

**Cause of Impairment:** Decaying seaweed trapped in canals depletes the dissolved oxygen

**Restoration Goals:** Prevent floating, wind-driven seaweed from entering into man-made canals

**Logistical Limitations:** Very few limitations: easy to permit, versatile, fairly low cost. Does require on-going operation and maintenance.

## 1. Two demonstration projects proposed for air curtains

**Air Curtain Alone** – Canal #287 Atlantic Estates between Hollerich and Atlantis Drives, Big Pine Key

**Air Curtain Combined with Organic Removal** – Canal #266 Drs. Arm between Wiitters and Baileys Lanes, Big Pine Key

**Effectiveness Monitoring will Compare Results**



# Update on Demonstration Projects for Air Curtains Canals #266 & #287 Big Pine Key (continued)

**2. Restoration – air diffusers installed across canal mouth to create a turbulent water column to block entry of seaweed**

## **3. Permitting**

- a) SFWMD – De minimus Exemption
- b) USACE 404 Permit with Federal Consultation for T&E Species
- c) FKNMS Permit
- d) Monroe County Building Permits

## **4. Construction Process**

- a) Teflon coated membrane air diffusers installed mounted on emitter assemblies set on canal bottom
- b) Self weighted air supply tubing installed from assemblies to location of air compressors
- c) Air compressors or blowers placed in noise reducing cabinets

## **5. Project Schedule and Cost**

- a) Construction estimated late summer to early fall
- b) \$50,000 to \$80,000 estimated





# Update on Canal #278 Pumping Demonstration Project - Eden Pines, Big Pine Key

**Cause of Impairment:** Lack of flushing due to canal configuration

**Restoration Goals:** Increase natural tidal flushing, increase dissolved oxygen, create a better habitat for marine life

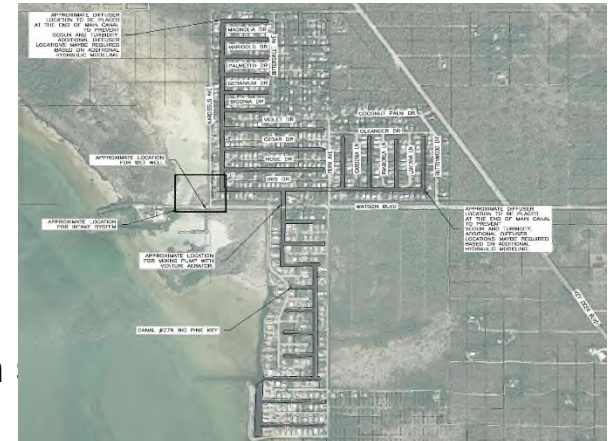
**Logistical Limitations:** High operation and maintenance cost, dependence on mechanical equipment.

**1. Restoration consists of pumping clean bay water to the farthest ends of the Eden Pines canal system to increase natural tidal flushing**

**2. Permitting – Not yet started**

**3. Overview of Conceptual Design**

- a) Pump intakes located in open water
- b) Pumps installed in wet well – est. capacity 1200+ gpm
- c) Water pumped to back ends of stagnant ends
- d) Tidal studies and hydraulic modeling required to design




# Restoration Effectiveness Monitoring by Florida International University

- **Water Quality and Benthic Resource Monitoring**
- **Pre-restoration and post-restoration monitoring**
- **Water Quality Monitoring Toolkit**
  - **Profile measurements** (YSI and Seabird)
    - Temperature, DO, Depth, Conductivity, Salinity, pH, Turbidity, Photosynthetically Active Radiation, Colored Dissolved Organic Matter
  - **Diel cycles** (24 h @ 10 min sampling rate)
    - DO, Turbidity, Conductivity, Salinity, Temperature, pH
  - **Water Quality analysis**
    - Nutrients - Total Nitrogen, Total Phosphorous, Dissolved Inorganic Nitrogen
  - **Enterococci bacteria** analysis (Enterolert)
- **Benthic Monitoring**
  - Seagrass, algae, fish and marine life, organisms on seawalls, sediment characteristics







Questions?