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Different Approaches in Upgrading UV Disinfection Systems to Meet New Challenges

July 27, 2018

Local Knowledge
INTERNATIONAL EXPERTISE

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TOPICS COVERED

- Contact versus Non-Contact UV Disinfection System
- Background
  - Blackhawk WWTP – Friendswood, Texas
  - Cotton Bayou WWTP – Mont Belvieu, Texas
  - TAMUG WWTP – Galveston, Texas
- Challenges
  - Meeting Bacteria inactivation permit limit
  - Ensuring compliance with the Bacteria Inactivation Limits during replacement/retrofit

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CONTACT VS NON-CONTACT UV

TROJAN 3000-PLUS IN-CHANNEL CONTACT UV

ENAQUA NON-CONTACT UV

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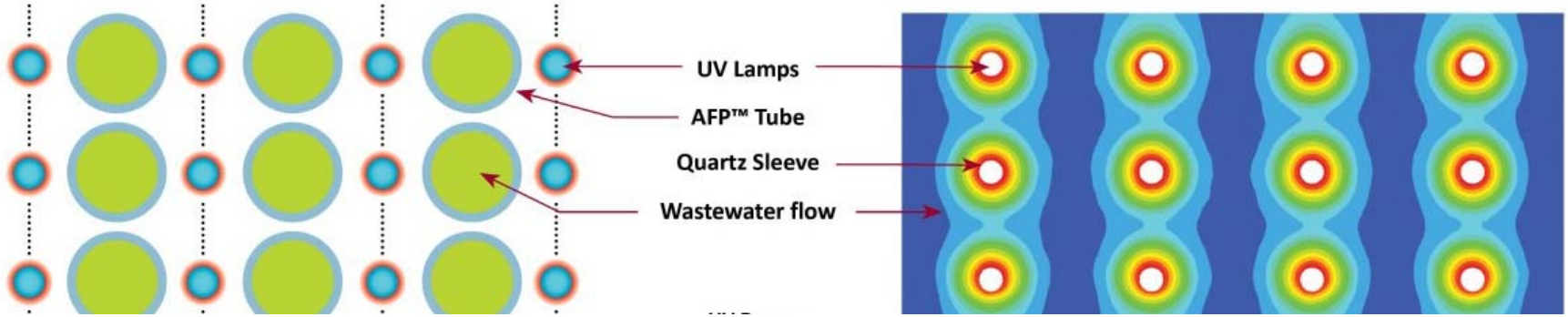
CONTACT VERSUS NON-CONTACT UV



CONTACT VS NON-CONTACT UV

Contact UV:

- Automatic cleaning system
- Flow and UVT proportional control
- Horizontal, inclined, or vertical lamps
- Downstream level control
- Existing chlorine contact chamber can be retrofitted into UV channels
- Can be designed for future expansion
- Common technology with several known manufacturers

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CONTACT VS NON-CONTACT UV

Non-Contact UV:

- Automatic cleaning of lamps is not required
- Level control is not required
- In-channel or stand alone installation
- Does not require downstream flow control
- Separate cooling system depending on capacity
- Relatively new technology in US with two known manufacturers


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BLACKHAWK WWTP
FRIENDSWOOD, TEXAS
Bay Area Blvd

BLACKHAWK WWTP

Background

- Originally constructed in 1980, upgraded in 1984, 1993 and recently in 2013-2015
- Average/Permitted Daily Flow – 5.5/9.25 MGD
- Actual and Permitted Peak Flow – 27.75 MGD
- Proposed rerating Peak Flow – 32.0 MGD

TROJAN UV AT BLACKHAWK WWTP

BLACKHAWK WWTP

TPDES Permit Effluent Limits – Daily Averages

- TSS – 12 mg/l
- Enterococci – 35 CFU or MPN/100 ml
- CBOD5 – 5 mg/l
- Ammonia Nitrogen – 2 mg/l

BLACKHAWK WWTP

Initial Problem

- Transmittance reduced during heavy rain events
- Old travelling bridge filters with low effluent UVT after rain events
- Enterococci exceeded permit limits during peak rain events
- High UV disinfection energy consumption

TROJAN UV AT BLACKHAWK WWTP

BLACKHAWK WWTP

Challenge

- How to maintain disinfection during construction?
- How to address low transmittance during peak rain events?

TROJAN UV AT BLACKHAWK WWTP

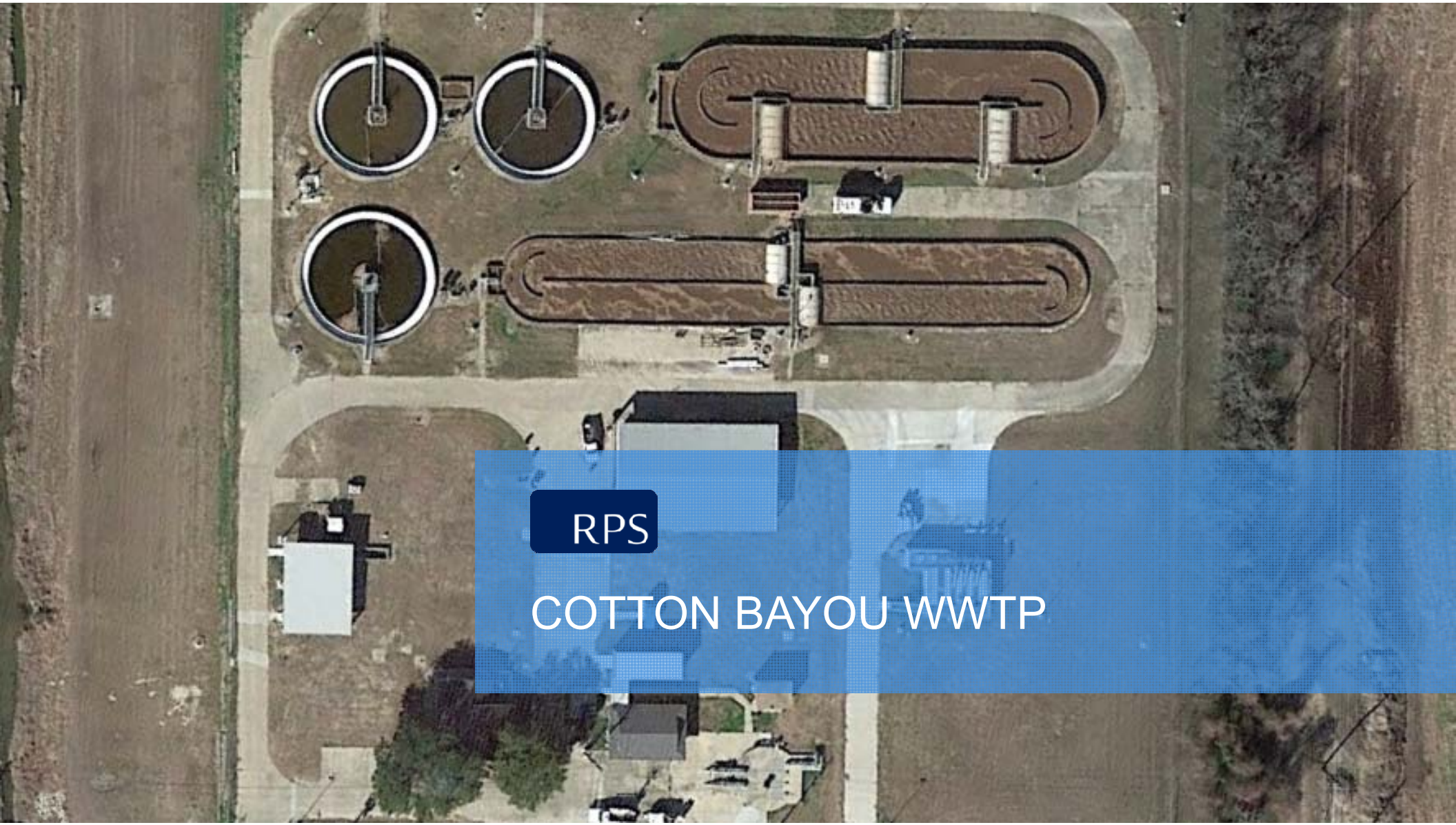
BLACKHAWK WWTP

Solutions

- Refurbished chlorination/dechlorination system for use during construction
- Refurbished two oldest traveling bridge filters
- Lowered the specified design transmittance from the recommended 65% to 55%
- Owner purchased equipment to expedite installation
- Design UV system to accommodate future expansion within the existing channels

BLACKHAWK FILTERS

TROJAN UV LAMPS



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COTTON BAYOU WWTP

COTTON BAYOU WWTP

Background

- Originally built in 1981 and upgraded in 1997, 2010 and 2015 (rehabilitation started September 2015)
- Average/Permitted Daily Flow – 0.6/1.5 MGD
- Actual and Permitted Peak Flow – 4.5 MGD

EXISTING UV AND CHLORINE CONTACT BASIN

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COTTON BAYOU WWTP

TPDES Permit Effluent Limits – Daily Averages

- TSS – 15 mg/l
- **E. coli** – 126 CFU or MPN/100 ml
- $CBOD_5$ – 10 mg/l
- Ammonia Nitrogen – 3 mg/l

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COTTON BAYOU WWTP

Initial Problem

- IDI Aquaray 40 had exceeded its design life
- Frequent maintenance outages
- Exceeded permit limits during outages and rain events
- High UV disinfection energy consumption

IDI AQUARAY 40

COTTON BAYOU WWTP

Challenges

- How to install new system while maintaining plant flow and disinfection?
- Can the UV system be installed in the existing chlorine contact basin?

OLD CHLORINE CONTACT BASIN

COTTON BAYOU WWTP

Challenges (cont.)

- Installing hydraulic head for tertiary filtration before UV
- Algae growth in secondary clarifiers

EXISTING CLARIFIER

COTTON BAYOU WWTP

Solutions

- Install covers above clarifiers launders for algae control
- Install new UV in existing chlorine contact basin.
  - Allows existing UV to remain in service during construction.
  - Reuse existing structure

CLARIFIER COVERS

COTTON BAYOU WWTP

Solutions

- Selected Non-Contact UV
  - Small footprint – fits in the existing structure
  - Low maintenance.
- Lowered the specified design transmittance to 50%
- Accommodate tertiary filtration into design
- Owner purchased equipment to expedite installation

ENAQUA UV


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TAMUG WWTP


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TAMUG WWTP

TAMUG WWTP

Background

- Originally built in 1970s and upgraded in 1997
- Average/Permitted Daily Flow – 0.1/0.2 MGD
- Actual and Permitted Peak Flow – 0.2/0.8 MGD

TAMUG WWTP

TPDES Permit Effluent Limits – Daily Averages

- TSS – 20 mg/l
- Enterococci – 35 CFU or MPN/100 ml
- $CBOD_5$ – 20 mg/l

TAMUG WWTP

Initial Problem

- Equipment beyond intended design life
- High energy consumption by aeration system
- WWTP and Chlorination system in close proximity to the campus
  - Hazardous Chemical
  - Esthetics
  - Odor problems

TAMUG WWTP

Solutions

- Part of the $47M campus expansion Design/Build project
- Selected Non-Contact UV
- Reduced design transmittance from 65% to 55% to accommodate lack of filtration prior to disinfection
- Accommodate future tertiary filtration into design

ENAQUA UV

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SUMMARY CAPITAL COST COMPARISION

	Blackhawk	Mont Belvieu	TAMUG
UV	Trojan 3000	Enaqua	Enaqua
Peak Flow	27 MGD	4.5 MGD	0.8 MGD
Equipment	$1,160,000	$320,000	$125,000
Installation	$400,000	$160,000	$25,000
Total	$1,560.000	$480,000	$150,000

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CONCLUSIONS

Selection of UV system:

- UV Transmittance/Pretreatment Process
- Consideration of adding tertiary treatment in the future
- Life Cycle cost analysis
- Logistics of disinfection during construction for retrofit projects
- Operational Considerations
- Considerations of future expansion
- Using existing structures if feasible
- Maintenance Contract
- Back-up power

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QUESTIONS?

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