City of **Littleton**

AGENDA FOR THE

JOINT BREAKFAST MEETING

ENGLEWOOD CITY COUNCIL

AND

LITTLETON CITY COUNCIL

JUNE 28, 2011

Wastewater Treatment Plant
2900 South Platte River Drive
7:30 A.M.

I. **CH2M Hill Report**

The Littleton City Council commissioned an independent analysis of the proposal to install an ultraviolet (UV) treatment system at the Bi-City Wastewater Treatment Plant.

The analysis has been completed and the Littleton City Council has requested time with the Englewood City Council to allow the consultants, CH2M Hill, to present their data and findings.

This presentation is for information purposes only. It is anticipated that there will be a follow-up meeting later this summer to determine the position of each Council regarding the funding of the proposed UV system.

Littleton/Englewood WWTP Assessment of Existing Disinfection System

Littleton City Council Meeting
June 21, 2011

CH2MHILL

Background – Previous Work by Others

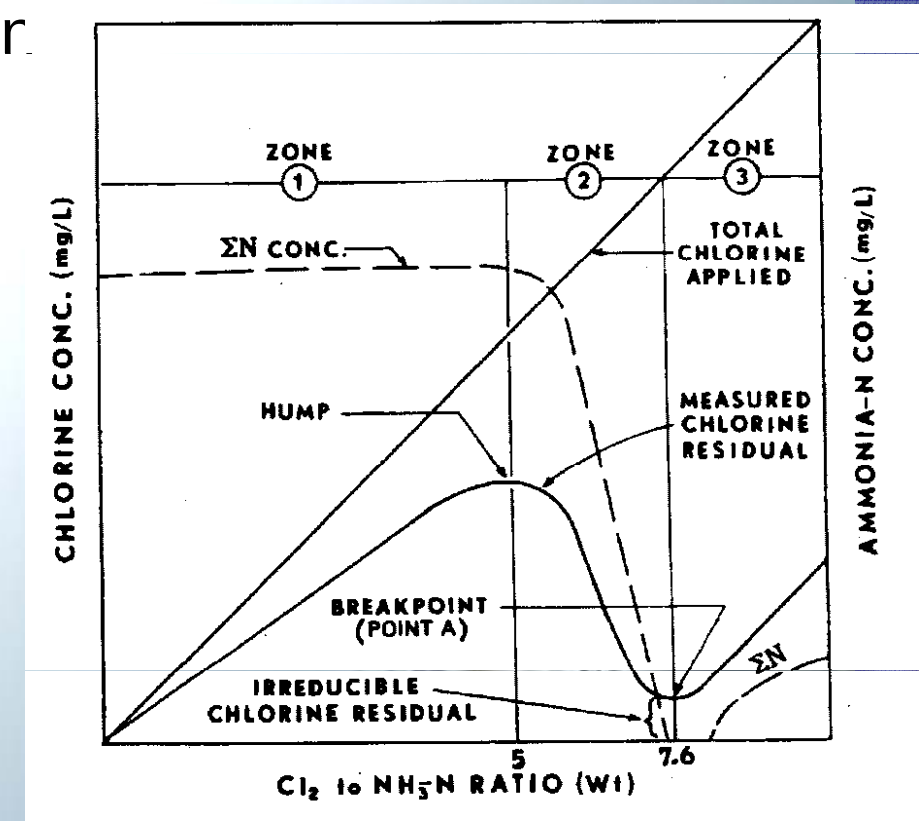
- B&C previously evaluated the existing system and alternative disinfection methods to comply with future ammonia limits.
- Previous finding for the existing disinfection approach:
  - "cannot be expected to consistently meet permit limitations" based on newly adopted discharge limits for the WWTP
- Identified UV disinfection as the selected alternative
- Ammonia Compliance Schedule approved by CDPHE and included in WWTP's discharge permit

Background – Previous Work by Others

- Previous work recommended UV disinfection based on following concerns with chlorine disinfection options:
  - Low ammonia concentrations complicate chlorination chemistry
  - Difficult process control
  - On-line ammonia analyzers, which are necessary for the chlorine disinfection options, are difficult to calibrate and do not always produce accurate results
  - Options with ammonia *addition* may increase risk of future permit violation
- The intent of CH2M HILL's study is to re-evaluate the feasibility of the chlorine disinfection options

Why Is Ammonia Important for Disinfection at the L/E WWTP?

- Ammonia is present in wastewater
- Ammonia must be removed to meet discharge limits
- Ammonia must be present at sufficient concentrations for effective chlorine disinfection
- Competing objectives result in a balancing act to remove enough but not all ammonia
- Chlorine/ammonia chemistry is complicated: the correct chemical ratio is required for effective disinfection

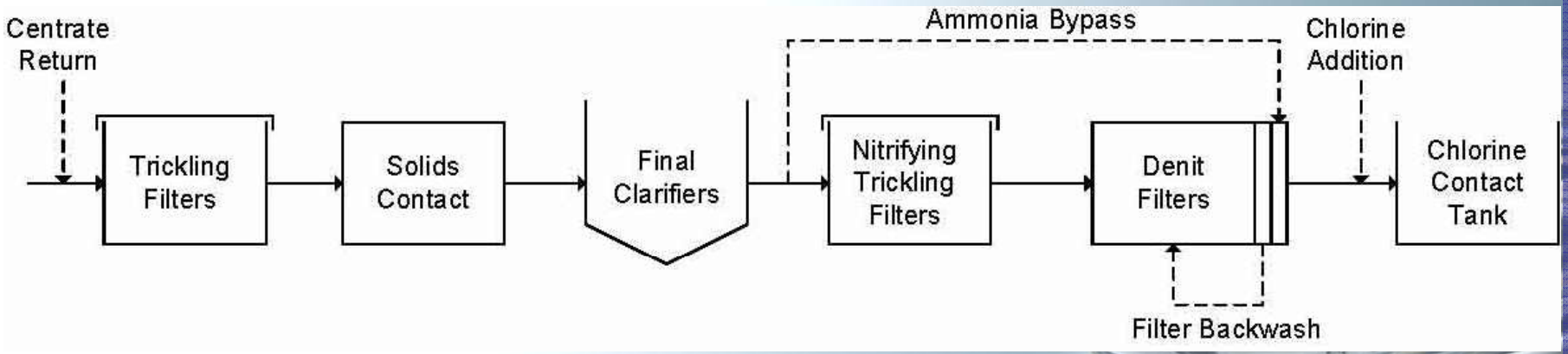


Evaluation of Chlorine Disinfection Options Previously Considered

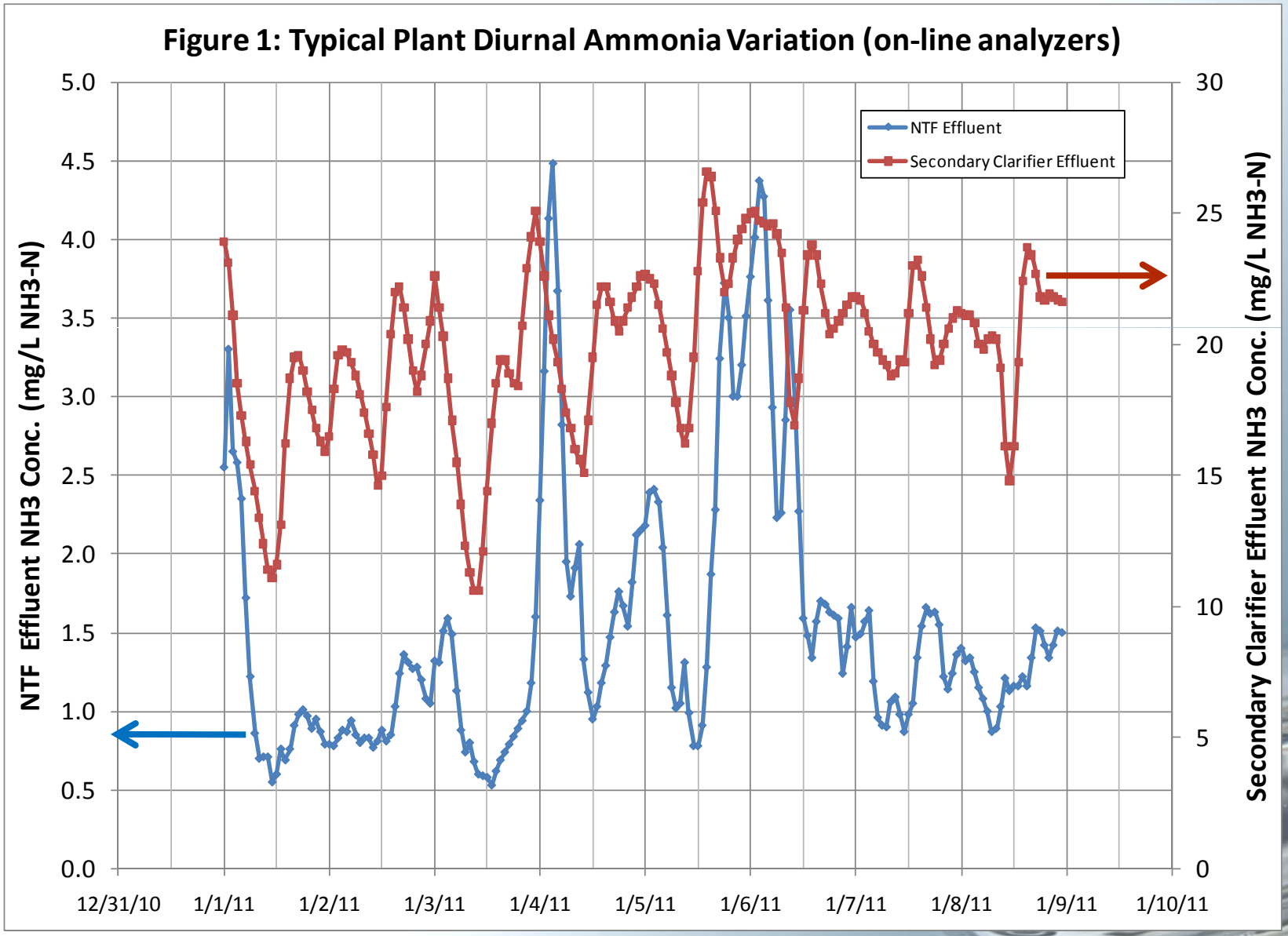
- **Option #1:** Free chlorine disinfection by breakpoint chlorination – high chlorine dose, high cost, not controllable, not recommended
- **Option #2:** Monochloramine disinfection using existing NTF Bypass
- **Option #3:** Monochloramine disinfection using external ammonia addition – higher cost than Option 2, no additional advantages

Difficulties with Current Approach

- Current approach bypasses some ammonia around nitrification
- Other plant operations complicate the process
  - Typical diurnal ammonia variations
  - On-line ammonia analyzer accuracy and reliability
  - Denit filter bumping and backwashing
  - NTF bypass control algorithm
  - Centrate return pumping

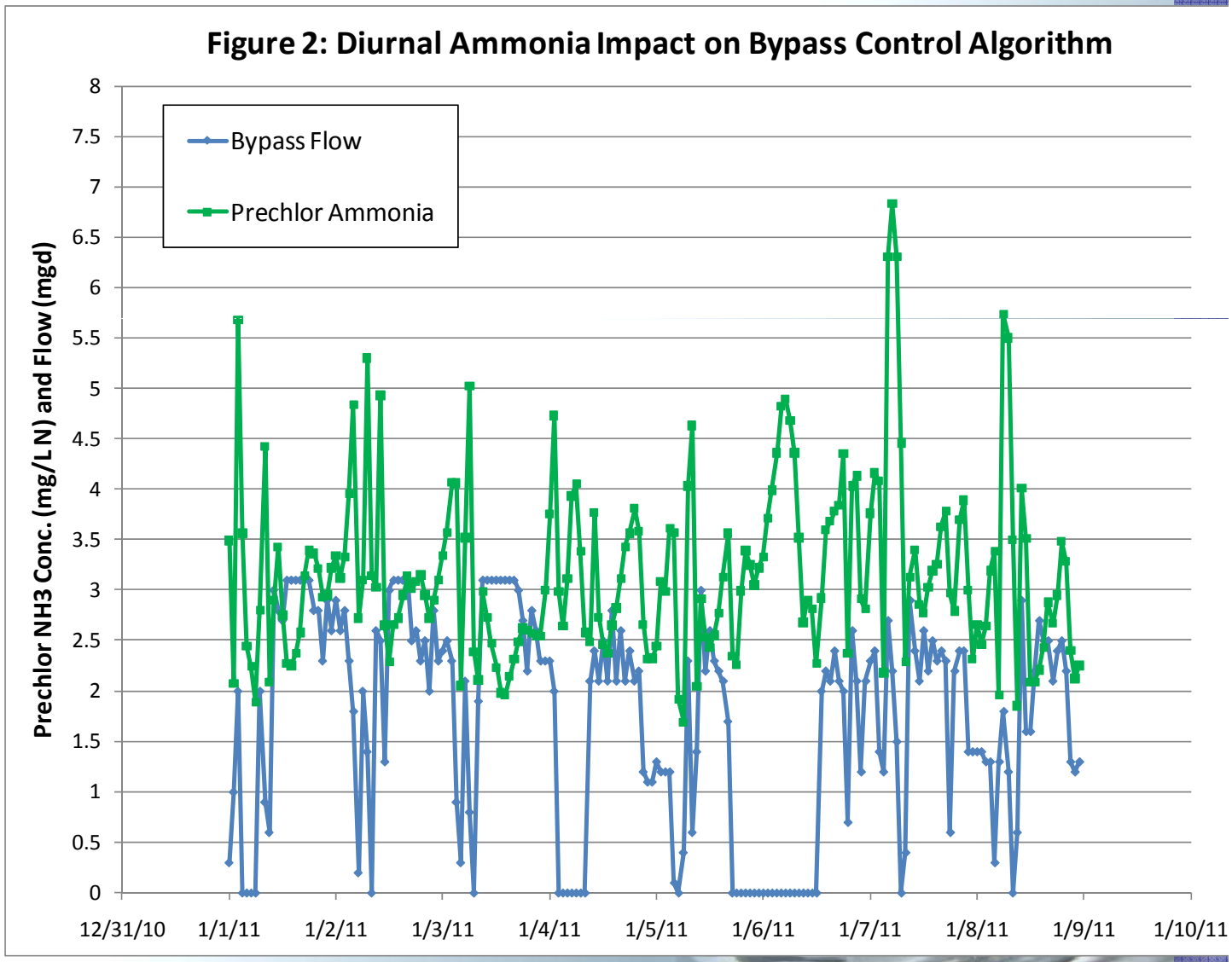


Ammonia Varies Significantly through the WWTP



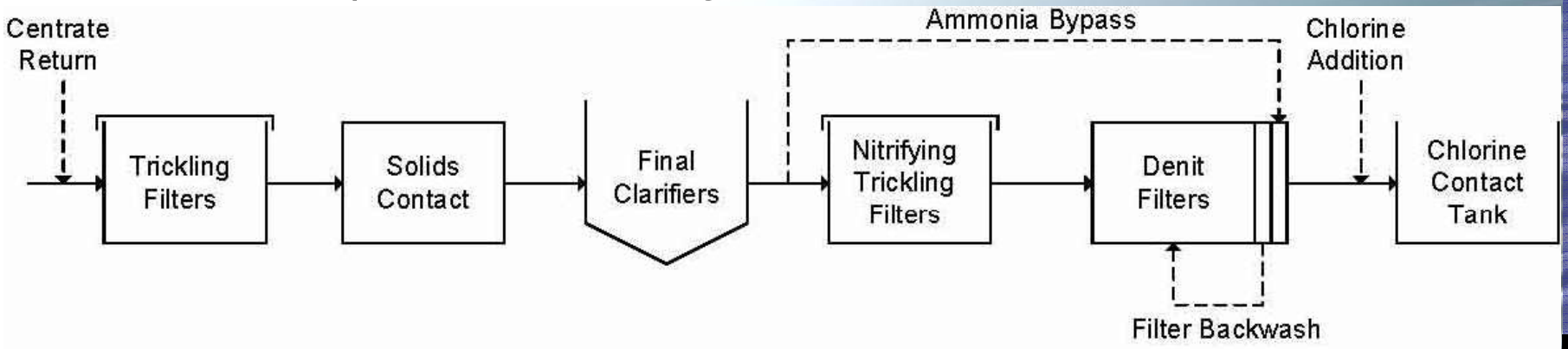
Ammonia Variations through the Plant Can Significantly Impact Control of the Disinfection Process

- Control at 2 mg/L not effective
- Prechlor ammonia varies from 1.5 to 5 mg/l
- Bypass flow varies between 0-3 mgd



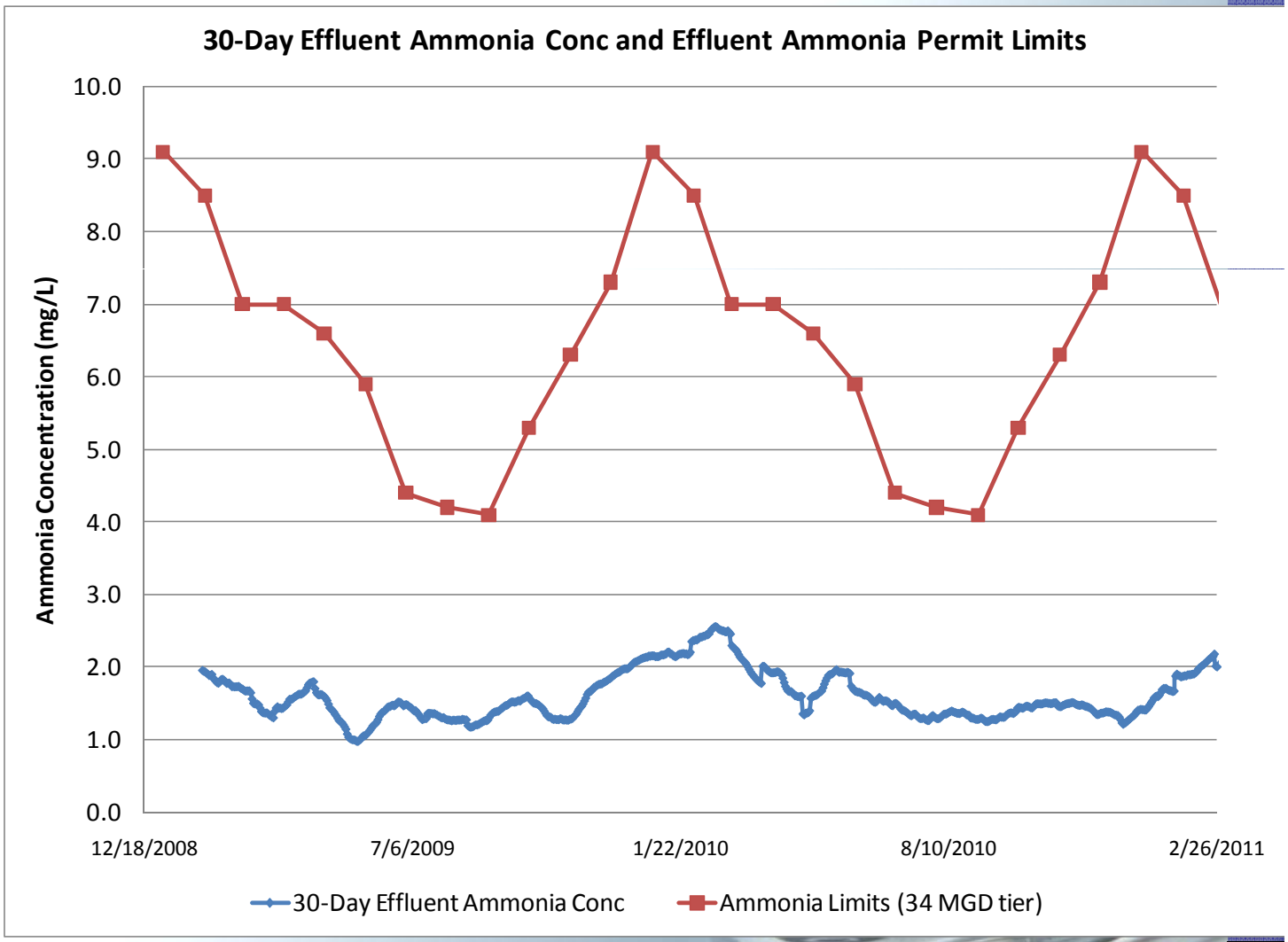
Difficulties with Current Approach

- Typical diurnal ammonia variations
- Denit filter bumping and backwashing
  - Large sudden flow variations
  - Rapid change in ammonia concentration
- Centrate pumping:
  - Sudden increase in ammonia concentration in NTF bypass
- NTF bypass control algorithm
  - Over-reacts to ammonia changes
  - Doesn't predict flow changes from backwash events



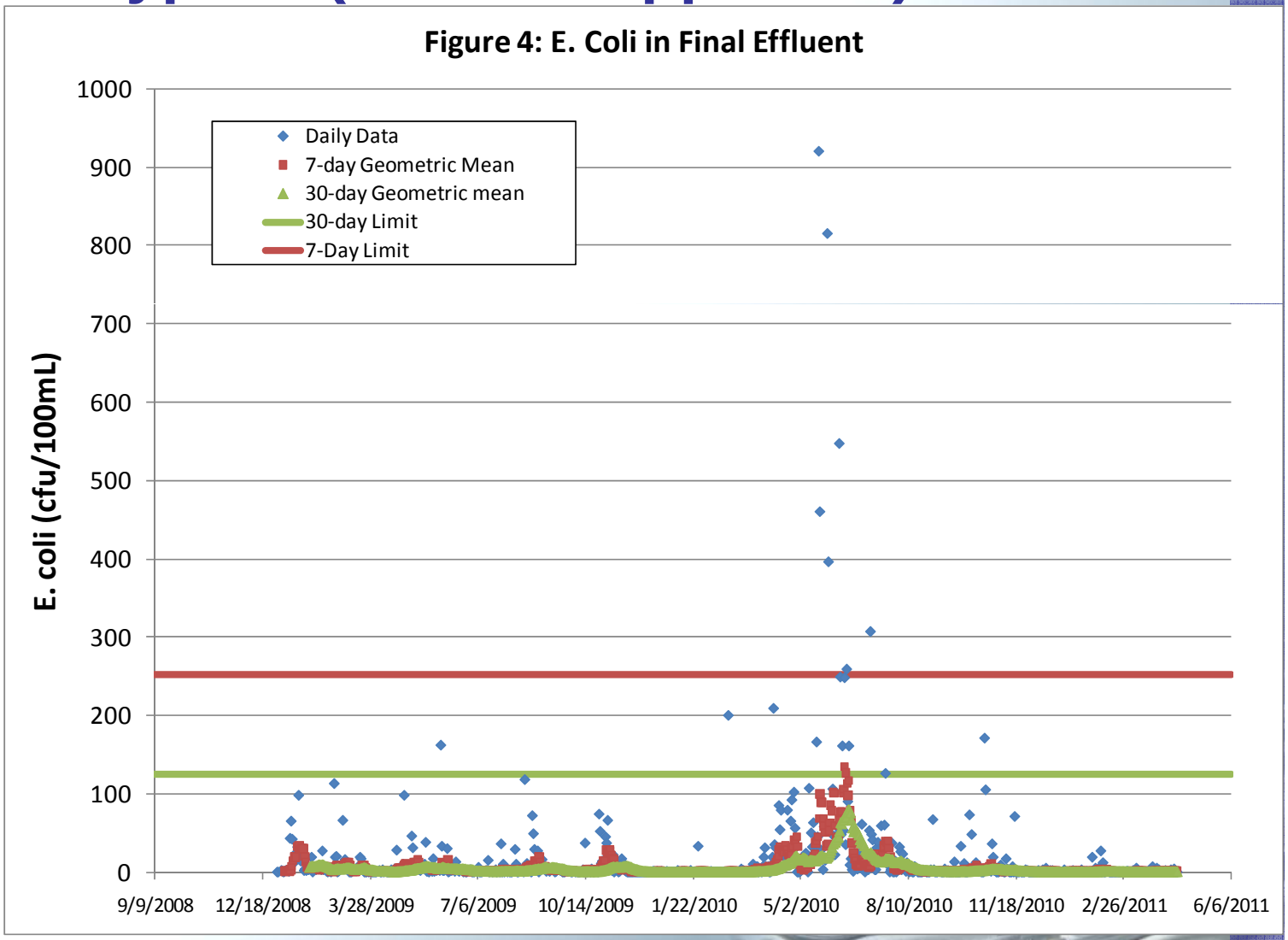
Ammonia Compliance with Future Regulations Using NTF Bypass (Current Approach)

- The most restrictive future ammonia limit is 3.2 mg/L (50 mgd, September)
- Compliance with future ammonia requirements has occurred
- Periodic inhibition events are problematic, but are more disruptive to ammonia compliance than disinfection



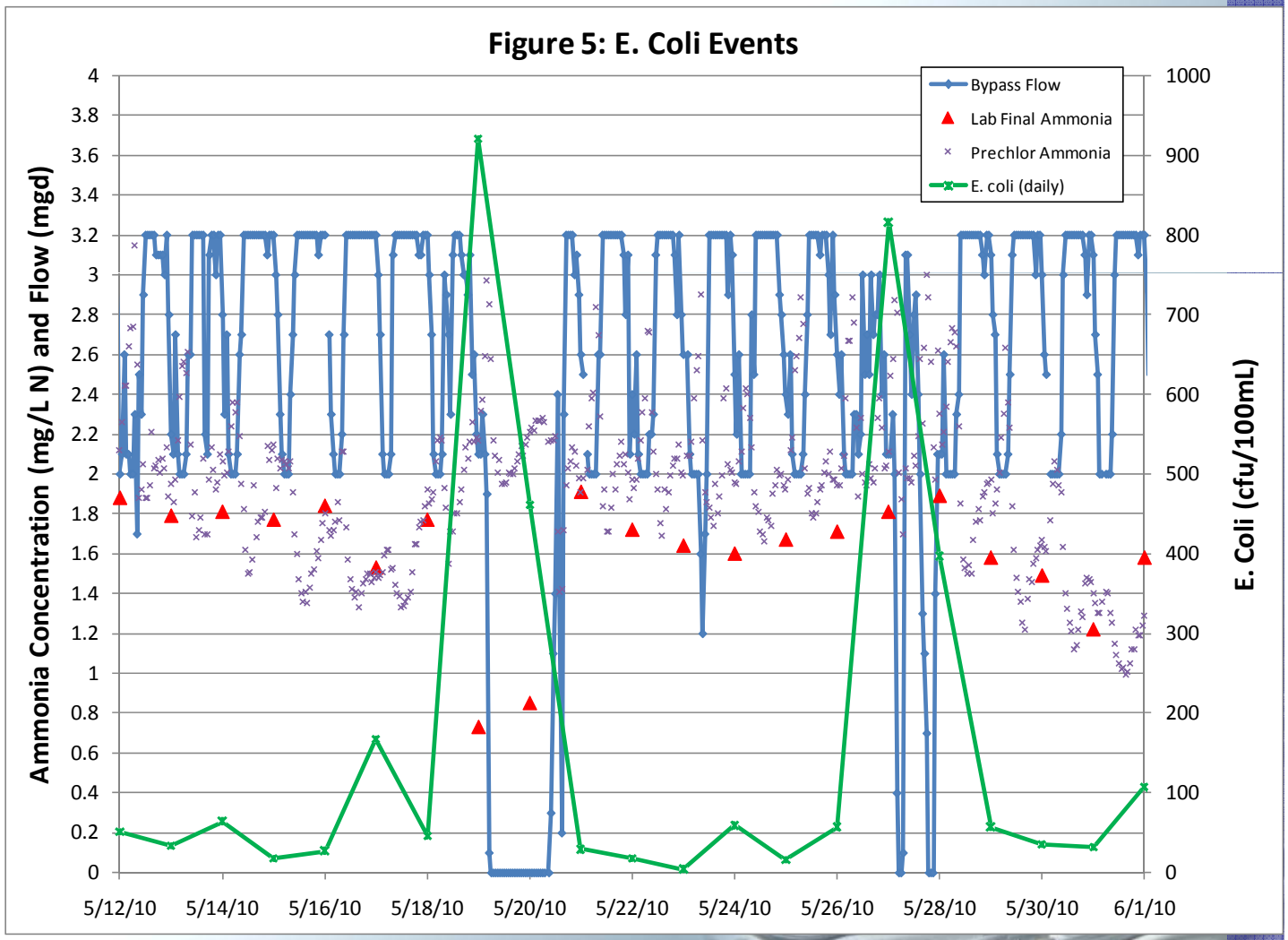
E. Coli Compliance with Future Regulations Using NTF Bypass (Current Approach)

- *E. Coli* limit will be more difficult to meet than fecal coliform
- Performance is generally good
- Almost exceeded future limits in summer of 2010



What Caused Elevated *E. coli* Levels in Summer 2010?

- Two *E. coli* "events" caused by erroneous on-line ammonia analyzer; (0.8 mg/L by lab versus 3 mg/L by on-line analyzers)
- Consequently, ammonia to the CCT was much lower than intended; resulted in formation of less germicidal chlorine species



Summary of Current Approach

- Objectives:
  - 1. Compliance with ammonia limit
  - 2. Disinfection (bacterial indicator organism compliance)
  - 3. Dechlorination
- Operators have done an excellent job achieving compliance with complicated system and numerous variables
- Potential improvements to current approach:
  - Control improvements
  - Dampening of bypass flow, replace pump for minimum flow
  - Off-line denit filter backwash supply
  - Continuous centrate return
  - New flowmeter for CCT influent
- Not possible to address all current issues (analyzer accuracy, diurnal variations)

Current Approach - Conclusions

- Compliance with the new permit's ammonia limits with the current control strategy has occurred consistently
- Indicator organism will change in 2014 to more sensitive organism – *E. coli*
  - Current control approach is highly complicated, and events compromising disinfection performance could occur

UV Disinfection Option

- UV is a proven and effective disinfectant
- UV performance is independent of ammonia concentration:
  - Ammonia controlled separately from the disinfection process
- Eliminates the need for dechlorination, thereby eliminating one potential route for permit non-compliance
- Provides the best option for potential future regulatory limits (DBPs, nitrosamines, other pathogen limits, more stringent nutrient limits)
- Part of CDPHE compliance schedule
- At some future time, UV may be required

Potential Difficulties with UV Disinfection

- Compared to monochloramine, UV is more sensitive to water quality excursions (TSS, UVT)
- Power quality changes can result in the UV system being off-line for 5-15 minute periods
- The use of UV disinfection:
  - Reduces the risk for *E. coli* non-compliance
  - Reduces the risk for ammonia non-compliance
  - Eliminates the risk of chlorine non-compliance

What Are Other Colorado Utilities Doing for Wastewater Disinfection?

WWTP	Current Disinfectant	Previous Disinfectant if Known	Annual Average Flowrate	Year Converted
			MGD	
Denver Metro	Sodium Hypochlorite	Chlorine - Gas	140	2010
Colorado Spring Utilities - LVWWTP	UV	Chlorine - Gas	65	2009
Boulder, 75th St WWTP	UV	Chlorine - Gas	25	2011
Fort Collins - Drake WRF	Sodium Hypochlorite	Chlorine - Gas	23	2004
Colorado Springs Utilities - JD Phillips Water Reclamation Plant	UV	New Plant	20	2007
Brighton	UV		18	
Longmont WWTP	UV	Chlorine - Gas	17	2003
Greeley	UV	Chlorine - Gas	14.7	2005
Broomfield	UV	Chlorine - Gas	12	2005
Loveland WWTP	UV	Chlorine - Gas	10	2003
Westminster	UV	Chlorine - Gas	10	2005
Centennial	UV	Chlorine - Gas	8.5	
Fort Collins - Mulberry WRF	UV	Sodium Hypochlorite	6	1997
Plum Creek	UV	Sodium Hypochlorite	5	2004

Assessment of Risk – Existing Data

- Assessment is determined solely from existing WWTP data
- Existing WWTP data incorporates the human element, and the L/E WWTP has a longstanding culture of accomplished WWTP operators doing their best to avoid permit violations
- Quantified risks of non-compliance were very low, although conditions could change in the future
- From the data, probability of compliance (ammonia, *E. coli*, chlorine residual) has been > 99%
- Potential financial penalties of non-compliance are small ($10,000 per day)
- What level of risk is acceptable? The answer varies from utility to utility

Risk Associated with Current Disinfection Approach (from Existing Data)

Option	Ammonia Permit Compliance Risk	E. Coli Permit Compliance Risk	Dechlorination Permit Compliance Risk	Complexity of Operation
Current Approach (NTF Bypass)	0.7%* (1 in 140 Days)	0.9%** (1 in 107 Days)	0.07%*** (1 Day in 4 Years)	High

Notes:

Risk quantification based on existing data, using more stringent criteria than permit language, thus actual risk of permit violation was less than the values shown

Data set analyzed: from 1/1/09 through 4/17/11

* 6 in 837 daily samples had ammonia concentration $\geq$ 4.0 mg-N/L

** 7 of 750 daily grab samples had *E. coli* levels $\geq$ 252 per 100 mL

*** 14 of 20120 hourly readings had ORP $\geq$ 240 mV

Risk Comparison of Disinfection Options

Option	Ammonia Permit Compliance Risk	E. Coli Permit Compliance Risk	Dechlorination Permit Compliance Risk	Safety Issues	Complexity of Operation
Current Approach (NTF Bypass)	0.7% (1 in 140 Days)	0.9% (1 in 107 Days)	0.07% (1 Day in 4 Years)	Medium	High
Modified Current Approach (NTF Bypass with Improvements)	Slightly Lower Risk (Reduced Compared to Current Approach)	Slightly Lower Risk (Reduced Compared to Current Approach)	No Change	No Change	No Change
Preformed Monochloramine	Lower Risk (Reduced Compared to Current Approach)	Lower Risk (Reduced Compared to Current Approach)	No Change	Higher (Additional Chemical Required)	Lower
UV	Lowest Risk (Reduced Compared to Other Options)	Lower Risk (Reduced Compared to Current Approach)	No Risk (Do Not Need to Dechlorinate)	Lower	Lower

Disinfection Option Cost Comparison

TABLE 2 – ESTIMATED COSTS

Option	Capital Cost	Annual Operating Costs
Current Approach with Modifications	$1,200,000	$118,000 / year
Preformed Monochloramine[1]	$2,100,000	$120,000 / year
UV[2]	$7,125,000	$88,000 / year

1. Capital costs represent a Class 4 estimate and include piloting, design, SDCs, and construction of new building for aqueous ammonia storage and feed. Operating costs include costs for 2 mg/L of sodium hypochlorite and 0.5 mg/L aqueous ammonia at an average flow of 23 mgd.
2. Costs for UV were identified in B&C's January 26, 2011 memorandum entitled "Evaluation of Alternative Disinfection Methods to Comply with the Recent Proposed Ammonia Limits". Annual Operating Costs were further refined in March of 2011 by B&C using Ozonia equipment information.

Summary

- Decision should be based on risk, cost, and values
- Current process has consistently met the 2014 ammonia and E. Coli standards
- Risk vs. Cost:
  - UV is the option with lowest risk and highest cost
  - Existing approach with modifications has higher risk, but lower cost
- Values are specific to your community

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