COMPUTER MODELING FOR IMPROVED CLARIFIER PERFORMANCE

THE NEW STAMFORD DENSITY CURRENT BAFFLE

Earle Schaller, President
NEFCO, Incorporated

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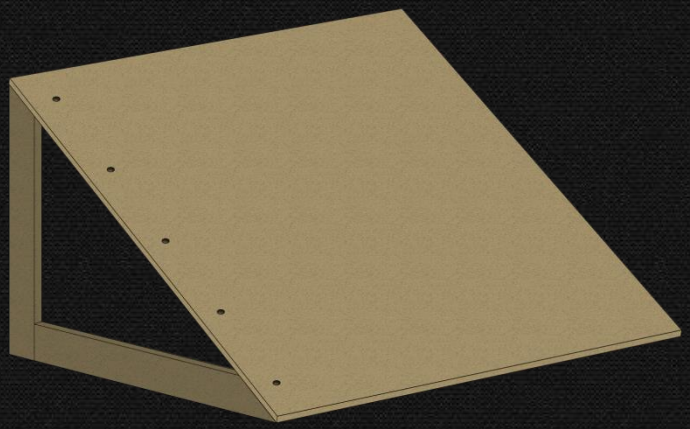
SOME HISTORY

THE STAMFORD BAFFLE



1979 – Bob Crosby on assignment at the Stamford, CT WWTP

- Observed that density currents were impacting clarifier performance
- Devised a passive plywood baffle to intercept currents
- Crosby's density current baffle reduced TSS by 38%.

1986 – The first full scale fiberglass density current baffles were installed at the Stamford, CT WWTP

1987 – Connecticut introduced a grant project for WWTP improvement, citing the benefits of the Density Current Baffle at Stamford …

1987 - The Connecticut EPA described the

DENSITY CURRENT BAFFLE

"…the most cost-effective improvement in clarifier performance available today."

And the Stamford Baffle was born!

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DENSITY CURRENTS

Occur in every activated sludge clarifier

Have a significant, negative impact on clarifier performance:

- Short circuit the main clarification volume
- Increase effluent TSS
- Reduces retention time
- Reduces clarifier hydraulic capacity

The density current baffle remains the most cost-effective improvement in clarifier performance available today.

DENSITY CURRENT BAFFLE

HOWEVER …

There hasn't been a significant improvement in baffle design or performance in 20 years!

45° INCLINATION ANGLE

THE STANDARD

WIDTH

DEPENDS ON WHO'S WRITING THE SPEC

BAFFLE POSITION ON THE WALL

PROBLEMATIC

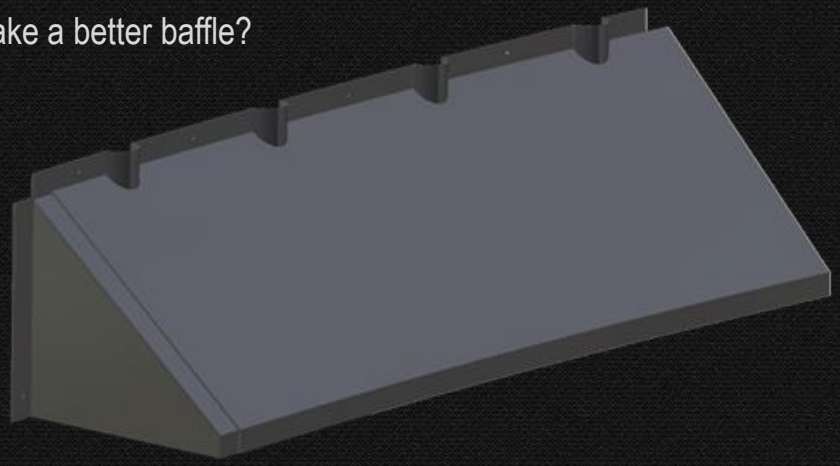
2004 - PRESENT

NEFCO STUDY

QUESTION

What are the keys to baffle performance? Can we make a better baffle?

- Horizontal Projection
- Inclination Angle
- Mounting Location
- Clarifier Depth
- Clarifier Diameter
- Blanket Depth



THE TOOLS

CFD Analysis – FLOW-3D software

PROCESSING

Dr. John Richardson, Blue Hill Hydraulic, Inc.

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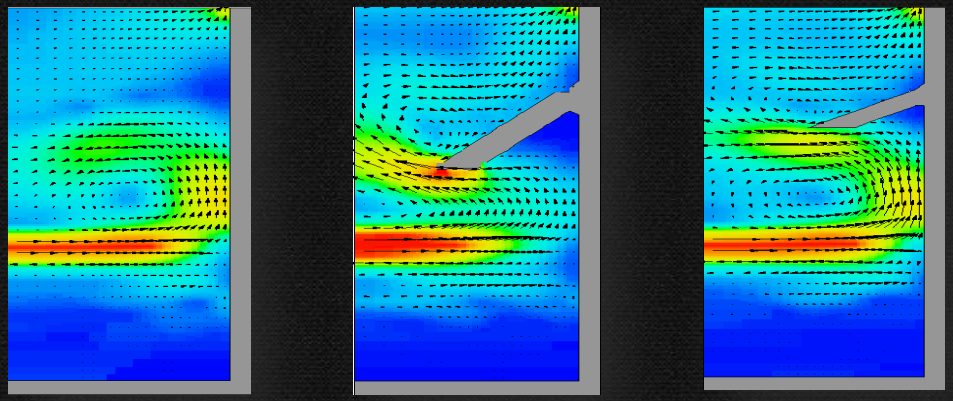
THE PLAN



1 Developed 3D model of 70 foot and 100 foot circular clarifiers.

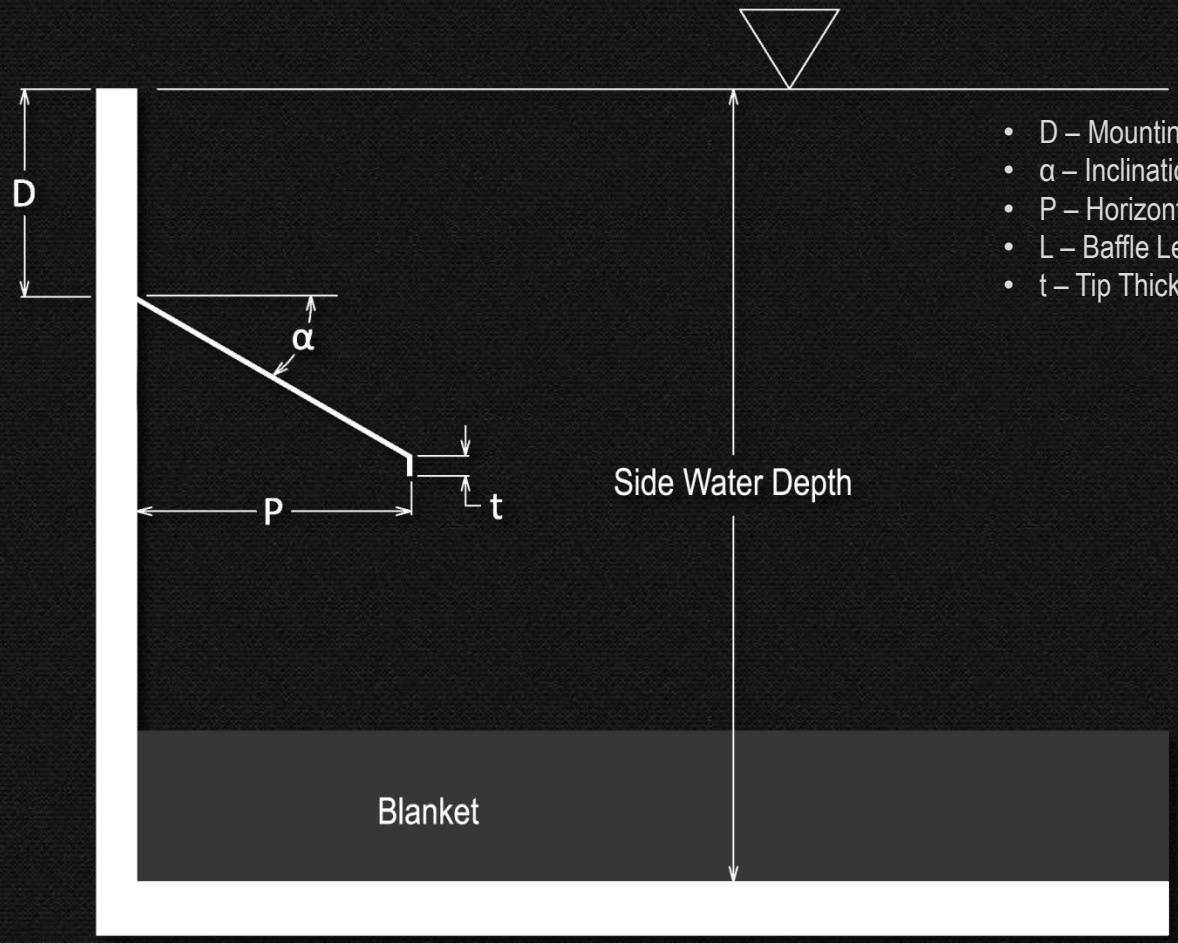
2 Selected operating conditions that produced strong density currents at outer tank wall

3 Developed detailed model of area at outer wall

4 Defined different baffle configurations and computed TSS concentration for each, then normalized results against the “No Baffle Case”

Qualitative Evaluation = Better Than/Worse Than Results

STUDY PARAMETERS



- D – Mounting Depth
- α – Inclination Angle
- P – Horizontal Projection
- L – Baffle Length
- t – Tip Thickness

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70 FT CLARIFIER

NEFCO STUDY

SIMULATION RESULTS

In the 70 foot and 100 foot simulations:

1. The Original Stamford Baffle performed well
2. The baffle with 30° inclination angle performed better
3. The baffle with increased projection was best overall

THE NEXT STEP: FOCUS ON THESE THREE CONFIGURATIONS

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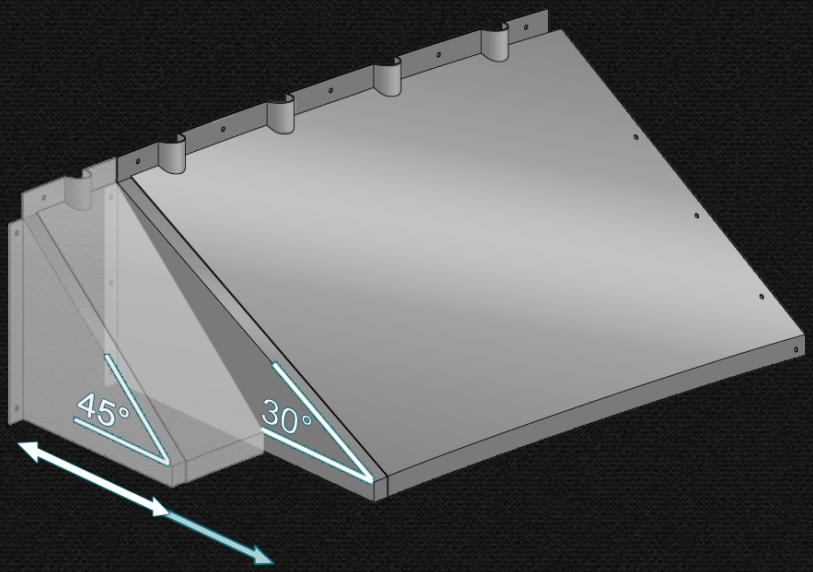
REFINE THE RESULTS

Case No.	Configuration	Relative Effluent Conc.
1	Original Stamford Baffle (α = 45°, HP = 32.0”)	1.0
4	Long Stamford Baffle (a = 45°, HP = 39.0”)	0.8
**	Modified Stamford Baffle (a = 30°, HP = 39.0”)	0.7



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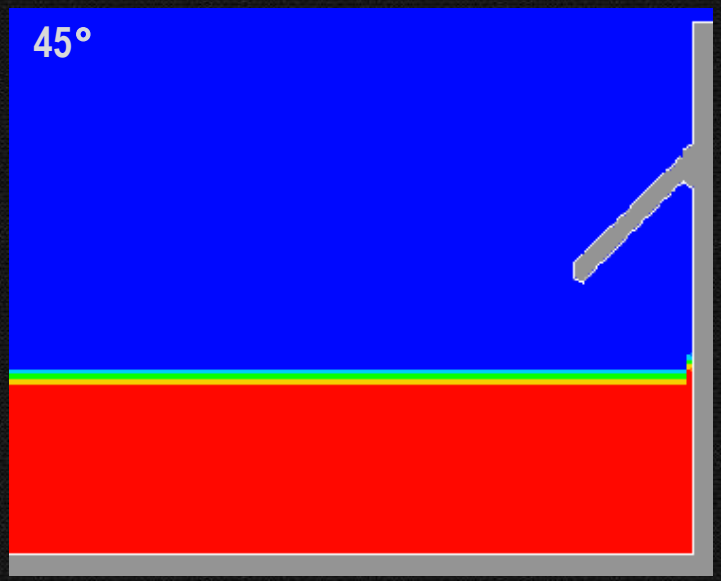
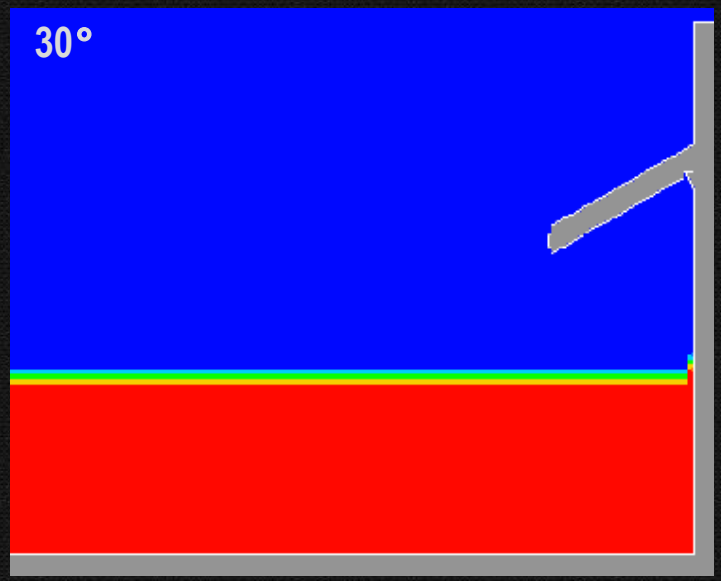
30° INCLINATION ANGLE

- Horizontal outflow
- Increased distance from blanket to tip of baffle
- No appreciable buildup of solids
- Other researchers concur

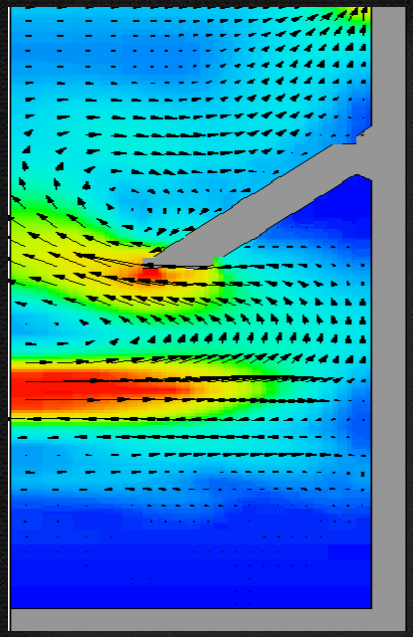




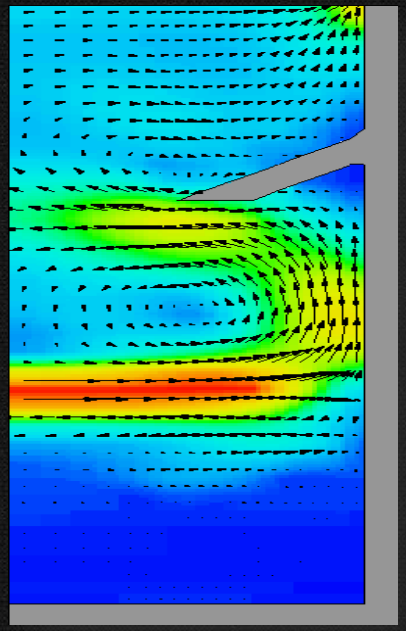
NEFCO STUDY

30° INCLINATION ANGLE

- Increases the space between the baffle tip and the blanket
- Outflow is horizontal rather than vertical



45°



30°

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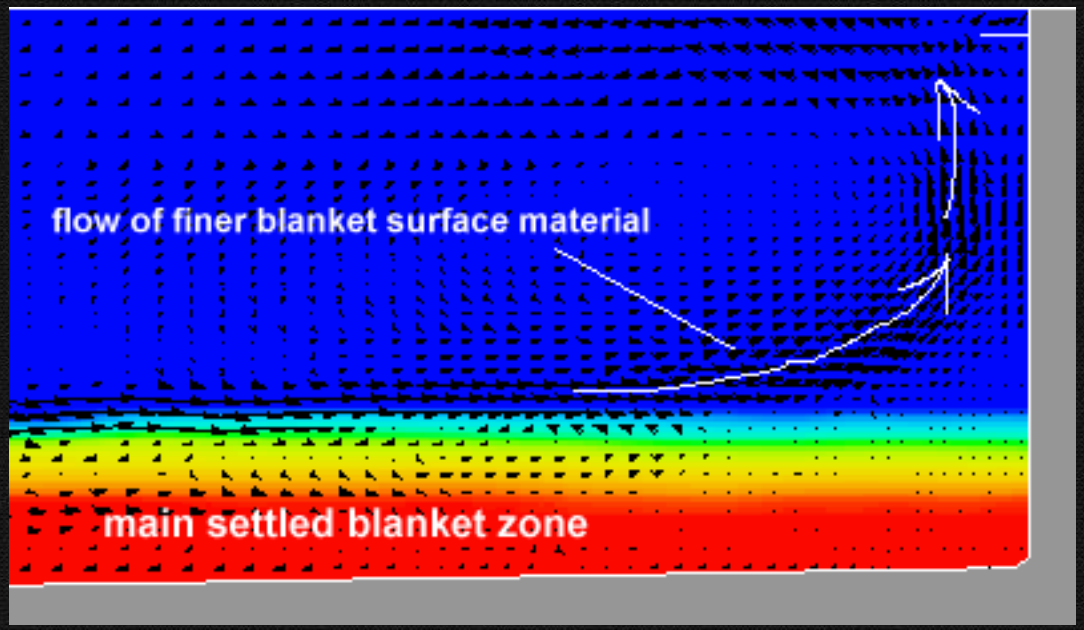
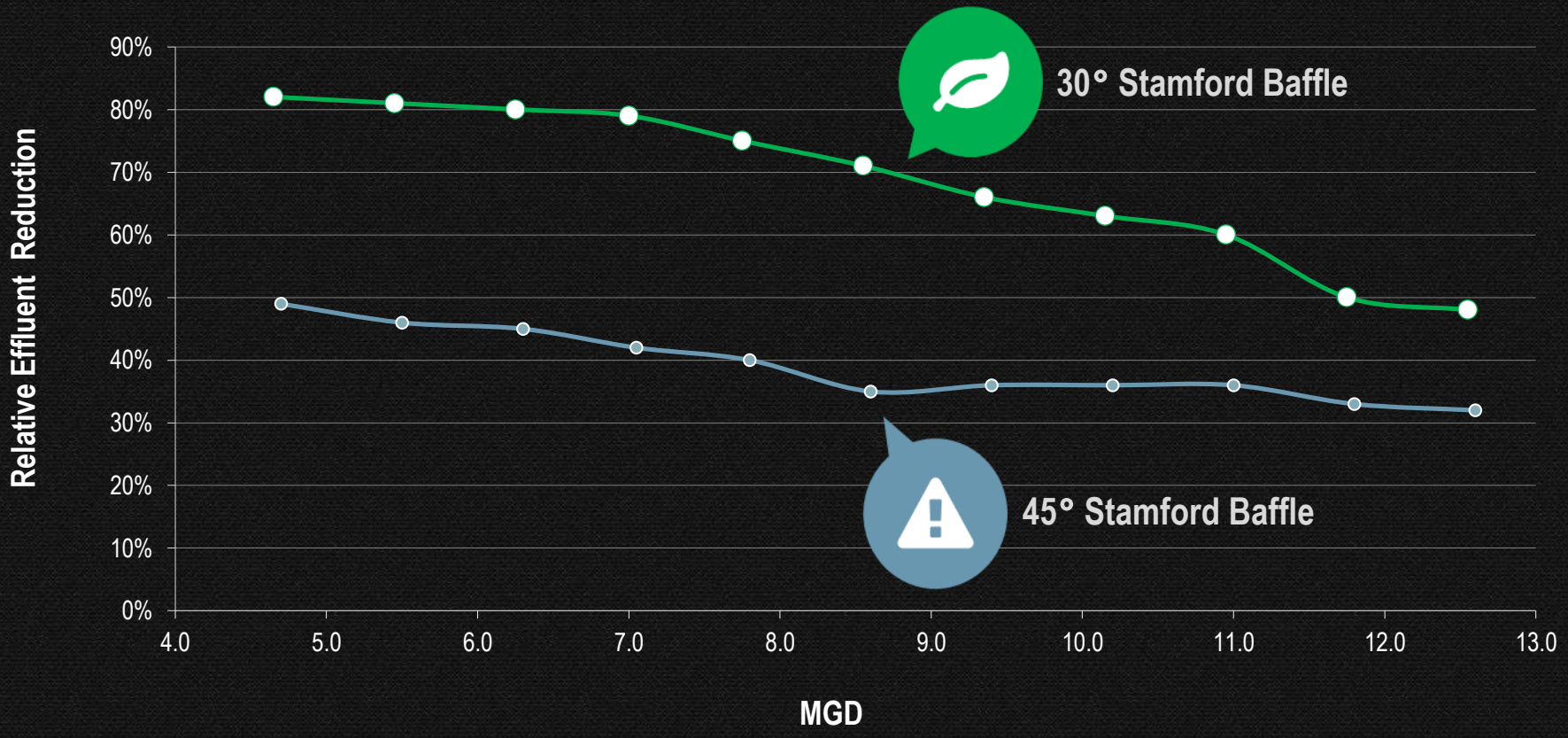
INCREASING THE PROJECTION

1. The density current rises from the blanket before reaching the wall
2. Extending the projection enables the baffle to intercept a greater volume of solids



Design Study – Test Results

BAFFLE PERFORMANCE



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30° LARGE PROJECTION BAFFLES AT AKRON, OH

An Introduction

THE MONCLOVA, MX EXPERIENCE

- Treatment facility serves the town and local industry (steel mill)
- City retrofitted plant to increase flow by 35% to 15.5 MGD and improve nitrification to meet industrial needs
- Three 112 foot diameter activated sludge clarifiers
- After the upgrade, the plant could not meet permit levels
- Increased flow caused TSS to exceed the 10 ppm limit

NEEDED TO REDUCE TSS TO LESS THAN 5 PPM

An Introduction

THE MONCLOVA, MX EXPERIENCE

INSTALLED MODIFIED STAMFORD BAFFLE

Clarifier No. 3 – July 2009

TESTING AUGUST 4 – AUGUST 21, 2009

Six samples per day

RESULTS CLARIFIER NO. 3

Average TSS

- with No Baffle > 10 ppm
- with Modified Stamford Baffle 2.34 ppm

MODIFIED STAMFORD BAFFLE REDUCED SOLIDS BY 77%

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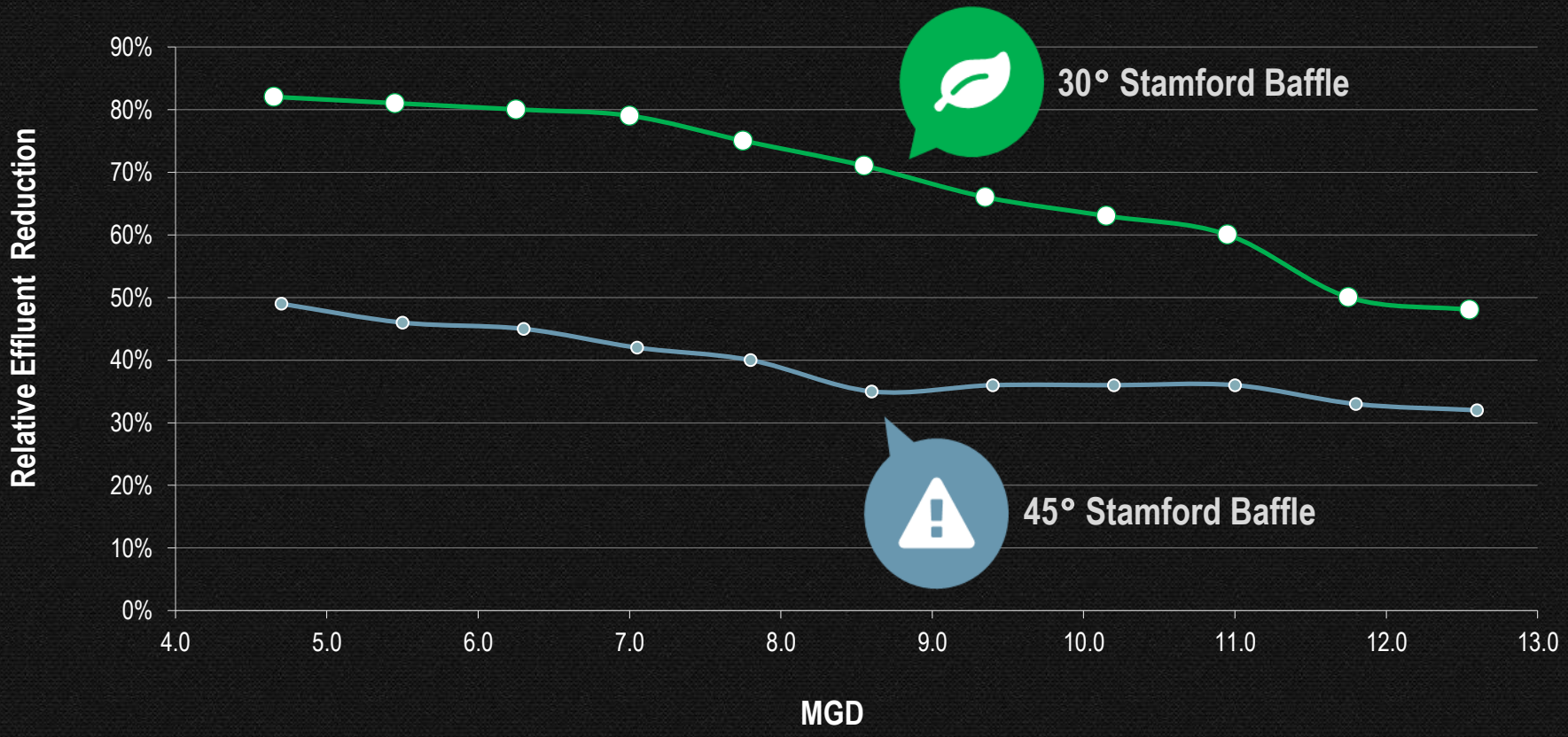
Design Study – Test Results

BAFFLE PERFORMANCE



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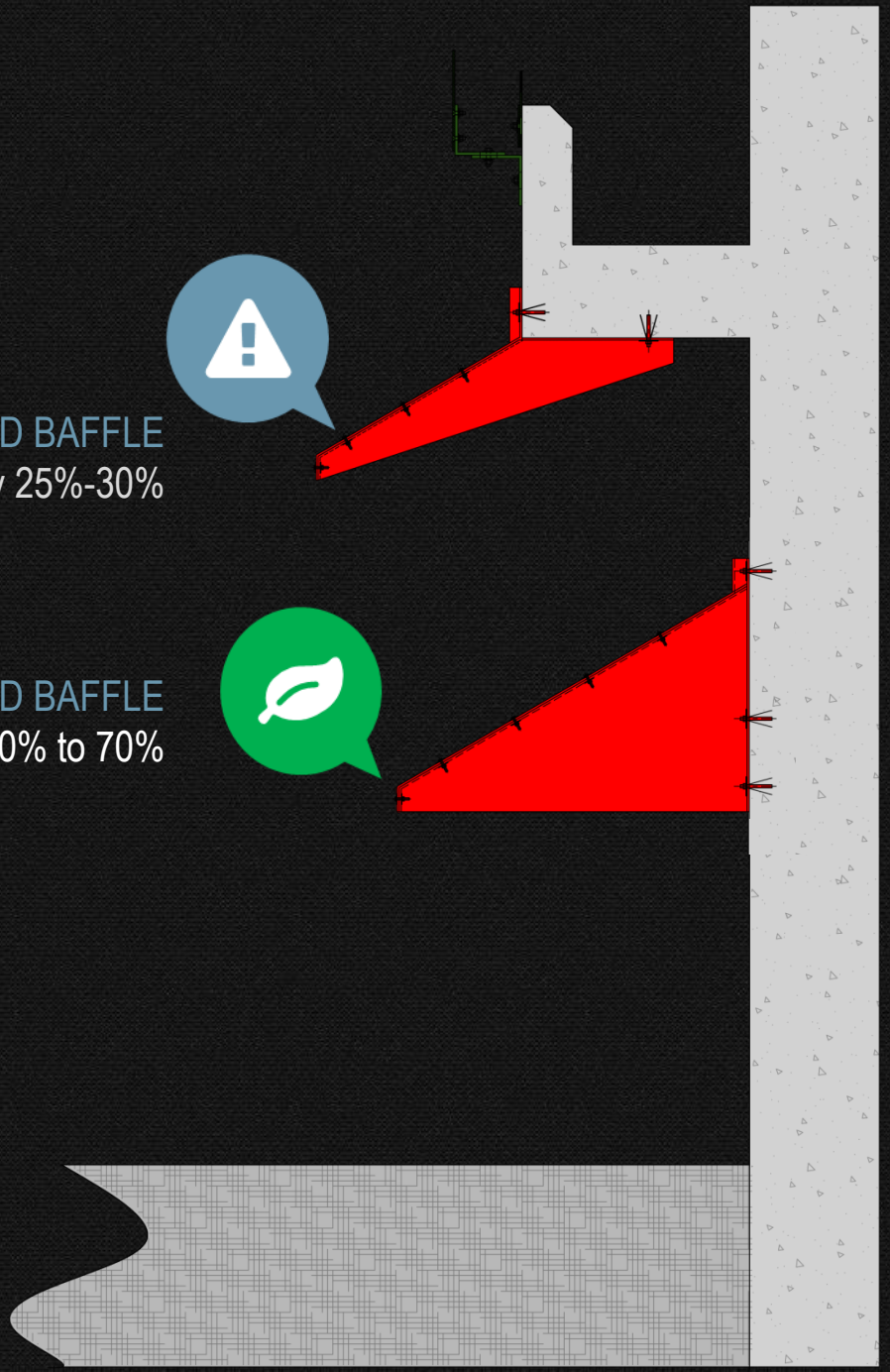
NEFCO STUDY

BAFFLE MOUNTING

LAUNDER MOUNTED BAFFLE
Reduces TSS by 25%-30%

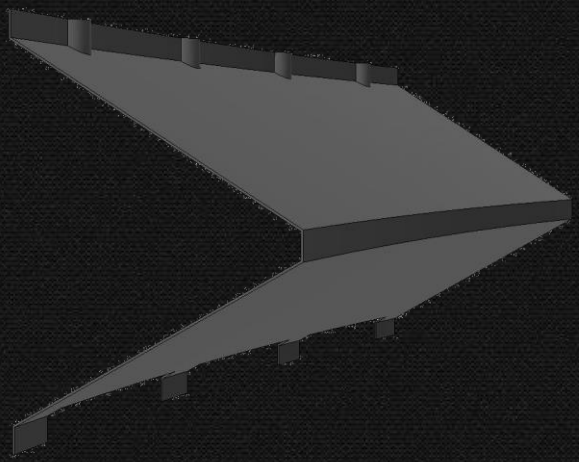
WALL MOUNTED BAFFLE
Reduces TSS by 60% to 70%

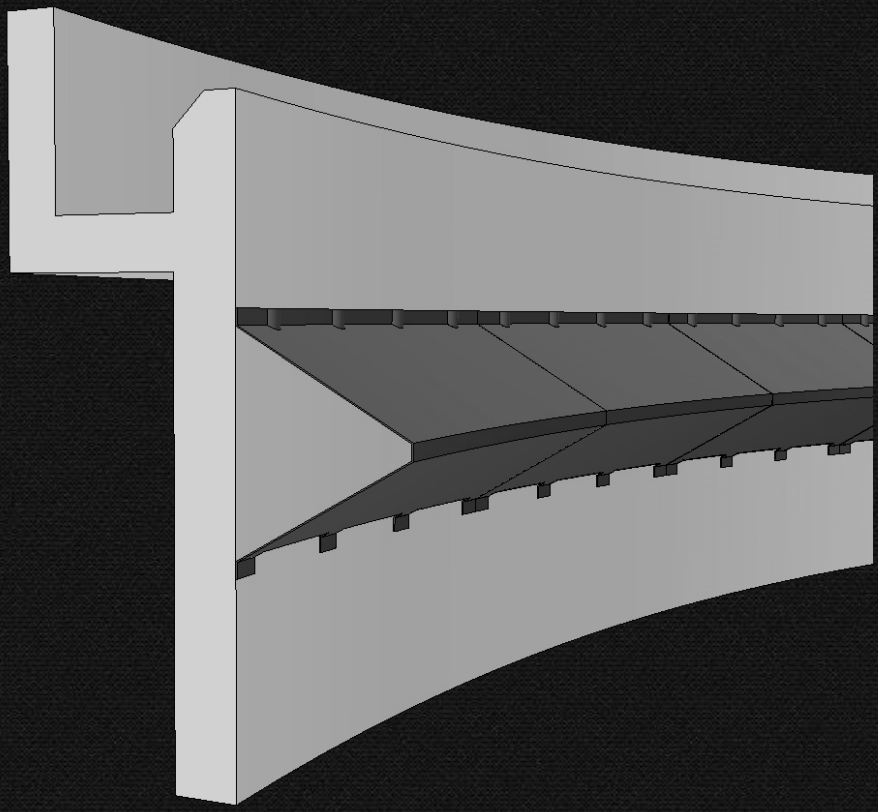


An Introduction

THE DUAL SURFACE BAFFLE

- Continued the study to examine a more radical baffle concept
- Leveraged the energy of the rising density current
- Added a mirror lower surface to the baffle.

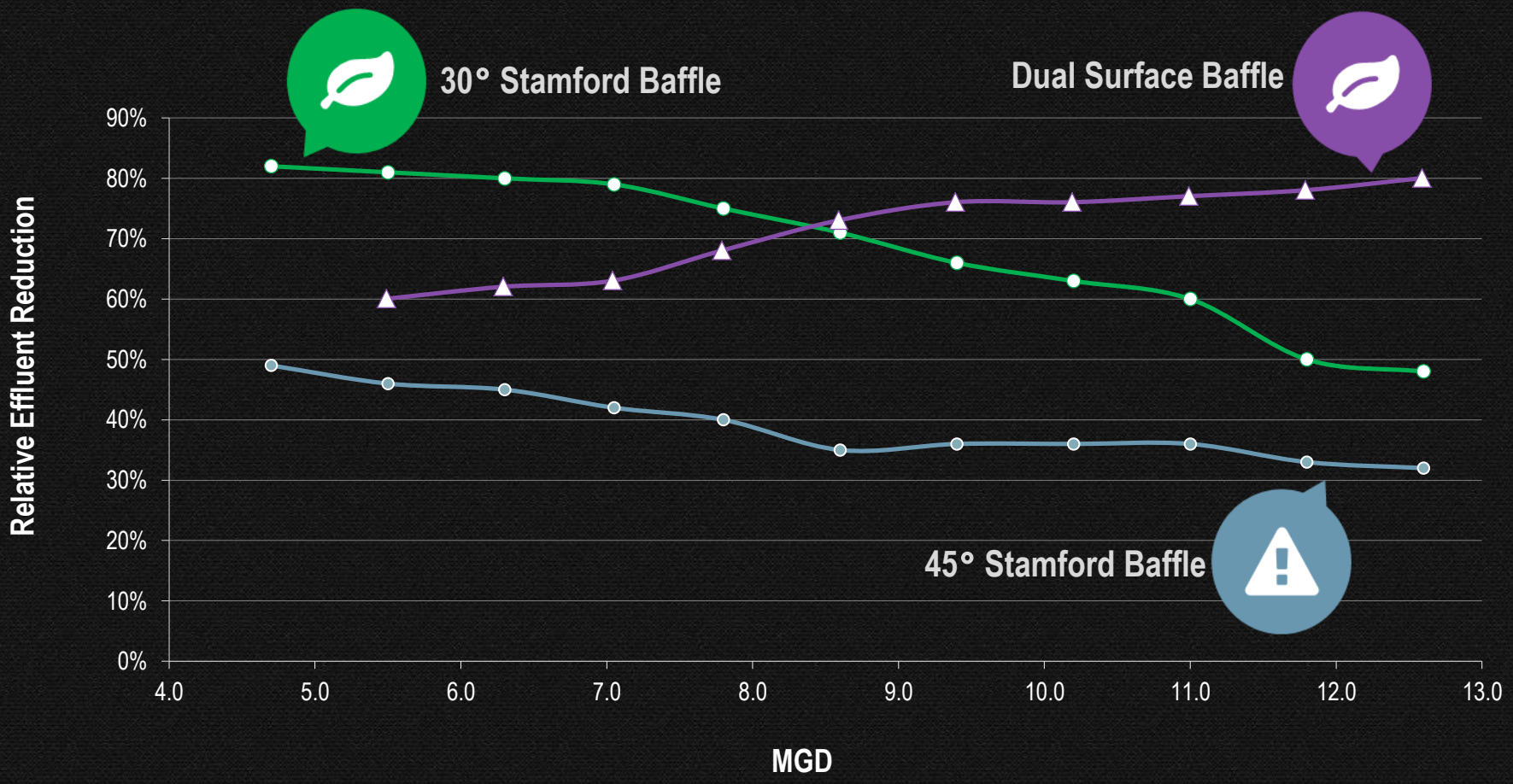




DUAL SURFACE BAFFLE IMPROVES CLARIFIER PERFORMANCE AT HIGHER FLOWS

Design Study – Test Results

DUAL SURFACE BAFFLE PERFORMANCE



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CONCLUSIONS

A Stamford Baffle with 30° inclination angle and increased horizontal projection is significantly more effective than the original Stamford Baffle

As clarifier flows continue to increase, a Dual Surface Baffle offers a new means to improve clarifier performance.

The study provided new tools to evaluate baffle and clarifier performance.