The background is a light blue gradient with several water droplets and bubbles of various sizes scattered across the surface. The droplets are rendered with soft shadows and highlights, giving them a three-dimensional appearance. The text is centered in the upper half of the image.

# **DRSCW NPDES PERMIT SPECIAL CONDITIONS: PHOSPHORUS REMOVAL STUDIES**

NICK MENNINGA, PE, DOWNERS GROVE SANITARY DISTRICT

JANUARY 28, 2016

# OUTLINE

- PERMIT LANGUAGE
- OPERATIONAL OPTIMIZATION PLAN AND IMPLEMENTATION
- TREATMENT PLANT IMPROVEMENT STUDY TO MEET SPECIFIC EFFLUENT STANDARDS
- STUDY SCOPE / APPROACH
  - DATA COLLECTION
  - PLANT MODELING
  - ALTERNATIVE TECHNOLOGY EVALUATION
  - COST ESTIMATES

# PERMIT LANGUAGE

- PHOSPHORUS DISCHARGE OPTIMIZATION PLAN (PDOP)
  - NOT UNIQUE TO DRSCW
  - INFLUENT REDUCTION MEASURES – RICK'S TALK
  - OPTIMIZING EXISTING TREATMENT PROCESSES WITHOUT CAUSING PROBLEMS
    - LIKELY PROBLEM #1: SOLIDS SETTLING (COMPLIANCE PROBLEM)
    - LIKELY PROBLEM #2: ELEVATED AMMONIA (STREAM HEALTH PROBLEM)
  - ARE MEASURES PRACTICAL, OR NOT?

# PERMIT LANGUAGE (CONTD)

- SPECIFIC OPERATIONAL MEASURES – ALL ASSOCIATED WITH ENHANCED BIOLOGICAL PHOSPHORUS REMOVAL (EBPR)
  - CHANGE SRT PER TYPICAL EBPR CONFIGURATION: SHORTER THAN FOR NITRIFYING-ONLY PLANT
  - ADJUST AIR RATES, LOW DO IN ANOXIC/ANAEROBIC ZONES (OR IN UPPER END OF PLUG FLOW BASIN)
  - IMPROVED AERATION FOR RECYCLE STREAMS
  - ADJUST FLOW PATTERN TO PROMOTE EBPR (NOT RE-PIPE)
  - INCREASE VFA PRODUCTION – KEY INGREDIENT FOR EBPR
- SCHEDULE: 24 MONTHS FOR PLAN, 36 MONTHS TO IMPLEMENT, REPORT ANNUALLY IN MARCH
- IF THESE MEASURES ARE IMPRACTICAL, REPORT NEEDS TO STATE WHY

# PERMIT LANGUAGE (CONTD)

- FEASIBILITY STUDY
  - NOT UNIQUE TO DRSCW
  - TREATMENT PLANT IMPROVEMENTS
  - 3D METRIC OF OPTIONS TO EVALUATE:
    - 1.0, 0.5, 0.1 MG/L LIMITS
    - MONTHLY, SEASONAL, ANNUAL AVERAGE BASIS
    - TECHNOLOGIES: CHEM PRECIP, EBPR, COMBINATION
    - 27 TOTAL OPTIONS? SOME WILL DROP OUT AS NOT FEASIBLE, OR OVERLAP
  - EACH OPTION NEEDS A START-TO-FINISH IMPLEMENTATION DURATION
  - FINANCIAL EVALUATION: CAPITAL, O&M, IMPACT ON RATES
  - SCHEDULE: SAME AS PDOP, 24 MONTHS. NO IMPLEMENTATION REQUIREMENT.

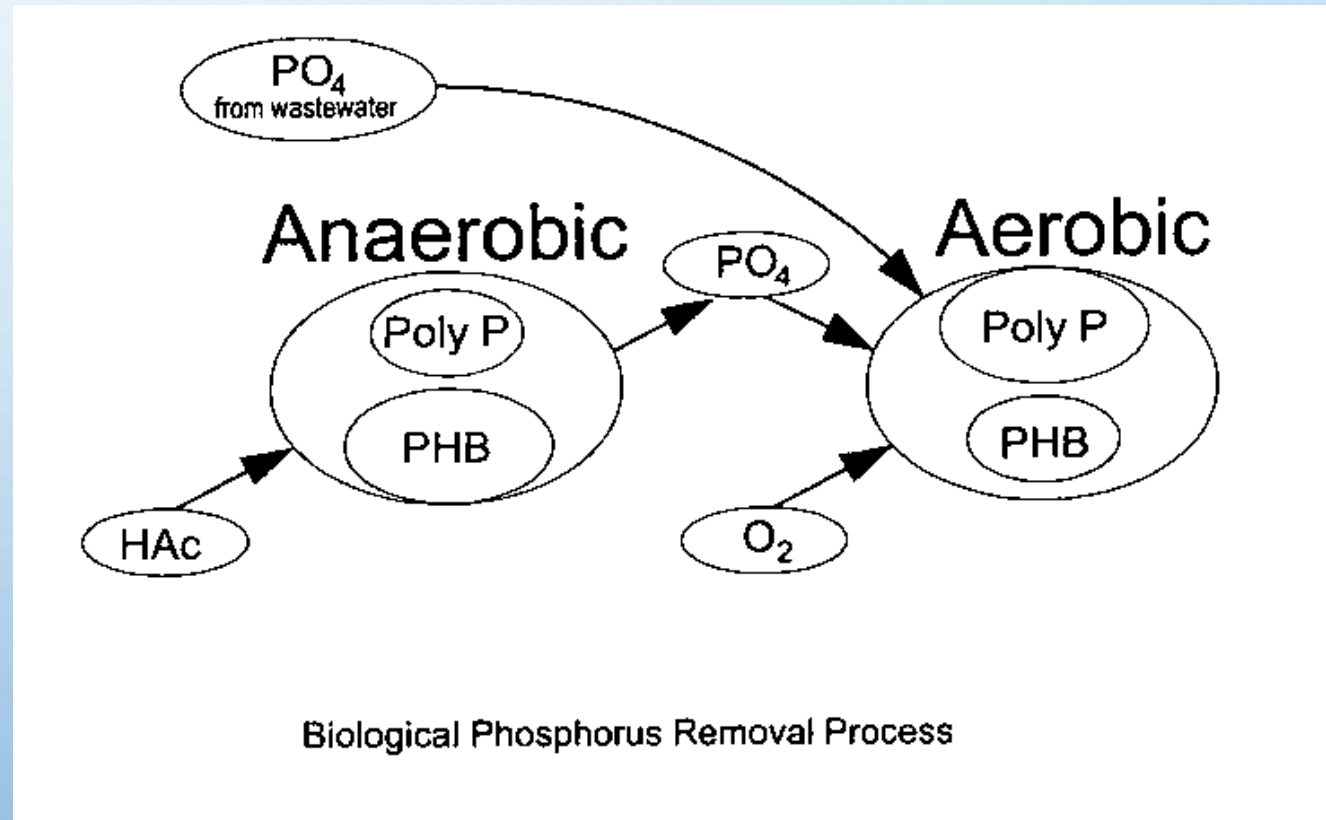


# PDOP

- KEY STUDY FOCUS: IS EBPR PRACTICAL WITH EXISTING FACILITIES?

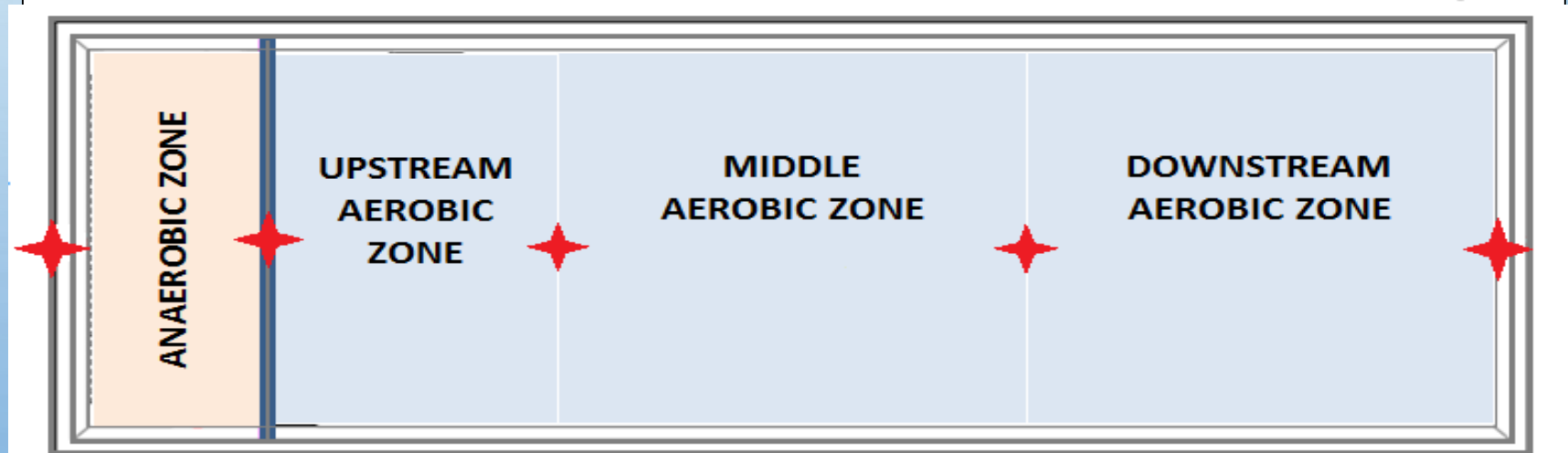
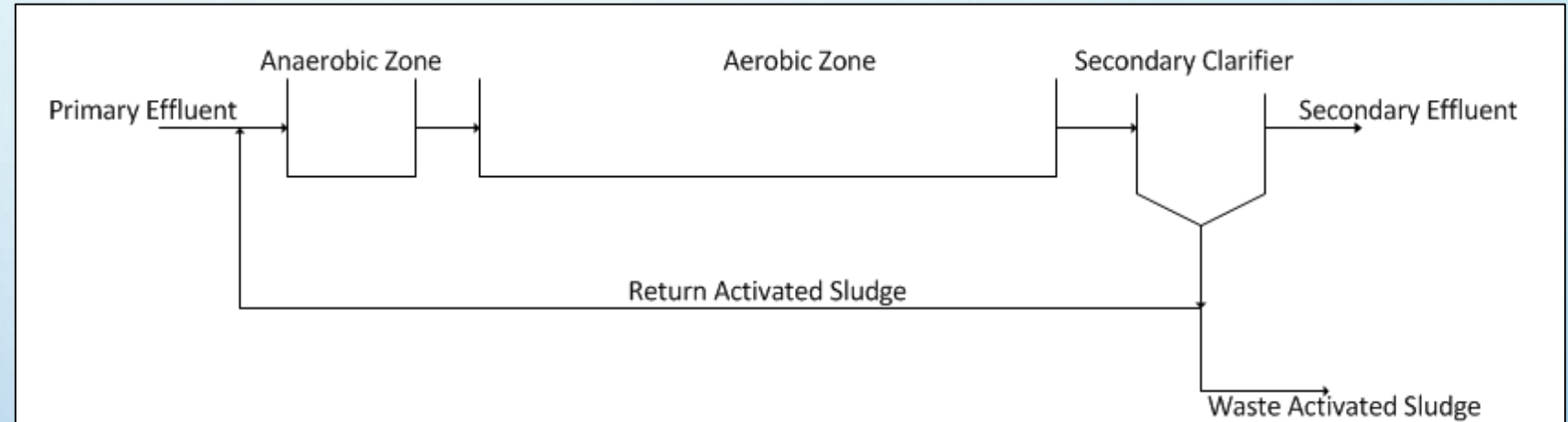
# ENHANCED BIOLOGICAL PHOSPHORUS REMOVAL

- PHOSPHORUS ACCUMULATING ORGANISM (PAO) METABOLISM
- CHALLENGES
  - TANKAGE – SEPARATION OF ANAEROBIC ZONE, LOSS OF NITRIFICATION SPACE
  - INHIBITORY CONDITIONS – NITRATES: LIKELY TO NEED DENITRIFICATION
  - SPECIFIC TYPE OF FOOD NEEDED: CARBON AS VOLATILE FATTY ACIDS: RBCOD
  - FILAMENTOUS CONTROL – SELECTOR, STRICT LOW SLUDGE AGE



# ENHANCED BIOLOGICAL PHOSPHORUS REMOVAL

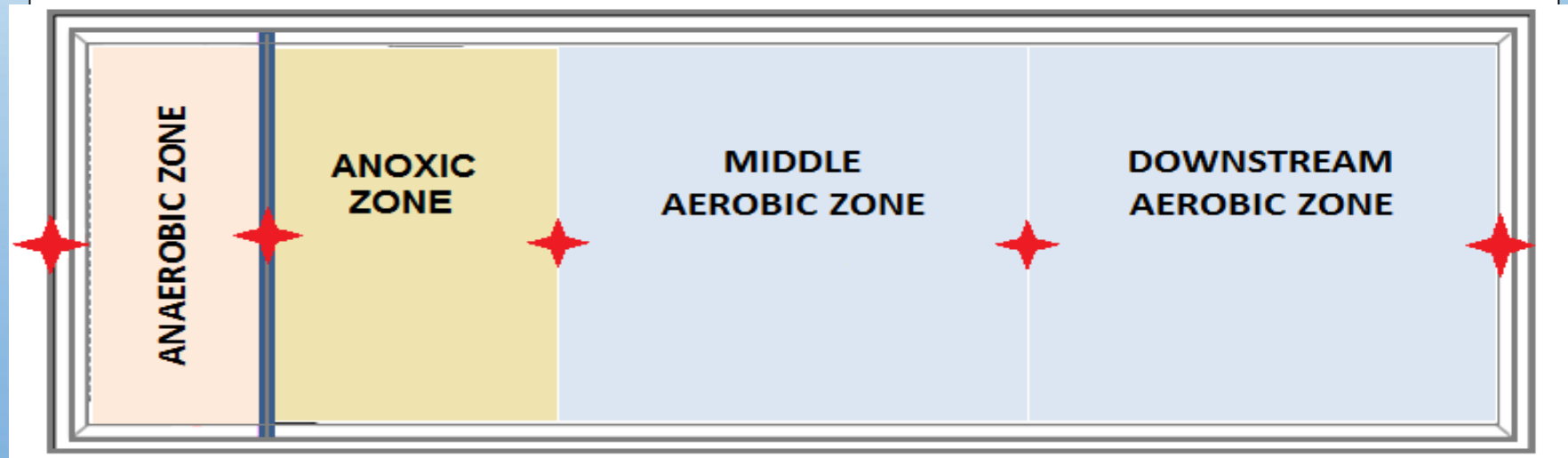
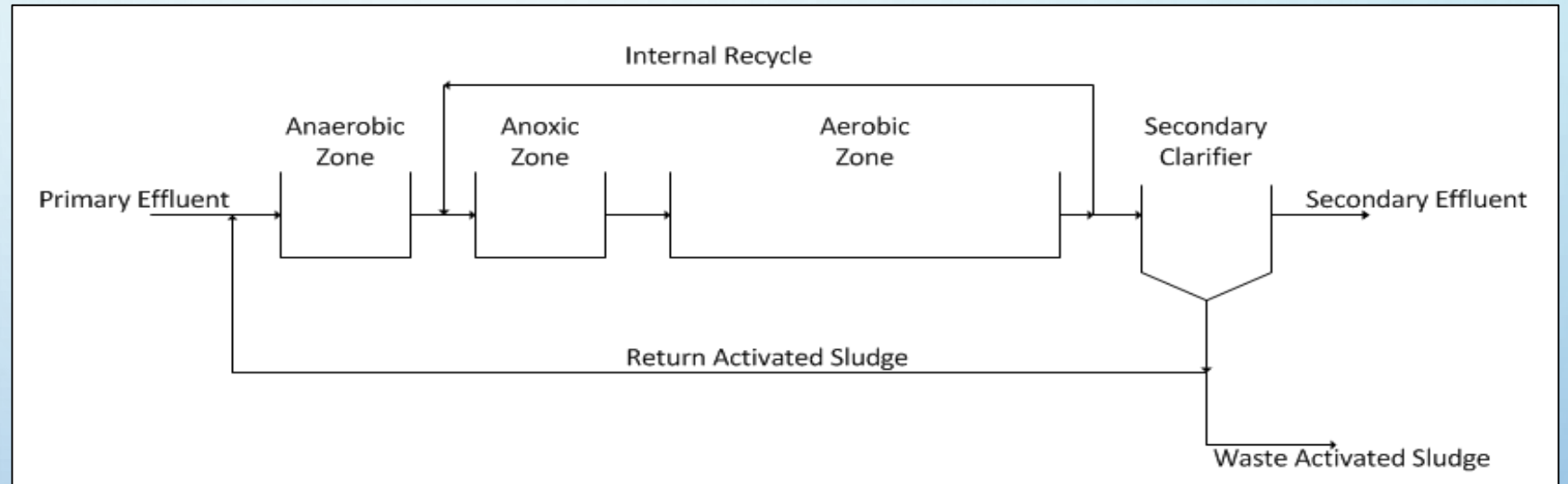
- AO PROCESS
- A2O PROCESS
- MLE PROCESS
- UCT PROCESS
- OTHERS





# ENHANCED BIOLOGICAL PHOSPHORUS REMOVAL

- AO PROCESS
- A2O PROCESS
- MLE PROCESS
- UCT PROCESS
- OTHERS



# CONSIDERATIONS FOR EBPR SUCCESS

- TANKAGE AND PIPING
- SEWAGE CHARACTERISTICS – C/N/P, IN PARTICULAR RBCOD
- SLUDGE TREATMENT AND HANDLING

# PDOP

- SIX ITEMS TO CONSIDER (FREE TO LOOK AT OTHERS)
  - SRT
  - REDUCE DO TO PROMOTE EBPR
  - TURN OFF AIR AT INLET SIDE OF PLUG FLOW BASINS
  - IMPROVE RECYCLE STREAM AIR
  - ADJUST FLOW THROUGH BASINS
  - INCREASE VOLATILE FATTY ACIDS
- IDENTIFY WHAT IS PRACTICAL
- MAKE IMPLEMENTATION SCHEDULE OF PRACTICAL ITEMS
- ROOM FOR ADAPTIVE MANAGEMENT
- ANNUAL PROGRESS REPORTS

# FEASIBILITY STUDY

- MORE TRADITIONAL ENGINEERING STUDY
- ASSURANCE FROM ENGINEER THAT RECOMMENDED IMPROVEMENTS WILL MEET TARGET PERFORMANCE CRITERIA
- UP TO 27 OPTIONS PER METRICS IN PERMIT
- FOR EACH OPTION: BASIS OF DESIGN, COSTS, IMPLEMENTATION SCHEDULE

# OVERALL SCOPE OF SERVICES: 2 STUDIES IN 1

- PDOP EVALUATION IS A SUBSET OF FEASIBILITY STUDY: EBPR USING EXISTING PLANT
- STUDY STEPS
  - DATA COLLECTION
  - PLANT MODELING
  - ALTERNATIVE TECHNOLOGY EVALUATIONS
  - COST ESTIMATES

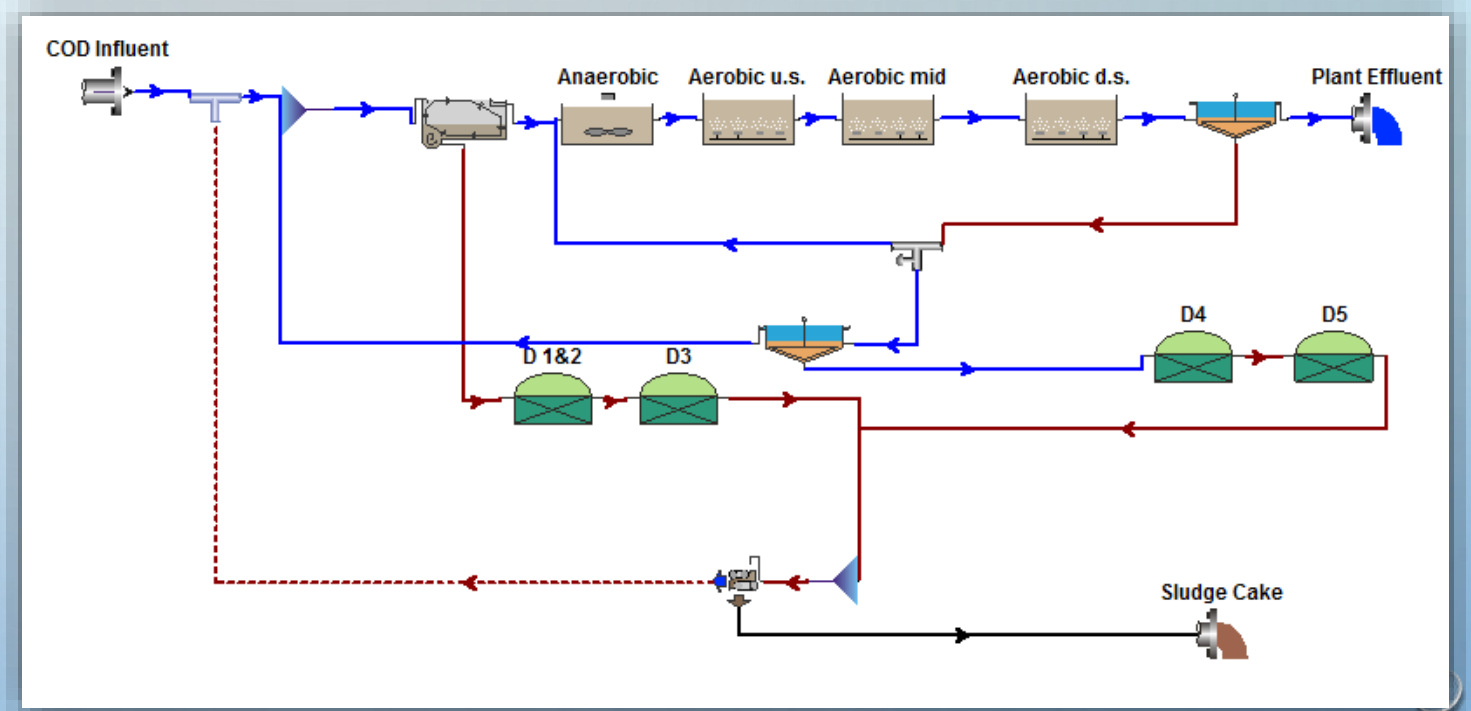


# DATA COLLECTION

- P DATA: P IS IN SEVERAL FORMS, NEED TO UNDERSTAND VARIOUS FRACTIONS TO EVALUATE EBPR AND CHEM PRECIP OPTIONS: INFLUENT, EFFLUENT, RECYCLES
- EBPR SUPPORT DATA: VARIOUS FORMS OF CARBON, ALKALINITY, PH, NITROGEN
- MONITORING PLAN SHOULD SPAN REPRESENTATIVE PERIOD, ADEQUATE AMOUNT OF DATA TO CONDUCT MODELING

# PLANT MODELING

- DESKTOP COMPUTER MODELS
  - COMPUTATIONAL ENGINES – PROPRIETARY OR OPEN SOURCE
  - PROPRIETARY USER INTERFACES
  - SPREADSHEET MODELING: SIMPLIFIED CALCULATIONS



# ALTERNATIVE TECHNOLOGY EVALUATIONS

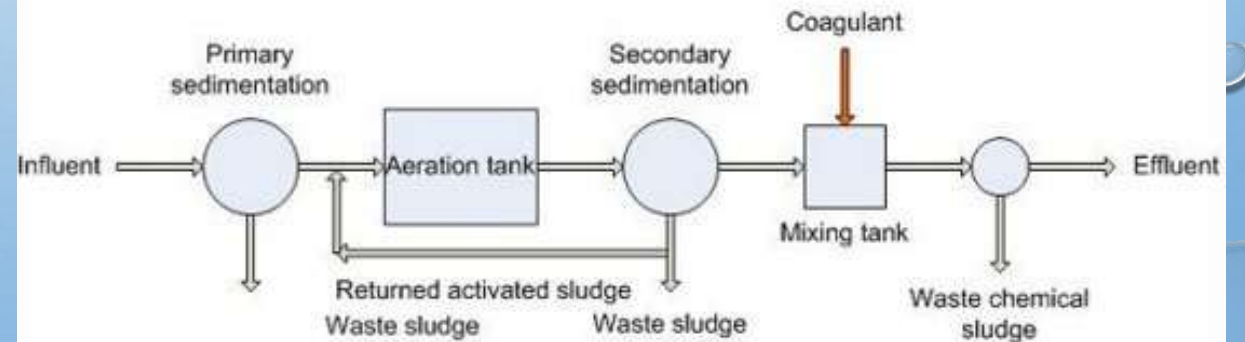
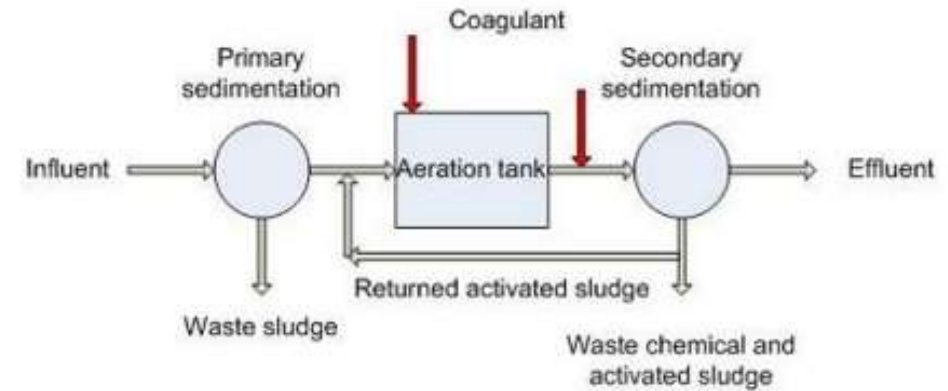
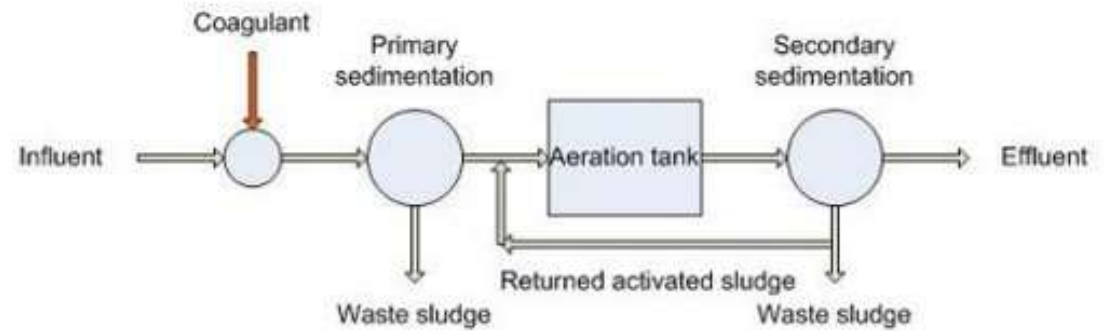
- EBPR
- CHEMICAL PRECIPITATION
- COMBINING THESE TECHNOLOGIES
- LOWER LEVELS WILL LIKELY INCLUDE IMPROVED FILTRATION

CHEMICAL PRECIPITATION

JAR TESTING

OPTIONAL FEED POINTS

ADDITIONAL SLUDGE



# OTHER CONSIDERATIONS

- OPPORTUNITIES FOR CAPACITY EXPANSION
- SLUDGE QUANTITIES AND CHARACTERISTICS
- RETROFIT VS NEW FACILITIES
- OPERATIONAL IMPACTS
  - I&C
  - STRUVITE FORMATION/CONTROL/RECOVERY
  - STAFF
  - FILAMENTOUS CONTROL
  - ENERGY
  - ODORS
  - SOLIDS DEPOSITION
  - OTHER PARAMETERS – AMM-N



# COST EVALUATION

- CAPITAL – NEED TO DEVELOP ALTERNATIVES TO A PLANNING LEVEL
- O&M – DON'T FORGET SLUDGE
- REVENUE REQUIREMENTS/BILLING RATES

# QUESTIONS

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