

CITY OF AMES

Nutrient Reduction Feasibility Study

FEBRUARY 2019

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NUTRIENT REDUCTION FEASIBILITY STUDY

The existing Ames Water Pollution Control Facility (WPCF) went into initial operation in 1989. It has and continues to meet National Pollutant Discharge Elimination Permit (NPDES) requirements.

As the Ames WPCF approaches 30 years in age, it faces two major challenges.

- More stringent regulatory requirements to remove the nutrients nitrogen and phosphorus as required in Iowa's 2013 Nutrient Reduction Strategy
- The age, condition, and remaining useful life of the four existing trickling filters that are the heart of the treatment process

This Summary of the Ames WPCF Nutrient Reduction Feasibility Study provides:

- A brief overview of work completed by HDR in collaboration with the City of Ames (City) Water Pollution Control staff in 2018.
- A cost-effective plan to address both challenges facing the Ames WPCF while providing additional capacity for the future.

The resulting plan recommends both off-site watershed nutrient reductions and on-site Ames WPCF nutrient reductions. In doing so, it balances the cost and timing of nutrient reduction to achieve lowa Department of Natural Resources (IDNR) goals with customer rate impacts and associated water quality benefits.

DRIVERS

The primary driver for the Ames WPCF Nutrient Reduction Feasibility Study is the 2013 Iowa Nutrient Reduction Strategy which is part of a broader regional plan to address nutrient related issues; both water quality related hypoxic issues in the Gulf of Mexico and water quality issues in local watersheds. The Nutrient Reduction Strategy targets 45 percent reductions in nitrogen and phosphorus leaving the State. It does so through a) required reductions at wastewater treatment plants, like the Ames WPCF, referred to as point sources and b) voluntary reductions in rural and urban watersheds, referred to as nonpoint sources, through implementation of best management practices.

A second driver for the Ames WPCF Nutrient Reduction Feasibility Study is the age, condition, and remaining useful life of the four existing trickling filters that are the heart of the Ames WPCF.

The trickling filters have performed exceedingly well for their original design purpose, but both the exterior structure and the interior media are approaching the end of their useful life. The existing trickling filters would cost an estimated \$8.8 million to replace, and would provide limited value treatment process wise with respect to the biological nutrient removal required by the 2013 Iowa Nutrient Reduction Strategy.

EXISTING AMES WPCF

The existing Ames WPCF is a trickling filter solids contact facility that treats an average daily flow of 6.19 million gallons per day, the equivalent of nearly 700 tanker trucks per day. The facility is designed to treat organic loadings (biochemical oxygen demand and total suspended solids) and ammonia. It was not designed to remove nutrients, but does currently remove approximately 42 percent of the nitrogen and 25 percent of the phosphorus. Both are less than the 66 percent nitrogen and 75 percent phosphorus reductions required by the Iowa Nutrient Reduction Strategy

EXISTING AMES WPCF AVERAGE FLOWS AND LOADS							
Parameter	Average						
Flow, Million Gallons per Day	6.19						
Biochemical Oxygen Demand, Pounds per Day	9,360						
Total Suspended Solids, Pounds per Day	11,000						
Ammonia, Pounds per Day	1,300						
Nitrogen, Pounds per Day	2,050						
Phosphorus, Pounds per Day	263						

EXISTING AMES WPCF TREATMENT PROCESS SCHEMATIC

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RECOMMENDED PLAN

The recommended plan to achieve the nutrient reductions required by the lowa Nutrient Reduction Strategy was developed based on the following.

- M Rigorous analysis of current and forecast future flows and loadings on the Ames WPCF
- ☑ Thorough assessment of existing WPCF performance capabilities
- ☑ Extensive quantification of nutrient sources throughout the watershed including influent to the WPCF
- Identification, screening, development, and evaluation of multiple watershed and WPCF nutrient reduction alternatives.

The recommended plan will transition the Ames WPCF from an existing trickling filter solids contact process to a future biological nutrient reduction process, incorporating one of three alternative technologies, simultaneous nitrification denitrification, carbonaceous activated sludge, or granular activated sludge. When complete, the Ames WPCF will provide capacity for projected growth and progressively achieve compliance with the 2013 lowa Nutrient Reduction Strategy. The specific biological nutrient removal technology will be determined at the beginning of the first phase of implementation since all three alternative technologies are comparable in cost and merit.

FUTURE BIOLOGICAL NUTRIENT REMOVAL

With implementation of the recommended plan, the Ames WPCF will progressively increase from current maximum month flows and loadings to projected future influent maximum month capacities as follows:

- 12.6 million to 15.7 million gallons per day flow
- 12,100 to 16,600 pounds per day 5-day biochemical oxygen demand
- 16,300 to 22,400 pounds per day total suspended solids
- 1,680 to 2,300 pounds per day ammonia
- 2,340 to 3,210 pounds per day total nitrogen
- 299 to 410 pounds per day total phosphorus

Limited, if any, nutrient reduction will be achieved in Phase 1, seasonal reduction will be achieved in Phase 2, and full biological nutrient reduction will be achieved in Phase 3. Two factors drive this progressive reduction. First, the need to take advantage of prior investment and the remaining useful life of the existing trickling filters while providing reliable capacity for growth. Second, the configuration of the existing Ames WPCF prevents separate parallel operation of the existing trickling filters and new alternative technology.

The recommended plan also includes a parallel track to continue to incorporate stormwater best management practices in public works projects and target additional off site watershed nutrient reduction projects to demonstrate commitment and progress toward the 2013 Iowa Nutrient Reduction Strategy. Projects will be targeted that achieve nutrient reduction in conjunction with other ancillary benefits such as flood mitigation, source water protection, erosion control, habitat restoration, water quality, and recreation.

Example sites have been identified and grouped by location on City Property, within the City, and upstream of the City. Example projects include bioreactors, constructed wetlands, conservation reserve, research, hydraulic modifications, stormwater detention, and riparian buffer. The City's future Capital Improvements Plan includes \$200,000 per year for use in conjunction with available grant funding for these types of projects. Nutrient reductions will be registered with the Iowa Nutrient Reduction Exchange as potential offsets to more stringent future requirements at the Ames WPCF.

IMPLEMENTATION

The estimated capital cost, including both engineering and construction, and timing for each phase of the recommended plan at the Ames WPCF is presented below. It is noteworthy that the estimate does not include any additional capital investment in the existing trickling filters to prolong their remaining useful life. The recommended plan will be implemented in 3 phases over the next 20 years at an estimated cost of \$30.5 million. Inflated to the actual construction periods, the estimated cumulative capital cost for all three phases is \$39.63 million.

PHASE 1	\$10.20 million (\$8.5 million in 2018 dollars) 1 st - 5 years	 Keep Trickling Filters in Services Incorporate 1st Phase of Alternative Technology Provides Redundant and some Growth Capacity (Current Permit Limits) Provides Limited, if Any, Nutrient Reduction
PHASE 2	\$14.26 million (\$11 million in 2018 dollars) 2 nd - 5 years	 Take Trickling Filters Out of Services as they Fail Incorporate 2nd Phase of Alternative Technology Provides Additional / Redundant Capacity Provides Seasonal Biological Nutrient Reduction
PHASE 3	\$15.17 million (\$11 million in 2018 dollars) Last - 10 years	 Take Remaining Trickling Filters Out of Service Incorporate 3rd Phase of Alternative Technology Provides Forecast 2040 Treatment Capacity Provides Full Biological Nutrient Reduction

Water and sewer are on the same utility bill, so the timing of rate adjustments are coordinated to avoid doubling up in a single year and projected for 10 years to provide a long-term picture where utility rates are heading. The 10-year plan presented to City Council spring shows 5- or 6-percent sewer rate increases in alternating years to pay for the recommended nutrient plan along with other ongoing needs.

TEN YEAR PLAN FOR PROPOSED AMES WATER AND SEWER RATE INCREASES											
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	
Water Fund	7%		9%		9%		9%		9%		
Sewer Fund		5%		5%		6%		6%		5%	

