Iowa Conservation Reserve Enhancement Program (CREP)
2019 Annual Performance Report

Preface

The Iowa Conservation Reserve Enhancement Program (CREP) is a performance-based water quality program focusing on the reduction of nitrate loads to surface waters through the restoration of strategically designed and located wetlands that intercept tile drains from cropped lands.

The following narrative and illustrated report details annual and cumulative performance accomplishments including a brief background, executive summary, accomplishments, and preliminary monitoring data. Table 1 and Table 2 summarize financial and active site data. Table 3 is a cumulative program summary.

Background

Approved on August 17, 2001, the Iowa CREP is available in thirty-seven counties in the tile-drained region of North-Central Iowa (Figure 1). Wetland restoration is one of the most effective strategies for reducing nitrate (N) transport to water resources from row-cropped lands; and research conducted at Iowa State University has demonstrated that strategically located and properly sized wetlands remove 40-90% of the nitrate from cropland tile drainage. The effect of wetlands on watershed scale nitrate reduction is largely determined by the watershed's total nitrate load that the wetlands intercept.

Practices eligible are wetland restoration (CP-23) and erosion control structures (CP-7), when needed as part of the wetland establishment.

Federal incentives include:

- 15 annual rental payments of 150% of the weighted average soil rental rate
- 50% cost-share for eligible costs of establishing conservation practices
- Practice Incentive Payment (PIP) up to 40% of the total eligible cost of practice installation.

State incentives include:

- Market based incentive payment for a 30-year or permanent easement (one-time payment)
- 10% cost-share for restoration costs
- Survey, engineering, design, permitting, oversight, public bidding, title services

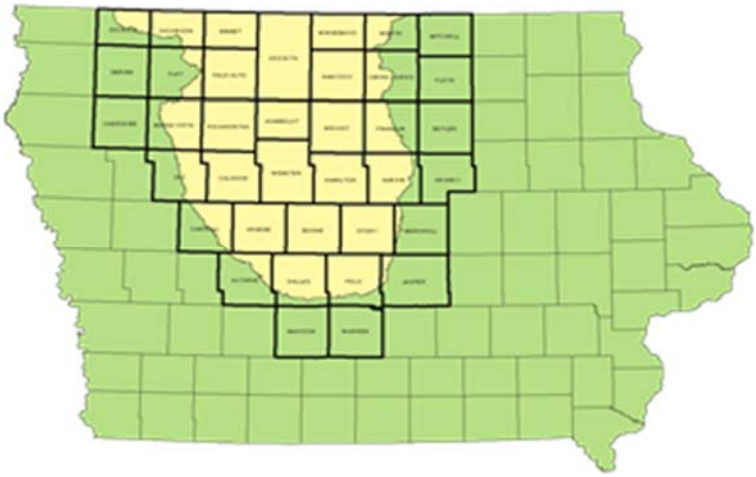

Figure 1. Counties Eligible for Iowa CREP

2019 Executive Summary

Landowner interest in the Iowa Conservation Reserve and Enhancement Program remains strong. However, the 4:1 Federal to State ratio of costs for the Iowa CREP remain unachieved. This is due to continued high land values, the CRP landowner $50,000 payment limitation cap applied to annual CREP payments under the program, and the increased costs of out-sourced engineering consultants and other technical services.

Farmland Values Survey for 2019 show that land values remain high. The average value of Iowa farmland in 2019 was reported as 2.3% higher than land values one year ago. The 2019 value is 3.85 times higher than the value in 2001 at the inception of the CREP program.

Construction was completed on four (4) wetlands during 2019 bringing the total wetlands restored to 91. These wetlands have a combined total of 873 acres of wetland pool and 3,700 acres of buffer plantings. These wetlands protect 116,923 acres of drainage area by removing an estimated 98,243 tons of N over their lifetimes at an average cost of $3.09 per acre of protected drainage area.

There are 17 wetlands under development. Collectively these 17 projects represent an estimated 210.6 acres of wetland surrounded by an estimated 824.1 acres of buffer which will treat over 18,000 watershed acres by removing an estimated 24,039 tons of N over their lifetimes. See Table 2 for additional details.

Partnerships and collaboration continue to provide support to the program and increase the number of sites completed. These partners currently include the State of Iowa Water Quality Initiative and the Lake Panorama Association. Recent partners include Ducks Unlimited, The Nature Conservancy and the National Fish and Wildlife Foundation Monarch Butterfly Conservation Fund.

Over the past 18 years of CREP, progress in successful designs and program implementations have been made through continued collaboration with the engineering consultants that design CREP wetlands and scientists at Iowa State University that monitor and evaluate water quality. Ongoing design adjustments have increased flood storage capacity, improved wetland longevity, and reduced costs while improving performance and maximizing nutrient removal. There has been varying success for wetland vegetation establishment. Although vegetation has a minimal effect on nutrient reduction, its success greatly enhances the habitat value and aesthetics of the wetlands.

The current field support staff level is at three (3) part time positions through an existing service contract with the Iowa Drainage District Association. The field personnel are and remain a proven essential component to carry out the processes involved with CREP.

Program Cost Justification

The current method of valuing state easement payments continues to be an effective means of providing fair value compensation to landowners enrolling in CREP. Without the approach of basing easement payments on the ISU Farmland Values Survey, CREP enrollment would be notably lower. The costs of the State easements remain high due to its reflection of the current land values in Iowa. This has a negative effect on the targeted 4:1 federal to state ratio of total project costs for the Iowa CREP. The targeted ratio has yet to be achieved due to high easement payments combined with the increased costs of out-sourced engineering and the state coverage of CRP payment limitations cap overages.

FSA soil rental rates were adjusted in 2018 which reduced the number of soil rental rate categories to three and in general lowered the FSA soil rental rates offered. However, the 150% incentive rate over regular CRP rental rates still makes this program enticing to landowners. The current soil rental rates were adopted in June 2018. According to the 2019 Farmland Value Survey conducted by Iowa State University, the state average for all grades of land was estimated to be $7,432 per acre, an increase of 2.3% from 2018. However, the average land value change varied by Crop Reporting District from a -2.9% change in Northeast Iowa to a 5.9% increase in the East Central Crop Reporting District. The primary factors for increasing land values are lower interest rates, a limited land supply and strong yields. Lower commodity prices, weather and trade uncertainty were the primary factors decreasing land value.

For medium to high grade land typical in the Des Moines Lobe, the farmland value ranged from -0.1% in the Northwest Crop Reporting District to 6.0% in the South Central Crop Reporting District. The average dollar value range is $4,371 to $10,757 per acre. Since inception of the CREP in 2001, the statewide average land value has risen from $1,926/acre to $7,432/acre, representing an increase of 3.85 times the value in 2001. (*Zhang, 2019*.)

Interest in Iowa CREP remains strong with a continued majority of landowners pursuing permanent easements. To date, all of the state funds that have been appropriated for CREP State FY2019 are currently obligated. Of the 37 eligible Iowa counties, CREP wetlands are present in 29 to date.

In 2013 there was an expected five year wait for state funds to become available. We are now anticipating a three year wait for new applicants for state funds. The goal for CREP is to maintain a wait time of no longer than two years. We have found that landowners become inpatient and frustrated with the longer wait time and have a higher likelihood of withdrawing their application.

The shorter wait time for project completion has been achieved partly by pushing the process from application to construction at a faster pace in tasks that CREP has control. However the commitment of partnerships with other programs and conservation groups is primary to stretch our budget and increase the number of wetlands installed per year. Highlighted in local, state and national media, public awareness of CREP's role in water quality improvement has increased, prompting more frequent inquiry for participation.

The current field support staff level is at three part time positions through an existing service contract with the Iowa Drainage District Association. The field personnel remain instrumental in helping to carry out the processes involved with CREP. They are the first contact with landowners and continue as liaisons between the landowner, CREP agencies, engineering consultants, and contractors throughout the entire process.

Accomplishments

2019 Wetland Restorations

Iowa CREP started construction on four sites during calendar year 2019. These sites have 77.87 acres of wetland pool and 267.65 acres of buffer plantings and will protect 9,272 acres of drainage area by removing an estimated 8,760 tons of N over their lifetime. Table 1 also lists five projects whose FSA contributions were paid in FFY2019. Their environmental impacts were reported in the 2018 report and are repeated in this report.

This brings the total wetlands restored up to 91 wetlands**.** The estimated annual N removal capacity of all wetlands**,** completed and in construction or development, is over 1,630,000 pounds per year with N removal costs averaging $0.27/lb. Without the CREP wetlands, landowners in north central Iowa would need to permanently retire an estimated 64,000 to 113,000 acres of cropland to obtain an equivalent nitrogen reduction.

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Of the seventeen wetlands under development, seven (7) wetland projects have a CRP contract starting October 2019 and are planned to bid in January 2020 for construction completion in calendar year 2020. Six (6) other wetlands under development are planned for a CRP contract starting October 2020. Additional wetlands may also be ready for CRP contracts if additional partner funds are leveraged.

The Water Quality Initiative Program (WQI) through the North Raccoon River Watershed Project partnered with the CREP on two projects to be completed in 2021. This brings the total of CREP/WQI partnership projects to eight. We look to further partnership with WQI in their priority watersheds within the CREP eligible counties.

The Nature Conservancy continues to obtain grants from Coca Cola, the Greater Cedar Rapids Community Foundation and other sources to partner with CREP projects within the Middle Cedar River Basin area. Plans are for them to apply for additional grants for one project in 2020 and more projects in the future.

The Lake Panorama Association-Rural Improvement Zone (LPA-RIZ) has completed construction on a second CREP wetland project on the east shoreline of the Lake Panorama in Guthrie County. The LPA-RIZ plans to continue working in partnership with CREP to complete similar projects in the future.

Policy Interpretation for Stream Mitigation When Constructing CREP Wetlands on Identified Stream Channels

In 2019 a policy interpretation by the U.S. Army Corps of Engineers (ACOE) started requiring mitigation of stream channel wetlands where CREP wetlands were being created in their stead.

This change in policy interpretation caused the CREP staff to re-evaluate which potential wetland projects would move forward toward implementation. All the potential wetland sites being assessed are evaluated as to the presence or absence of permanent streams identified as “blue line” streams on standard United States Geologic Service (USGS) topographic maps. Assessed sites which have a “blue line” stream are placed on hold and a full assessment for CREP criteria is not completed even when the landowner has contacted CREP staff for site eligibility.

CREP staff and IDALS administrators and managers continue to meet with ACOE officials and others to negotiate a solution at the national level that expands opportunities for CREP projects without the additional cost and administrative burden of compliance with stream mitigation requirements.

Tile Zone Wetland Design

A new wetland design called "Tile Zone Wetlands" is being researched and moving to field trial application at Iowa State University. This type of wetland is suited to pothole, low-gradient landscapes. To create a wetland using this design, existing tile lines are intercepted by a newly installed tile line which re-directs drainage water to surface outlet to a pothole lower in the landscape. After this drainage water is treated by flowing though the wetland, it is collected and re-deposited into the same tile line that it originated from further downslope in the landscape, or to another suitable outlet. This type of wetland design has several advantages. First, the amount of surface water entering the wetland is greatly reduced since primarily only tile drainage water is directed to the wetland. Secondly, since the wetland is a naturally-formed pothole, the earthwork cost for a structure and berm are eliminated or minimal. Third, the easement area necessary for this type of wetland could be much smaller since the volume of water treated and size of the wetland would also be smaller. Researchers at Iowa State University are actively identifying sites which may work for this type of design.

The Water Quality Initiative Program staff funded seven tile zone sites in 2019 for engineering and design. This type of wetland site development was requested and received concurrence to be included as an acceptable methodology for CREP as long as the site met all other CREP eligibility criteria. One tile zone wetland site was constructed in 2019 using Water Quality Initiative funding. The remaining six sites are in the preliminary design or final design stages of development. One of these sites meets CREP criteria and will be installed in 2020. An additional four sites in the design stage meet CREP criteria and may be installed in 2021.

The State has also moved forward with new design concepts that help to provide temporary flood storage benefits while maintaining the high level of water quality performance already in place. IDALS has engaged in a collaborative process with the engineering consultants that design CREP sites and scientists at Iowa State University to further enhance the water quality performance of CREP sites by identifying and incorporating design features that improve hydraulic efficiency, maximize wetland area, and increase the overall habitat value. Results from these minor structural modifications to the designs indicate that significant improved nutrient removal performance is being achieved.

Program Evaluation

Tables 1 through 3 highlight CREP site data, costs, and projected nitrate reductions. Cost per pound for N removed remains below the current cost per pound of nitrogen fertilizer application to cropland, and considerably below reported cost per pound of N removal by municipal treatment plants. Data from ISU monitoring indicate Iowa CREP wetlands are a highly cost effective method for removing nitrate from tile-drained landscapes thus improving water quality in local streams, drinking water supplies, and the Gulf of Mexico.

References

Zhang, W. 2019. *"2019 Iowa State University Farmland Value Survey: Overview."* CARD working paper 19-WP 597, Iowa State University Extension and Outreach, Center for Agricultural and Rural Development.

Presentations/Publications/Outreach

Iowa CREP remains in the public attention with requests for tours, presentations, and interviews from groups and organizations including ISU Iowa Learning Farms; farm managers and landowners; Iowa local and national leaders; watershed management groups; Iowa and national publications; local, county and state agency cooperators and the general public. Some of the presentations/publications/activities are listed below:

- 2/21/2019 CREP and Drainage Engineers Meeting, Fort Dodge. Provided program updates on the CREP, tile zone wetland concept and design and pertinent policy updates to consulting engineers. 100 participants
- 4/11/2019 CREP presentation to the Big Bear (central Iowa) Chapter of Trout Unlimited, West Des Moines. Gave an informational presentation of the CREP covering program goals, benefits, progress and future plans to club members. 30 participants.
- 7/19/2019 Capital Crossroads-sponsored tour "Exchange for Ag and City Leadership". Tour participants included Des Moines-area agricultural and urban leaders to discuss local water issues affecting everyone. One stop on the tour was a CREP wetland. 80 participants.
- 8/21/2019 Conservation Technology Information Center Conservation in Action Tour. Marshall County CREP site. Tour participants included national, regional and local leaders from government agencies, agribusiness, commodity groups and nonprofit groups interested in conservation and environmental improvements within agriculture.
- 10/10/2019 CREP tour to Ducks Unlimited CEO Adam Putnam, Secretary of Agriculture Mike Naig and several state legislators. Story County. A video and a news article in the local media outlet was produced. The link to the video and news article is provided here: https://www.amestrib.com/news/20191012/ducks-unlimited-ceo-visits-iowas-newest-wetland?fbclid=IwAR3KOi6R2qpN0yQPZktNLMxA6UbD1Un8If32BXPwrLBDZ3KPdMY_OKyb7AA
- 11/7/2019 Iowa Learning Farms field day. Floyd County. Toured and CREP wetland.
- 12/5/2019 Wetland Field Specialist annual meeting, Fort Dodge. Provided program updates on the CREP, discussion to review existing land easements with visiting with landowners on potential CREP sites and collaborating and coordination with watershed coordinators.

Monitoring and Evaluation—Preliminary Annual Report of Findings

A unique aspect of the Iowa CREP is that nitrate reduction is not simply assumed based on wetland acres enrolled, but is calculated based on the measured performance of CREP wetlands. As an integral part of the Iowa CREP, a representative subset of wetlands is monitored and mass balance analyses performed to document nitrate reduction. By design, the wetlands selected for monitoring span the 0.5% to 2.0% wetland/watershed area ratio range approved for Iowa CREP wetlands. The wetlands also span a threefold range in average nitrate concentration. The wetlands thus provide a broad spectrum of those factors most affecting wetland performance: hydraulic loading rate, residence time, nitrate concentration, and nitrate loading rate. In addition to documenting wetland performance, ongoing monitoring and research programs will allow continued refinement of modeling and analytical tools used in site selection, design, and management of CREP wetlands.

Summary of 2019 Monitoring

Seventeen wetlands are being monitored in 2019 (Figure 1), including 16 Iowa CREP wetlands and one mitigation wetland (DD15-N). Monitoring is ongoing at these 17 wetlands and a final annual report will completed in early 2020.

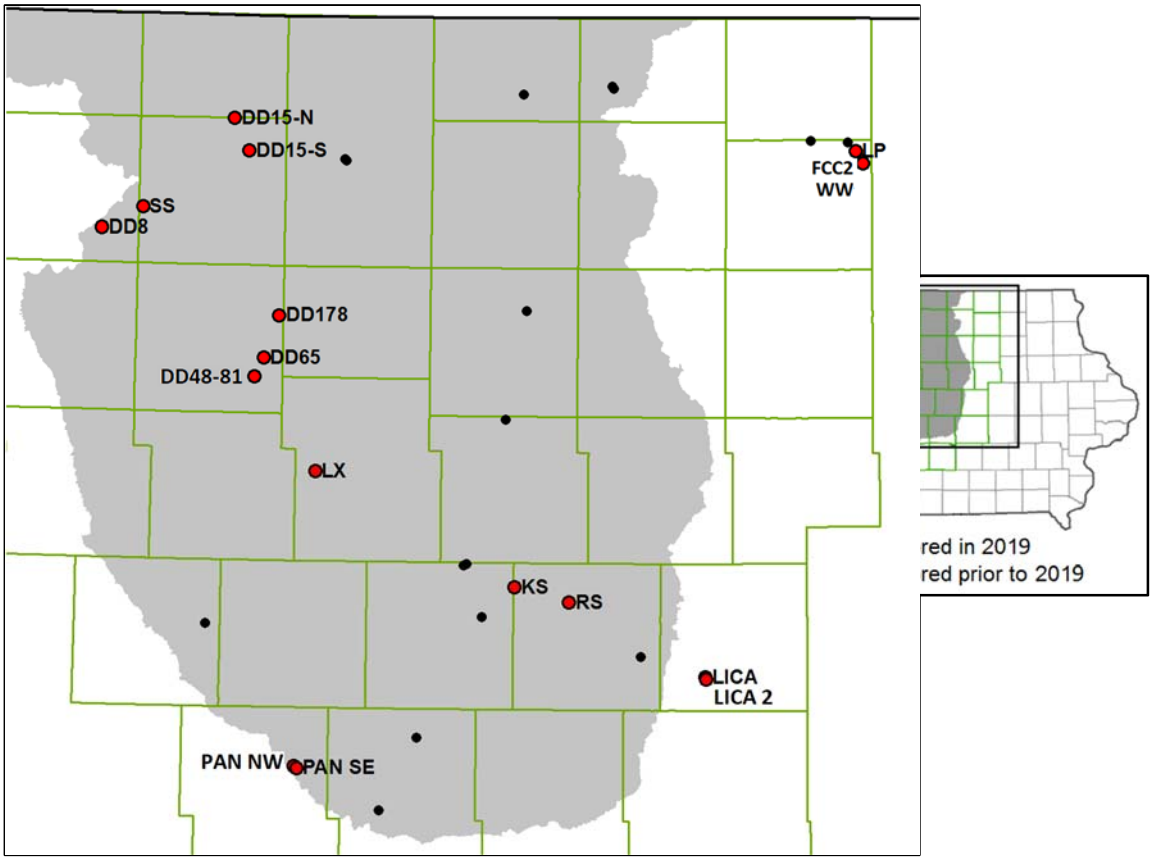

Figure 1. Wetlands monitored in 2019 (red circles, labeled) and additional wetlands monitored in prior years (blue squares). The shaded area represents the Des Moines Lobe in Iowa.

Monitoring is being conducted at the 14 wetlands that were monitored during 2018, plus three additional wetlands: PAN SE, PAN NW, and LICA 2 (Figure 1). Monitoring at the PAN SE and PAN NW wetlands was initiated during June, so the spring flow which typically carries the bulk of the annual nitrate load was not monitored. Accordingly, most of the nitrate loading was missed for 2019 at the PAN SE and PAN NW wetlands, however, the infrastructure is in place to obtain a full year of monitoring data at these sites during 2020. Similarly, monitoring at the LICA 2 wetland was initiated during May so the infrastructure is in place for a full year of monitoring during 2020.

Wetland monitoring included measurements of wetland inflows, outflows, pool elevations and water temperature, and collection of weekly to biweekly water quality grab samples and daily automated samples. Daily samples were collected using automated samplers programmed to collect a daily sample at wetland inflows and outflows when temperatures were sufficiently above freezing to allow the equipment to function properly. Due to occasional equipment failure, some daily values are missing. Flow during winter periods having freezing temperatures below which the monitoring instruments can function is estimated using water yields from nearby United States Geological Survey river gage station data scaled to the individual wetland watershed areas.

Wetland inflow and/or outflow channels were instrumented with submerged area velocity (SAV) Doppler flow meters and stage recorders for continuous measurement of flow velocity and stream depth, respectively. The SAV measurements were combined with cross-sectional channel profiles and stream depth to calculate discharge as the product of water velocity and wetted cross-sectional area. Water depth upstream of V-notch weirs is monitored, but water velocity is generally not, and discharge is calculated using calibrated weir equations. Wetland pool water levels were monitored continuously using stage recorders in order to calculate pool volume, wetland area, and discharge at outflow structures. The discharge equations and SAV based discharge measurements are calibrated using manual velocity-area based discharge measurements collected during 2019 and prior monitoring years. Manual velocity-area discharge measurements were determined using the mid-section method whereby the stream depth is determined at 10 cm intervals across the stream and the water velocity is measured at the midpoint of each interval. Velocity was measured with a hand held Sontek Doppler water velocity probe using the 0.6 depth method where the velocity at 60% of the depth from the surface is taken as the mean velocity for the interval. The product of velocity and area summed over intervals gives the total discharge. In total, 52 manual discharge measurements were collected during 2018 with nine more during 2019. At least one manual discharge measurement has been collected at each wetland to calibrate the SAV and V-notch weir discharge equations.

During 2019 a beaver dam was observed on the KS wetland outflow structure, the LX outflow structure, the WW outflow structure, the LICA outflow structure, and the DD65 outflow structure causing elevated water depth in these wetlands. A beaver dam was observed in the inflow stream to the LICA wetland causing elevated water depth and reduced water velocity in the inflow stream. These beaver dams are periodically removed by the field crew but are generally rebuilt within days.

Patterns in Nitrate Concentrations and Loads

Despite significant variation with respect to nitrate concentration and loading rates, the wetlands display similar seasonal patterns and general relationships to discharge (Figure 2). Historically, inflow nitrate concentrations are variable during the winter. However, because winter flows are typically low, the winter nitrate loading is also low during most years. Snow-melt often results in increased flow during late February or March but nitrate concentrations in the melt water and associated runoff are typically low. Spring flow is usually high and shows the highest nitrate concentrations. Nitrate concentration generally declines through July and August during dry periods, but may remain elevated as long as there is sufficient flow. Nitrate concentration during large summer flow events often declines abruptly with peak flows and is thought to be associated with surface runoff having low nitrate concentration; however, nitrate concentrations often rebound within a few days of these high flow events. These nitrate concentration and flow patterns are consistent with those of CREP wetlands monitored in prior years and represent the likely patterns for future wetlands restored as part of the Iowa CREP.

Wetland Performance (Nitrate mass loss and removal efficiency)

Wetland performance is a function of hydraulic loading rate, hydraulic efficiency, nitrate concentration, temperature, and wetland condition. Of these, hydraulic loading rate (HLR) and nitrate concentration are especially important for CREP wetlands. The range in HLR expected for CREP wetlands is significantly greater than would be expected based on just the four fold range in wetland/watershed area ratio approved for the Iowa CREP. In addition to spatial variation in precipitation (average precipitation declines from southeast to northwest across Iowa), there is large annual variation in both precipitation and water yield. The combined effect of these factors results in annual loading rates to CREP wetlands that vary by more than an order of magnitude, and will to a large extent determine nitrate loss rates for individual wetlands.

Mass balance analysis and modeling were used to calculate observed and predicted nitrate removal, respectively, for each monitored wetland. Wetland bathymetry data were used to characterize wetland volume and area as functions of wetland water depth. Wetland bathymetry has been determined by ISU on the basis of wetland construction plans and/or bathymetric surveys. These bathymetric relationships were used in both numeric modeling of water budgets and nitrate mass balances to calculate nitrate loss, hydraulic loading, and hydraulic residence time. Wetland water depth and temperatures were recorded at five minute intervals for numerical modeling of nitrate loss.

The monitored wetlands generally performed as expected with respect to nitrate removal efficiency (percent removal) and mass nitrate removal (expressed as kg N ha^{-1} $year^{-1}$). Variability in wetland performance is in part due to differences in wetland characteristics and condition and partly due to differences in loading rates and patterns. At a given annual HLR, differences in wetland condition and in timing of loading can result in significant differences in performance.

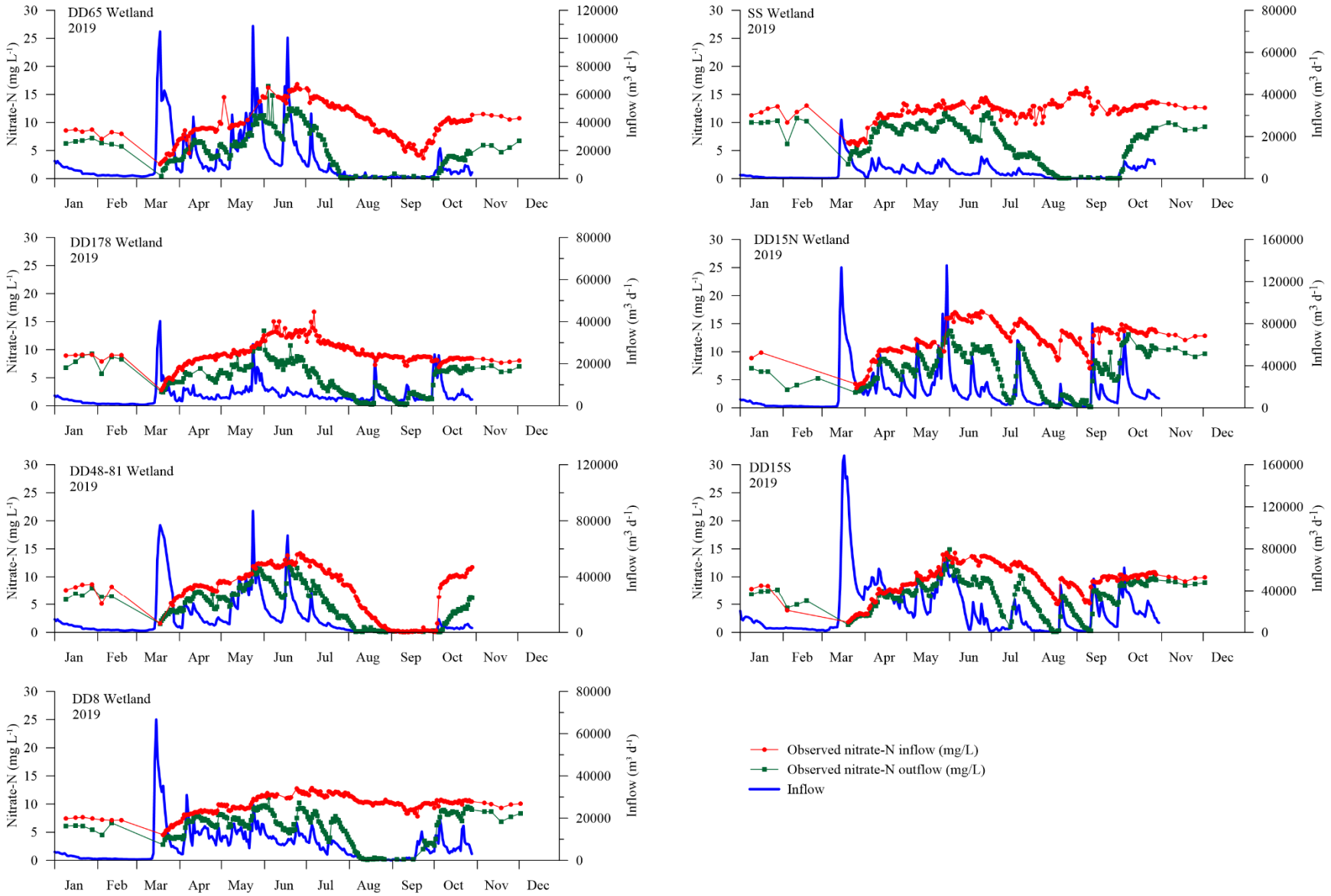

Figure 2. Measured nitrate concentrations and flows for northwest Iowa wetlands monitored during 2019.

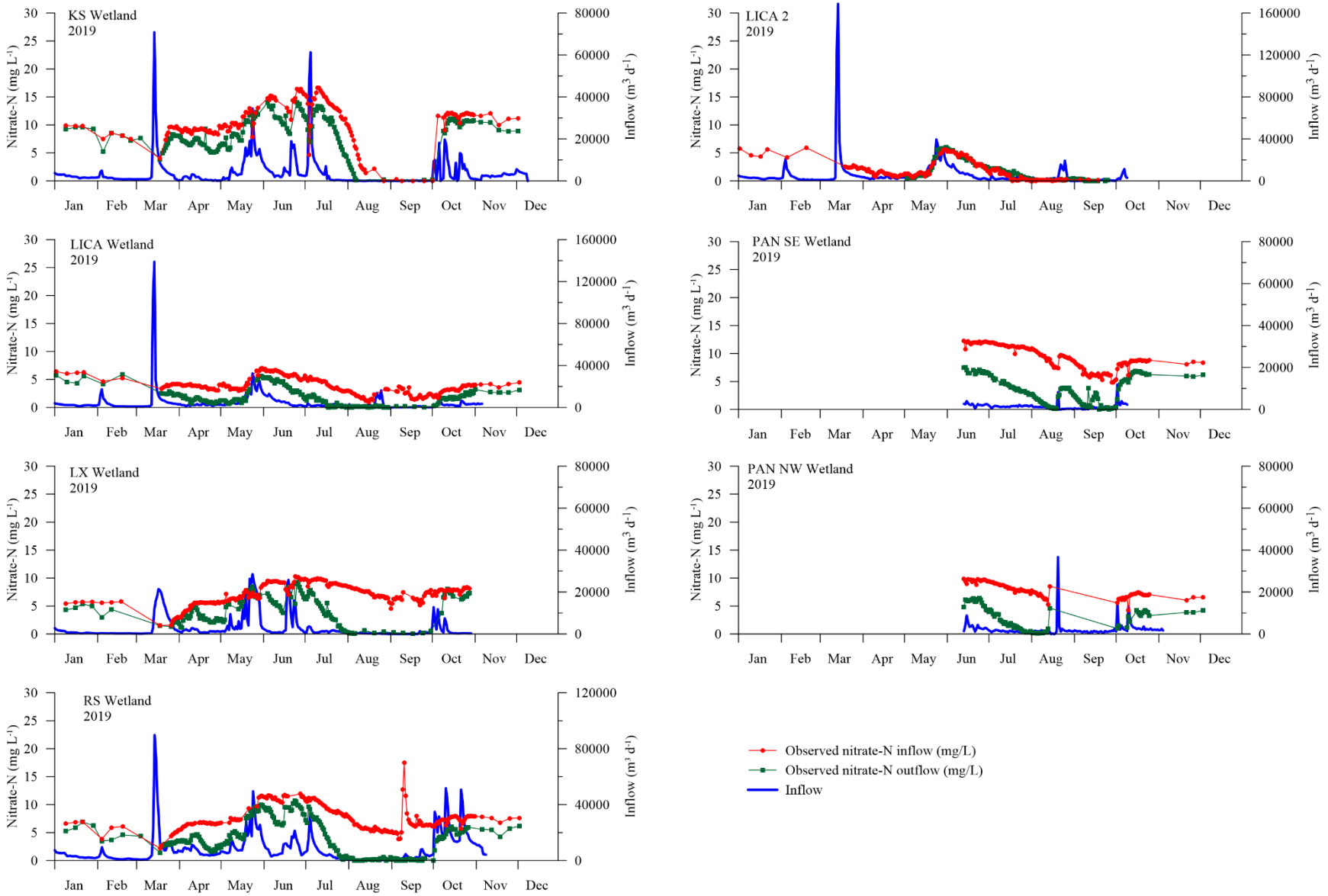

Figure 2. (Continued) Measured nitrate concentrations and flows for central Iowa wetlands monitored during 2019.

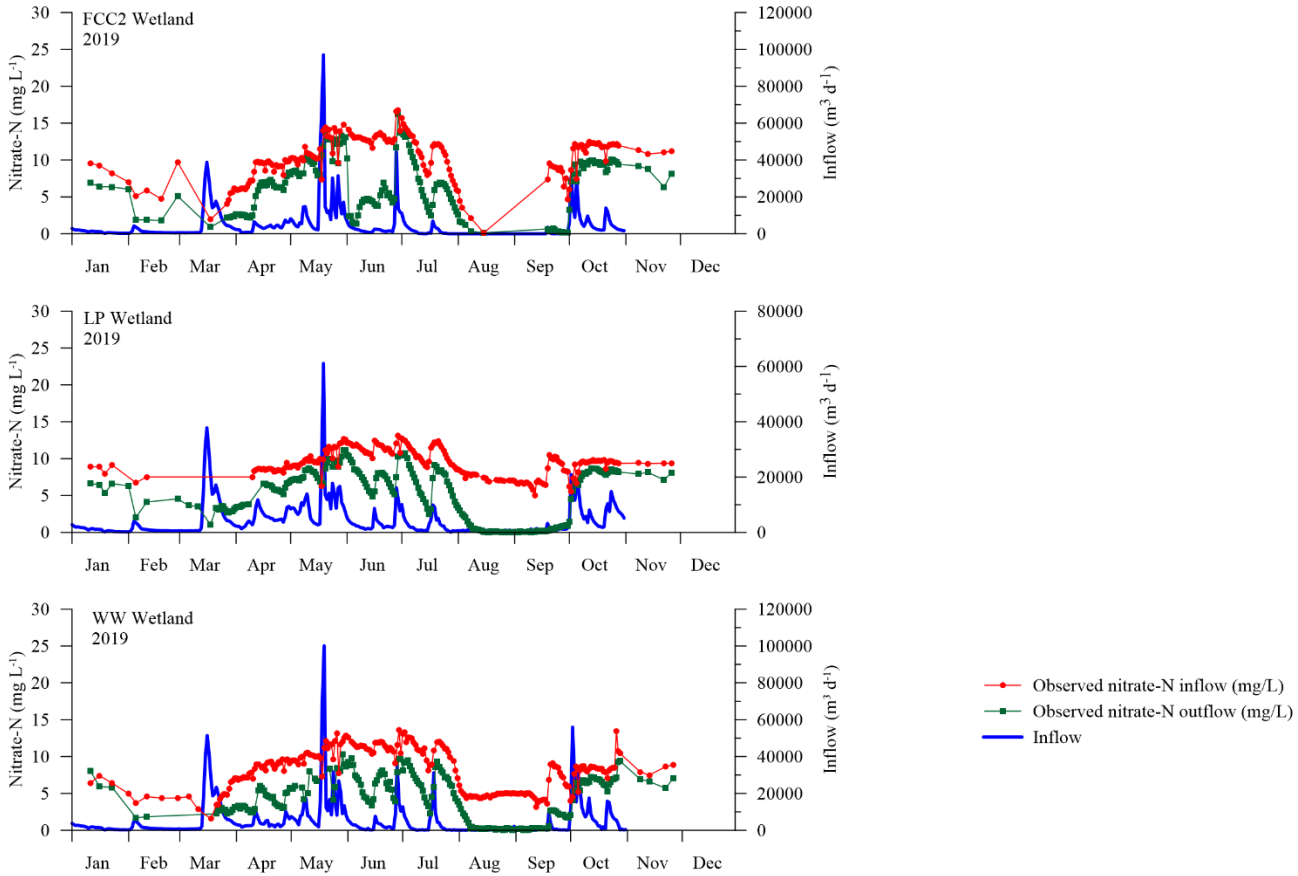

Figure 2. (Continued) Measured nitrate concentrations and flows for northeast Iowa wetlands monitored during 2019.

Mass balance analysis and modeling was also used to examine the long term variability in performance of CREP wetlands including the effects of spatial and temporal variability in temperature and loading patterns. In addition to calculating the percent mass removal observed for wetlands monitored from 2004 through 2019, the percent nitrate removal expected for CREP wetlands was estimated based on hindcast modeling over the period from 1980 through 2005. The results illustrate reasonably good correspondence between observed and modeled performance and demonstrate that HLR is clearly a major determinant of wetland nitrate removal performance (Figure 3).

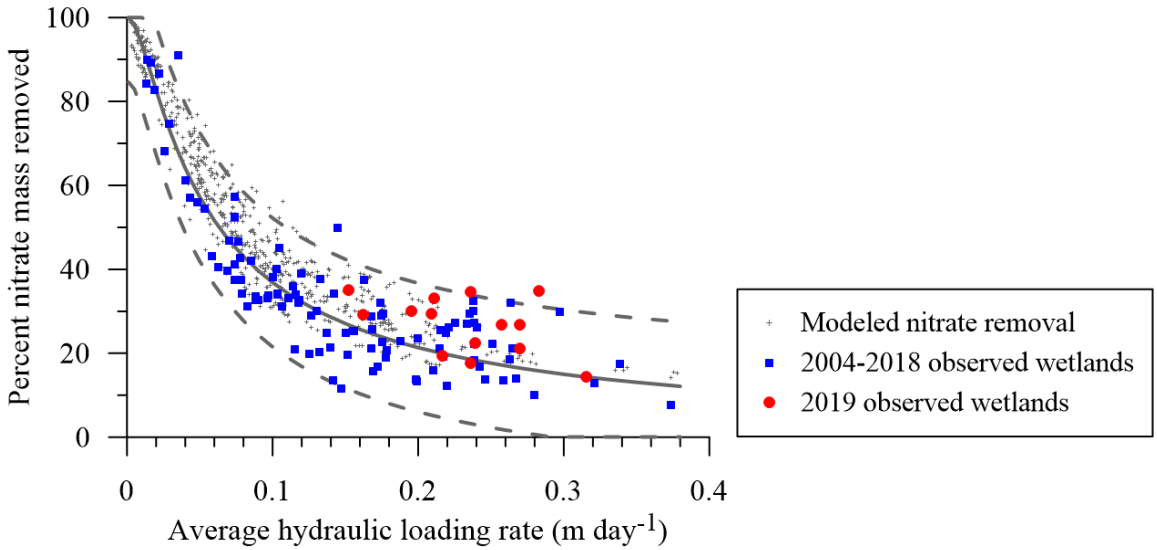

Figure 3. Percent nitrate removal performance for 2019 (January to September, red circles) and wetlands monitored during prior years (2004-2018, blue squares). The dashed lines indicate the range expected to contain 95% of similar wetlands in Iowa on the basis of the 2004 to 2015 monitored wetlands.