FEBRUARY 26, 2026

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RE: DESIGN REPORT FOR SAC883604B – NUTRIENT REDUCTION WETLAND

PROJECT OBJECTIVE & PLANNING ACTIVITIES

PROJECT OBJECTIVE

In order to pursue the goals of the Iowa Nutrient Reduction Strategy. This project will construct a nutrient reduction wetland per Iowa NRCS CPS 656 for the purpose of "improving water quality of storm water runoff, tile drainage outflow, or other waterflows." The project will pump water from a tile main and remove nitrates via denitrification in the wetland.

PLANNING ACTIVITIES

Meetings with the landowner were held during the pre-design and preliminary design phases. The initial pre-design meeting was held in the Fall of 2024 where the design intent, scoping, and contract between IDALS, ISG, and the landowner was discussed. The preliminary design review meeting between IDALS, ISG, and the Landowner was held on February 12th, 2025 where the proposed design and easement was discussed, ISG proceeded with final plans following this meeting.

PERMITTING & COMPLIANCE

The CPA 52 Worksheet is completed by others.

CULTURAL RESOURCES

ISG's review of the Sites public viewer indicates potential for cultural resources. Refer to IDALS for additional information regarding cultural resource reviews.

THREATENED & ENDANGERED SPECIES

No known threatened or endangered species within project area.

REGULATORY COMPLIANCE

STATE

The site is subject for review by the Iowa DNR Floodplain section. Since the overall drainage areas to the floodplain near the site is less than 10 square miles, the proposed work may be exempt from a floodplain permit. A separate floodplain report has been provided by ISG.

FEDERAL/TRIBAL

Refer to IDALS for permitting for USACE 404/401 requirements. No special federal or tribal compliance requirements have been made known to the ISG outside of referenced design criteria.

LOCAL

The project is located adjacent to Drainage District No. 4 Sac County. The District maintains an open channel and a tile system in an established waterway. Records pulled from the drainage district show that the tile has minimal cover (<2ft) in the north-south section of the channel. It is desired to provide treatment to the tile over the open ditch. The proposed wetland would ideally intercept the tile and divert flow to the pump; at the current depth, the interception would be below the existing grade line to avoid need for restriction and provide depth for future repair/improvement to the tile. Due to the current condition of the district tile, this project will replace portions of the tile upstream and downstream of the tie in to

avoid future failure. Coordination with the Drainage District will be necessary to complete the proposed repairs. Proposed access lane to the site will require a permit from the Sac County Engineer, this permit is the responsibility of IDALS.

SITE ASSESSMENT & SURVEY

SITE LOCATION & ASSESSMENT

The project site is located in Section 04, T88N, R36W in Sac County, Iowa. The proposed site receives overland flow from approximately 9.89 acres of adjacent crop land. Additional hydrology will be provided to the wetland by pumping water that is diverted from the nearby DD4 tile, which drains approximately 1600 acres. A desktop review and assessment using soil maps, historical aerial imagery, and LiDAR information was performed by ISG.

The initial site assessment included a review of the drainage ditch and tile, survey, and district tile maps acquired from the county by ISG.

SURVEY NOTES

A topographical survey was performed by ISG in October 2024. The survey was conducted using a base-rover GPS in Iowa Regional Coordinate System Zone 4 and NAVD 88. Control was established with RTK GPS methods. One (1) benchmark was set for control. Major features were collected, and general topo was made with a grid pattern approximately 50'x50' or adjusted based on natural change in elevation observed in the field. The topo grid included the proposed pool area, drainage ditch, and existing stream. A tile probe and drainage maps from the county were used to locate the district tile within the drainage ditch. Topo survey was used for everything except the watershed delineation, in which LiDAR elevations were utilized. It is anticipated that additional temporary control will be set if machine control is requested by the hired contractor. ISG will perform an additional survey to locate and document section corners for easement plat development prior to construction.

DESIGN DOCUMENTATION

PRIMARY NRCS PRACTICE

- 656, Constructed Wetland

SUPPORTING NRCS PRACTICES

- 327, Conservation Cover
- 342, Critical Area Planting
- 356, Dike or Levee
- 378, Pond
- 533, Pumping Plant
- 554, Drainage Water Management
- 587, Structure for Water Control
- 606, Subsurface drains, Main
- 607, Surface Drain, Field Ditch
- 620, Underground Outlet

DESIGN CRITERIA

PRESCRIPTIVE DESIGN CRITERIA

- Watershed:Pool Ratio
  - Criteria Range 0.5% to 2.0%
  - Design: 1.5% (utilizing an extrapolated "equivalent" watershed value based on the proposed pumping rate)
- Deep Pool Areas
  - Maximum depth of the wetland is 2 feet with an average depth of 1 foot
- Design Storms

- Principal Spillway: 5 year – 24 hour MSE Type 3 (CPS 378)
- Auxiliary Spillway: 25 year – 24hour MSE Type 3 (CPS 378)

Table 1:Design Stage-Storage

Feature	Elevation	Storage Volume (ac-ft)	Surface Area (acres)
Floor	1275.50	0.00	0.002
Principal Spillway -NWL	1277.50	1.00	1.68
5yr-24hr Storm	*1277.95*	*Time to return: 30 hours*	
Auxiliary Spillway	1278.00	2.00	2.38
25yr-24hr Storm	*1278.12*		
Design Berm + Freeboard	1278.40	3.07	3.00

DESIGN ASSUMPTIONS

We included a continuous base flow up to 1.33 cfs which is an equivalent 1/16 inch drainage coefficient to evaluate additional freeboard and return to normal pool requirements. This base flow is intended to account for any pumped flows into the wetland from the DD4 tile and was included in the hydrologic model.

HYDROLOGY & HYDRAULICS

A study of site hydrology and hydraulics was completed as part of the design of the wetland structural and outlet components. As part of the study, the drainage area was reviewed, and stage storage analysis was completed based on a combination of survey and LIDAR data. Land use and management practices were determined through site visits and aerial photography. This wetland will receive the overland flow from approximately 9.89 acres of agricultural and meadow lands. Flows from the remaining 1600 acres upstream of the wetland do not flow into the wetland and bypass via the existing DD4 tile and surface channel. Therefore, these acres were not considered as direct flows into the wetland as part of the analysis. A small portion of these flows would enter the wetland through the pumping system and has been accounted for via a base flow in the model. Flows from the adjacent surface channel may back up into the wetland during times of flooding or high flow. Refer to the floodplain report for further information.

The existing system and proposed wetland modifications were modeled using HydroCAD 10.20-3c software, due to the watershed size and expected model complexity. The system is represented through a series of nodes to represent the wetland and the contributing drainage area.

The curve number for the catchment was assumed to be 78, which is based on the standard value for a field planted with straight row crops with a Hydrologic Soil Group of “B” or a meadow with Hydrologic Soil Group “C”. Time of concentration was calculated within HydroCAD for the catchment.

The storage volume for the wetland area was determined from Civil3D after final grading was completed.

Design storms and rainfall data used to generate the NRCS 24-hour MSE3 rainfall distributions for the project area were obtained from the NRCS National Engineering Handbook Figure IA2-25. See Appendix C for more information. Runoff calculations in the model were performed using the SCS TR-20. Given rainfall data, HydroCAD models the rainfall events, and the resulting flows and water elevations are produced within HydroCAD. The storm events modeled include the 2-, 5-, 10-, 25-, 50-, and 100-year events.

Since the site has a relatively low small and localized drainage area the proposed outlet configuration utilizes a single outlet culvert with primary and auxiliary intakes. The primary intake and water control structure is designed for the 5-year 24-hour storm while the auxiliary spillway and intake is designed for the 25-year 24-hour storm. The proposed 21” RCP outlet culvert is sized for the necessary capacity to handle flows from both the primary and auxiliary spillways and intakes. A separate auxiliary spillway was requested by IDALS for consideration but was ultimately forgone due to the limiting site topography and significant excavation needed for a flow path directly into the DD4 surface channel.

See Appendix C for more information on model inputs and results.

SOILS INVESTIGATION

USGS Web Soil Survey was used to identify soils of concern for major components such as the dike. Our field review looked at the side of drainage ditch to profile soils where the wetland is proposed. Outside of this investigation, it is expected that the soils in flood plain will predominately be alluvial deposits and highly variable. Therefore, a small foundation trench is proposed below the dike to identify potential tile but also provide measures to reduce lateral flow-infiltration from the wetland to the ditch.

STRUCTURAL DESIGN

EARTHEN EMBANKMENT/DIKE

The embankment of this wetland is designed to as a class IV dike per CPS 356. The maximum embankment height is 4.5 feet in and combination with total storage, is not subject to Iowa DNR Dam Safety. A grassed overflow is provided so when the river comes out of the bank, where flow is then directed to an area intake to outlet to the ditch. There is also a designated place to draw down the wetland to reduce erosion potential along the embankment. Furthermore, located in the floodplain, and with flatter sideslopes, bromegrass was elected for planting on the embankment to help resist shear stresses from larger floods. Seepage and piping is not of substantial concern, but An Anti seep collar is proposed along the pipe outlet.

Constructed Elevation: 1180.0

Top Width: 10 feet
Side Slopes: 8H:1V & 4H:1V
Max Height: 4.5 feet

VERTICAL STRUCTURES

The water control structure is designed as 60-inch CMP structure with internal stop logs to control flow. To add weight to resist buoyancy and stress from flood flows, a concrete base is proposed. A 24-inch area intake is also planned to be constructed to direct auxiliary overflows to the primary outlet and reduce flooding and erosion to the area surrounding the wetland.

ARMAMENTS

Riprap is placed at each of proposed pipe outlets and sized based on anticipated shear stresses from large flood event. Iowa DOT Class E riprap has been selected for this purpose. To accommodate bulk material sourcing in other components, aggregate is proposed as a base material instead of engineering fabric.

VEGETATION, EROSION, AND SEDIMENT CONTROL

SEDIMENT DESIGN LIFE

No detailed sediment analysis was computed, due to the limited size of the local watershed. CPS 656 prescribes a minimum of 1 inch per year for the design life of the wetland. As the buffer is not expected to contribute to sedimentation, sediment accumulation is proportioned to 0.73 inches per year. From a maximum depth of 2.0 feet, this equates to a 29-year sediment life.

$$\left(2.0\ feet\ \times \frac{12\ inches}{1 foot}\right) \div \left[1 \frac{inch}{year} \times \left(\frac{9.89\ acres - 1.55\ acres}{9.89\ acres}\right)\right] = 29\ years$$

EROSION MANAGEMENT

Depending on the time of year construction will occur, existing vegetation management will dictate erosion control during construction. Language has been added to the plans to accommodate this and IDALS has provided comment on vegetation management in the plan notes.

Post construction erosion control will include minimal structural controls where disturbance of the drainage ditch occurs. Establishment of vegetation, and mulching where necessary is the proposed means of final stabilization.

ENVIRONMENTAL CONSIDERATIONS

Language regarding environmental concerns and considerations has been added within the plan construction notes; it is the contractor's responsibility to monitor rain events and move equipment out of the floodplain in imminent threat. No anticipated negative impacts to threatened or endangered species because of the proposed project. The shallow pool will provide conditions favorable to wetland biota, and the easement area will be seeded with native grasses and forbs that will provide habitat benefits to wildlife and pollinators.

LAND RIGHTS & UTILITIES

DRAINAGE DISTRICT AND ROAD RIGHT-OF-WAY

The shallow segment of tile has a 50 foot long blowout that has eroded the west ditch bank and likely caused siltation within the downstream tile as water exiting to the blowout was not being taken back underground but traversing down the ditch. The upstream section of the tile visible in the blowout is dual wall 24-inch HDPE indicating a previous repair has been made to the original tile (22" clay). For long term operation of the wetland, it is desired to go upstream of the shallow tile section, so that if no improvements are made, the wetland inlet can still intercept drain water with minimal sediment.

The tile main is within the existing ditch top of bank, which has been claimed as permanent easement by the drainage district per Iowa Code 468.27.2. Therefore, work on the tile associated with the wetland intercept is expected to occur within the drainage district permanent easement.

The most recent profile of the tile and ditch show that the tile was routed to the south road bank in order to establish additional cover therefore it is desired to intercept the tile near the road embankment foreslope toe. Coordination with the Sac County Engineer will be needed to protect the roadway.

Easement for the proposed wetland has been discussed with the landowner and will be secured prior to construction. A permanent access lane is proposed and will be coordinated by IDALS with the Sac County Engineer.

SAFETY CONSIDERATIONS & CONSTRUCTION OVERSIGHT

The contractor is responsible for safety on the work site and providing all necessary safety measures for the protection of life, as required by regulating agencies. The contractor is to contact Iowa One Call for utility locations a minimum of two (2) business days prior to any excavation/construction. When not in operation, the contractor will be responsible for securing all equipment and materials stored on site.

A construction inspection plan is included within sheet C0-20 of the construction plans.

INSPECTION PLAN

The construction inspection plan is included within the construction plans.

QA/QC PROCESS

Design Progress	Documents	Internal QA/QC Reviewer	Date
Concept	V1-V7	Caleb Rasmussen	03-30-2025
Schematic Design – 30% Plan	Plan Set V1-V2	Haley Toms	05-20-2025
Design Development – 60% Plan	Plan Set V3	Caleb Rasmussen	06-02-2025
		Haley Toms	
	HEC-RAS Model	Caleb Rasmussen	06-01-2025
	HydroCAD Model	Caleb Rasmussen	05-29-2025
Design Development – 90% Plan	Plan Set V4	Haley Toms	07-01-2025
		Owen Oeltjenbruns	
Construction Documents – 95% Plan	Plan Set V5	Haley Toms	08-13-2025
		Caleb Rasmussen	
		Owen Oeltjenbruns	

	Specifications	Caleb Rasmussen	08-15-2025
	HEC-RAS Model & Report	Caleb Rasmussen	08-15-2025
Construction Documents – 100% Plan	Plan Set V6	Haley Toms	12-12-2025
		Spencer Pech	
		Owen Oeltjenbruns	
	Specifications	Spencer Pech	12-12-2025
	HEC-RAS Model & Report	Spencer Pech	12-12-205

Sincerely,

Spencer D Pech

Spencer Pech, PE
Civil Engineer

spencer.pech @ISGInc.com

APPENDIX A: ITEMS OF WORK

PROJECT: 31714 IDALS SAC883604B

ITEMS OF WORK

Bid Item	Sub-Item	Description	Specifications No.	Quantity	Unit or Select	As-Built
1	-	Site stripping & preparation	IA CS-001	1	LS	
2	-	Crop damage	IA CS-001	0	AC	
3	-	Straw Wattle	IA CS-005	738	LF	
4	-	Buffer Seeding	IA CS-006	4.2	AC	
5	-	Structure and Waterway/Channel Seeding	IA CS-006	0.7	AC	
6	-	Mobilization and Demobilization	IA CS-008	1	LS	
7	-	Drain Tile Investigation	IA CS-009	2	HR	
8	-	Drain Tile Removal & Burial	IA CS-009	579	LF	
9	-	Drain Tile Connection >18"	IA CS-009	3	EA	
10	-	Excavation (General)	IA CS-021	1,911	CY	
11	-	Earthfill (General)	IA CS-023	1,902	CY	
12	-	Topsoil Placement	IA CS-026	3,971	CY	
13	-	Modifed SW401 Outlet Structure, 48"	IA CS-031	1	EA	
14	-	Lift Station Structure, 60"	IA CS-031	1	EA	
15	-	Pump Assembly, Electrical, and Solar Panels	S-6	1	EA	
16	-	Wetland Outlet Pipe, Reinforced Concrete Pipe				
	A.	18"	IA CS-031	45	LF	
	B.	21"	IA CS-031	35	LF	
17	-	Pipe Apron, RCP w/ Metal Guard				
	A.	18"	IA CS-031	1	EA	
	B.	21"	IA CS-031	1	EA	
18	-	HDPE Dual Wall Corrugated Pipe				
	A.	24"	IA CS-046	579	LF	
	B.	15"	IA CS-046	67	LF	
19	-	2-Chamber Water Control Structure Assembly, 10'x15"	IA CS-051	1	EA	
20	-	CMP Water Control Structure	IA CS-051	1	EA	
21	-	Culvert, CMP				
	A.	12"	IA CS-051	40	LF	
22	-	Class E Riprap	IA CS-061	37	TN	
23	-	Class A Roadstone	IA CS-061	30	TN	
24	-	Trench Stabilization Material	IA CS-061	140	CY	

APPENDIX B: OPERATION AND MAINTENANCE

OPERATION AND MAINTENANCE PLAN
CONSTRUCTED WETLAND
CODE 656

Landowner/Operator: Youberg, John & Linda Rev Trust Date: 2/27/2026

Address: 1604 Bataan Lane, Gulf Breeze, FL 32563

Job Location – County: Sac Section: 04 Township: 88N Range: 36W

Prepared By: _____ Farm/Tract No.: _____

Operation and Maintenance Items

Operation and maintenance (O&M) is necessary for all conservation practices and is required for all practices installed with the Natural Resources Conservation Service assistance. The purpose is to create an artificial ecosystem with hydrophytic vegetation for water treatment. The land user is responsible for proper O&M for as long as the practice is used but no less than the life of the practice, 15 years, and as may be required by federal, state, or local laws or regulations.

Operation refers to operation of the practice in compliance with all laws, regulations, ordinances, and easements; and in such a manner that will result in the least adverse impact on the environment and will permit the practice to serve the purpose for which it was installed. Maintenance includes work to prevent deterioration of the practice, repairing damage, or replacing components which fail.

Necessary operation and maintenance items include:

1. Inspect after significant storm events and at least annually to identify repair and maintenance needs.
2. Inspect the downstream toe of the embankment annually. If there are wet areas or seeps at the downstream toe of the embankment, it could be a serious problem. Ask for assistance from a qualified professional to evaluate the seepage.
3. Clear accumulated trash away from water control structures, pipe inlets, rock riprap, and vegetated spillways.
4. Repair erosion at outlet of principal spillway pipe as needed.
5. Fill rills and gullies that occur on the embankments and in the vegetated spillway. Reseed the filled areas.
6. Check frequently for burrowing animals. When found, remove the burrowing animals, replace embankment materials, and reseed.
7. Maintain a vigorous vegetative cover by regular mowing and fertilization. Time the first mowing after nesting birds have hatched. Remove excess cut grass. Do not burn or overgraze. Operate mowing and other equipment on slopes in accordance with the machinery operation manual.
8. Prevent woody vegetation from growing on or around the embankment, abutment, or vegetated spillway areas. Control tree and bush growth by hand cutting, mowing, or chemicals. Avoid damaging grass with herbicide sprays.
9. Repair or replace damaged fences to keep livestock out of the wetland, where applicable.
10. Maintain a riparian filter around the perimeter of the wetland to trap sediment, where applicable.
11. Monitor and control invasive species.
12. Maintain a diverse stand of aquatic vegetation by manipulating water levels where applicable. Replace vegetation as needed. Specify timing and depth of dewatering and reflooding operations.
13. Control flow to the wetland according to the water budget. Monitor the wetland performance.
14. Sample effluent from the wetland for nutrients prior to utilization.

Other Recommendations and Notes:

Included within the project is a training/demonstration of lift station operation, to be provided by the pump supplier. The landowner should attend this training to better understand how to operate and maintain the lift station. In general, the lift station should always remain active and operational to maximize nutrient treatment and removal. The lift station supplier should be consulted for winterization and potential cold weather shutdown approach and procedures.

The control structure, upstream of the lift station on the diversion tile, can be utilized to block flow into the lift station when the lift station needs to be drawn down for inspection or maintenance. The stop logs within the control structure should remain open (raised) under normal operations and only lowered for inspection and maintenance of the lift station.

Below is a recommended schedule for the establishment and maintenance of the wetland.

Establishment

YEAR 1

- Monitor wetland vegetation and perform replacement planting as necessary.
- Mow vegetation at 6-8 inches after a weed height of 12 inches is reached. Do not mow after August 1, or after weed height reaches 4+ feet high.
- Do not use broadleaf chemical spray.

YEAR 2

- Monitor wetland vegetation and perform replacement planting as necessary.
- Replace wetland vegetation to maintain at least 50% surface area coverage in wetland plants after the second growing season.
- Mow seedlings to a height of 6-8" when after a weed height of 12 inches is reached. Do not mow after August 1, or after weed height reaches 4+ feet high.
- Do not spot treat with broadleaf chemical spray.

YEAR 3

- Monitor wetland vegetation and perform replacement planting as necessary.
- Spot mow as necessary where weeds are prevalent.

Routine Maintenance

BI-MONTHLY

- Inspect inlet and outlet structures to confirm they are functioning as designed. Remove any debris or obstructions.

SEMI-ANNUALLY

- Inspect shallow areas on edge of wetland and upland areas and remove trees and shrubs.
- Inspect wetland and upland slopes for erosion or compromised slopes.

ANNUALLY

- Inspect auxiliary spillway (overland outlet) for obstructions or erosion. Remove any obstructions found.
- Identify any invasive vegetation or noxious weeds and remove where possible.

- Inspect outlet water control structure.

BI-ANNUALLY

- Maintain surrounding vegetation by means of mowing or controlled burning.

CONTACT YOUR LOCAL NATURAL RESOURCES CONSERVATION SERVICE (NRCS) OFFICE FOR ANY ADDITIONAL TECHNICAL ASSISTANCE YOU MIGHT NEED FOR IMPLEMENTATION OF THIS OPERATION AND MAINTENANCE PLAN.

Signatures:

Landowner/Operator: _____ Reviewer: _____ Date: _____

APPENDIX C: HYDROLOGY & HYDROLOGIC CALCULATIONS

(SEE ATTACHMENT)