Des Plaines River Watershed Workgroup

Continuous Specific Conductance and Chloride Sampling At USGS Gages (Des Plaines River @ Lincolnshire, Gurnee and Russell)

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Background and Problem

The Upper Des Plaines River originates in Racine and Kenosha Counties of Wisconsin and flows into Illinois through Lake and Cook Counties. In southwestern Cook County, Illinois, the Des Plaines River converges with the Kankakee River and Chicago Sanitary and Ship Canal to form the Illinois River, which discharges to the Mississippi River. The entire Upper Des Plaines River watershed encompasses a total of 480 square miles in Wisconsin and Illinois (Lakecounty.gov). In Illinois the Des Plaines River watershed drains approximately 346 square miles of a variety of land usages including agricultural, urban/industrial, and forest. The Lake county portion of the watershed drains approximately 200 square miles, and includes 33 municipalities and 12 townships which discharge to the Des Plaines River (Lakecounty.gov).

Throughout the entirety of Des Plaines River watershed, the Des Plaines River is negatively impacted by the discharge of nutrients and other pollutants from agricultural operations, wastewater treatment facilities, as well as urban and industrial development. As a result, numerous lakes, streams, and segments of the Des Plaines River have developed a variety of water quality impairments including; higher than recommended concentration of phosphorous, chloride, fecal coliforms, and other pollutants. These impairments have led to sections of the Des Plaines River in Illinois being listed on the Environmental Protection Agencies (EPA) section 303 (d) list of the 1972 Clean Water Act, which identifies waters impacted by low water quality as well as pollutants causing or expected to cause water quality violations within each state's waterways.

To address the impairments to the Des Plaines River within the Lake county portion of the Des Plaines River watershed, the Des Plaines River Watershed Workgroup (DRWW) was formed in 2015. The DRWW is a voluntary coalition of dues paying stake holders formed with the intent of improving water quality issues in the Des Plaines River Basin in Lake County to meet Illinois EPA water quality standards, through local decision making processes. In order to better inform decision making for future studies and potential management practices and locations, the DRWW has implemented a comprehensive monitoring strategy, which began with a broad water quality sampling event in 2015. The comprehensive sampling event consisted of data collection for; water and sediment chemistry, fish speciation, macro-invertebrates, and habitat quality and availability at more than 45 locations throughout lake county. Additional monitoring and data analysis of stream flow from 15 temporary Burns & Mcdonnel and 6 established USGS stream gages began at the end of 2016. The flow monitoring network will be used in an attempt to characterize discharge of the main stem of the Des Plaines River as well as several of its major and minor tributaries. Continued collection of discrete and continuous water quality data has been proposed to asses spatial and temporal changes of various water quality parameters of concern throughout the watershed, including specific conductance and chloride concentrations. Future water quality data will be used in conjunction with measured and estimated stream flows in an attempt to calculate daily loads of various water quality constituents of concern.

In support of this effort the USGS proposes to install real time water quality monitoring equipment at up to three existing USGS stream gages being utilized for the flow monitoring portion of the study (figure 1) and sample for seasonal or bi-monthly chloride concentrations. The USGS proposes to install the water quality monitoring equipment at the Des Plaines River at Lincolnshire (Station # 05528100), Des Plaines River at Gurnee (Station # 0552800), and Des Plaines River at Russell, Il (Station # 0552780) USGS stream gages, figures 2-4. By installing water quality equipment at the existing USGS

stream gaging stations, the USGS will attempt to provide useful data detailing temporal changes in water temperature, specific conductance, and chloride concentrations at locations already providing real-time continuous stream flow data. The collected data could be used to identify seasonal peak specific conductance and chloride concentrations as well as other smaller event based fluctuations that are often missed with monitoring plans that are limited to only discrete water quality sample collection.

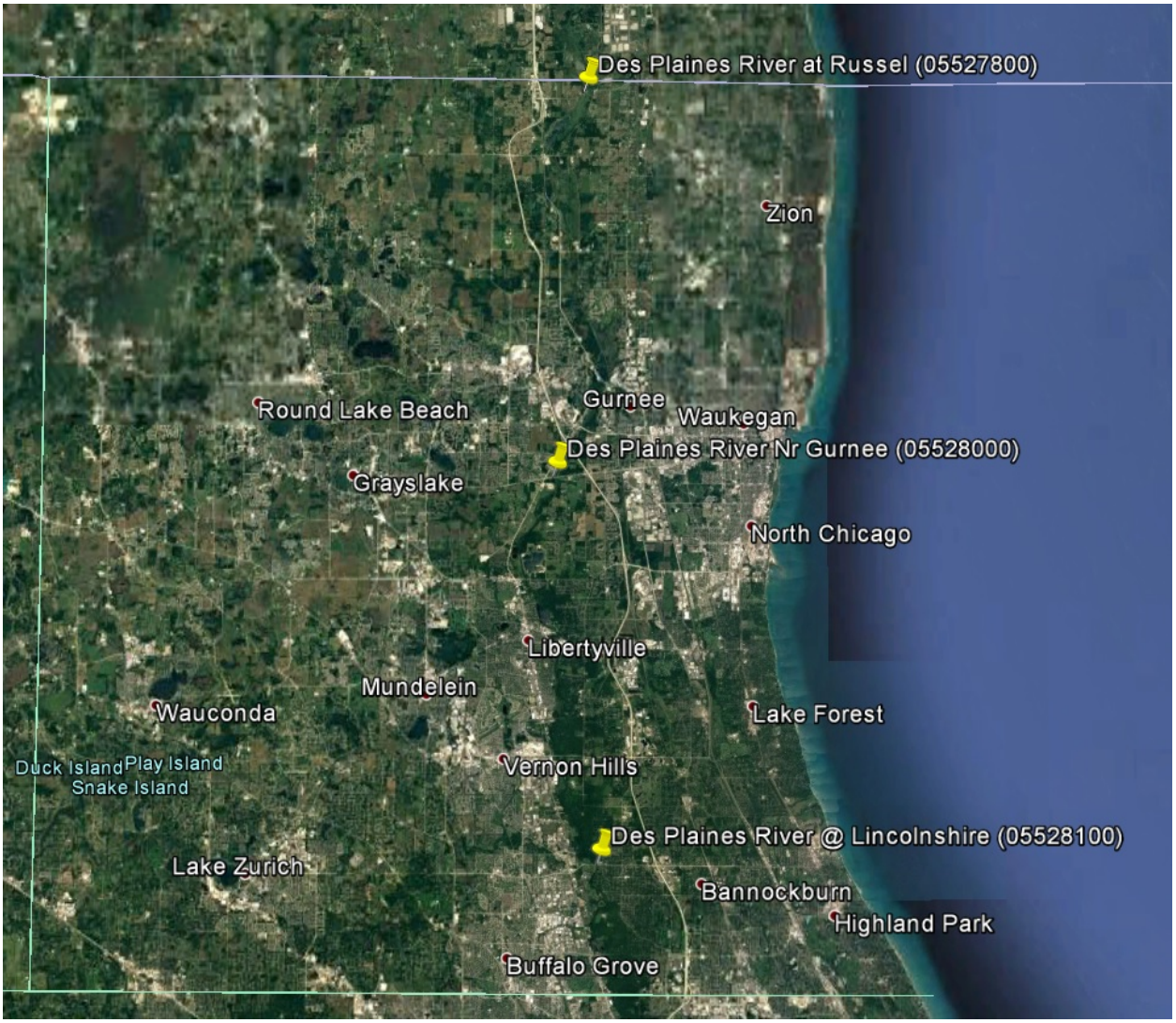

Figure 1: USGS stream gages (Des Plaines River at Russell, Des Plaines River near Gurnee, and Des Plaines River at Lincolnshire, at which the USGS proposes to install continuous water quality monitoring sensors, and collect bi-monthly or seasonal discrete chloride samples.

Figure 2: Ariel photo of USGS stream gage Des Plaines River at Russell, IL, station number 05527800.

Figure 3: Ariel photo of USGS stream gage Des Plaines River Nr. Gurnee, IL, station number 05528000.

Figure 4: Ariel photo of USGS stream gage Des Plaines River at Lincolnshire, IL, station number 05528100

Goals and Objective

The objective of the proposed work is to monitor to the best of our ability 'real time' diurnal and seasonal water temperature and specific conductance, and collect a total of 6 chloride samples each year at one or all of the following USGS gages; Des Plaines River at Lincolnshire (Station # 05528100), Des Plaines River at Gurnee (Station # 0552800), and Des Plaines River at Russell, Il (Station # 0552780). Chloride samples collection will either be collected bi-monthly throughout the entire monitoring year, or monthly during the winter and spring seasons, where chloride concentrations tend to be at their highest.

Relevance and Benefits

The Upper Des Plaines watershed is impacted by higher than acceptable chloride concentrations, as outlined by the Environmental Protection Agency, at several locations throughout Lake County. The collection of accurate temporal water temperature and specific conductance data, as well as discrete chloride concentrations may be useful to the DRWW in gaining a better understanding of how specific conductance and chloride concentrations fluctuate under various seasonal and

hydrologic conditions. The collection of continuous specific conductance data in conjunction with accurate discrete chloride concentrations could also be used by the DRWW to identify a relationship between specific conductance and the concentrations of chlorides within the watershed. This improved understanding my help to identify conditions and locations that management strategies or the reduction of salt application would most effective to improving water quality conditions for chlorides within the Cook County portion of the Des Plaines River Watershed. With the ultimate goal of meeting water quality standards set by the IEPA and eliminating the chloride impairments of the Des Plaines River in Cook County within the EPA section 303 (d) list of impaired water ways in Illinois.

Monitoring Plan/ Approach

The USGS proposes to install water quality monitoring equipment to measure continuous water temperature and specific conductance at up to three existing USGS Stream gages on the Des Plaines River including; at Lincolnshire (Station # 05528100), near Gurnee (Station # 05528000), and at Russell, IL (Station # 05527800) beginning in March of 2016. The USGS will install In-Situ Aqua troll 100 water temperature and specific conductance sensors at one or more of the previously mentioned stream gages. In addition to providing near 'real time' continuous data for water temperature and specific conductance, the USGS will collect 6 chloride samples at each of the USGS monitoring stations to be analyzed by the USGS National Water Quality Laboratory in Denver Colorado.

The water-quality data collection proposed in this project will make use of the existing steel shelter housing, data collection platform (DCP), and GOES satellite telemetry system and antenna, currently utilized by the USGS for monitoring stage and discharge at the described stations. An additional deep cycle 12 volt battery for the water quality sensor will need to be installed at each gaging location, in addition to data cable and sensor housing infrastructure described below in the field equipment section of Equipment and Supplies. USGS personnel will visit the gage every 1 to 2 months during pre-scheduled stream gage service visits to clean and calibrate the water quality equipment to ensure accurate data collection. Water quality service visits will be added to existing stream gage service schedule in order to reduce cost burden to the DRWW that would occur from separate monthly water quality service visits. During these water quality site visits USGS personnel will complete a series of water quality measurements over a cross section of the Des Plaines River at the monitoring station in order to ensure the deployed sensor is measuring data that accurately represents changes in water chemistry across the entirety of the stream. Cleaning and calibration checks performed during each visit will be done in accordance with the USGS National Field Manual and the Guidelines and Standard Procedures for Continuous water-quality Monitors: Station Operation and Record Computation and Data Reporting outlined in USGS report TM1-D3 (Wagner et al, 2006). A discharge measurement will also be completed by the hydrologic technician during each visit prior to servicing the water quality sensor. This will provide an accurate cross section of water quality data and discharge during the water quality measurement.

Water quality data for specific conductance, and temperature, will be collected on a 15 minute interval. The data from the monitoring station will be retrieved hourly and made publically available on the USGS National Water Information System (NWIS) at http://waterdata.usgs.gov/il/nwis/qw. Real time data from the gages will be monitored daily for erroneous data and equipment malfunction. Following events where rapid fouling or equipment malfunctions occur, USGS personnel will attempt to service the gage as quickly as possible to minimize loss in data. Shortly after each service visit, real time data

collected for each of the water quality parameters will be evaluated and reviewed by USGS personnel in order to quality assure the real time data. This process includes eliminating erroneous data points and applying data shifts and data corrections to account for accumulated error between site visits. This error may be the result of fouling growth on the sensors and calibration drift. This process is then checked and reviewed by additional USGS personnel.

Breakdown of Cost Options and Explanations

The equipment and Supplies tables below outline the infrastructure parts, monitoring equipment, laboratory supplies and associated costs needed to install the previously described monitoring equipment at one of the USGS stream gageing stations listed above. The following two sets of tables (Monitoring Option 1 and Monitoring Option 2) outline the associated installation equipment costs as well as the labor and overhead associated with installing and maintaining the equipment over the course of a year, and quality assuring the continuous data for specific conductance and water temperature. Monitoring option 1 is the full cost rate for the selection of a single USGS gage, Monitoring option 2 provides a discounted costs associated with installing monitoring equipment at all three of the described USGS stream gages. Cost for 3 gages are discounted approximately 22% when compared to costs of a single gage installation and Operation & Maintenance for 1 year. This discount is able to be applied to the purchase of multiple gages because spare equipment pulled from previously finished projects can be installed in the place of purchasing all new equipment. These spare sensors are generally withheld as contingency, should other deployed sensors fail, unless a network of gages is being installed. In these cases available sensors can be used to aid in offsetting cost to the cooperator. The last set of tables outline the cost of yearly continued operation and maintenance of monitoring equipment and data quality assurance for additional years after installation. The cost outlined are for a single gage.

Equipment & Supplies (needed per gaging Station)

Installation Parts & Equipment	# of Units	Total Cost
Deep Cycle Marine Battery	1	$ 243.00
CSG Stainless Steel Brackets	4	$ 80.00
Schedule 80 2-in PVC Pipe + Misc.	~30 Feet	$ 90.00
¾ inch Liquid-Tight Data Cable Conduit + Mounts	~100 Feet	$ 159.00
Misc. Hardware	1	$ 250.00
	Total	**$ 822.00**

Monitoring Supplies	# of Units	Total Cost
In-Situ Aqua troll 100 sensors	1	$ 2,130.00
25’ Vented Troll Cable	1	$ 282.00
Troll Cable Extender	1	$ 239.00
75’ Vented Troll Cable	1	$ 468.00
3 (ft) Flying Lead Troll to DCP adaptor	1	$ 331.36
1 yr supply Specific Cond. Stds (500, 1000, and 2500 us/cm)	1	$ 579.57
	Total	**$ 4,029.93**

Laboratory Supplies	# of Units	Total Cost
Chloride Sample (LC 1571) Lab Costs	6	$ 120.00
High Capacity Capsule Filters	6	$ 141.66
HDPE Sample Bottles	6	$ 0.00
	Total	**$ 261.66** ($43.61/sample)

Monitoring Option 1: Single Gage Installation (s)

Installation and 1rst Year of Operation and Maintenance Costs

Direct Salary and Benefits	$9566.42	*Includes hours for installation, routine maintenance and calibrations, and data record quality assurance procedures.
Installation Equipment	$822.00	Hardware and infrastructure to house new water quality equipment
Monitoring Supplies	$4029.93	Includes sensors, data cables, and calibration standards
Laboratory Supplies	$261.66	Includes Lab costs and consumables for 6 Chloride samples
Vehicle Costs and Maintenance	$375	Extra Mileage for service visits, and installation not included in service visits for existing stream gage
Total Direct Costs	$15,055.01	Totaled costs from above
Indirect Costs	$11,508.11	USGS Overhead, Contingency Funds
Total Costs	**$26,563.12**	

Monitoring Option 2: Installation of 3 Gaging Stations

Discounted 1rst Year Installation and O&M for 3 Gageing Stations

Direct Salary and Benefits	$24,000.03	*Includes hours for installation, routine maintenance and calibrations, and data record quality assurance procedures.
*Installation Equipment	$1,730.00	Hardware and infrastructure to house new water quality equipment
*Monitoring Supplies	$8,518.45	Includes sensors, data cables, and calibration standards
Laboratory Supplies	$784.98	Includes Lab costs and consumables for 6 Chloride samples
Vehicle Costs and Maintenance	$825	Extra Mileage for service visits, and installation not included in service visits for existing stream gage
Total Direct Costs	$35,858.46	Totaled costs from above
Indirect Costs	$26,556.28	USGS Overhead, Contingency Funds

Total Costs	**$62,414.74**	

* Represents discounted costs.

Continued Yearly Operation and Maintenance Costs (per gageing station)

Direct Salary and Benefits	$7,514.74	*Includes hours for installation, routine maintenance and calibrations, and data record quality assurance procedures.
Installation Equipment	$0.00	Hardware and infrastructure to house new water quality equipment
Monitoring Supplies	$779.68	Calibration Standards, Misc. Consumables
Laboratory Supplies	$261.66	Includes Lab costs and consumables for 6 Chloride samples
Vehicle Costs and Maintenance	$300	Extra Mileage for service visits not included in service visits for existing stream gage
Total Direct Costs	$8,856.08	Totaled costs from above
Indirect Costs	$7,058.86	USGS Overhead, Contingency Funds
Total Costs	**$15,914.94**	

Installation Time Line

Monitoring equipment and other modifications necessary to deploy the water quality monitoring equipment will take place over a 1 day period at each of the USGS gages selected during March of 2017. Additional future monitoring will be determined based on the needs and discretion of the Des Plaines River Watershed Workgroup.

References

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