USGS Value Engineering Study – Water Quality
Summary Report
September 29, 2009

Executive Summary:

The U.S. Geological Survey (USGS) conducts critical work of monitoring the nation's water resources and their quality. In order to improve the efficiency of its field procedures, the USGS worked with the Interstate Council on Water policy (ICWP) to commission a study which provided an outside perspective on the agency's processes.

The study (March-May 2009) identified four major areas of improvement. These recommendations focus on automating water quality data collection, reducing waste associated with equipment usage, adding telemetry/wireless capabilities in order to reduce frequency of field visits, and streamlining additional steps.

The Value Engineering Team strongly encourages the USGS to seriously consider these insights and assess their feasibility to implement. The savings achieved through streamlining and consolidation of processes could be very significant.

Introduction:

The USGS assembled a team of experts in in-situ water quality sensors and applications to conduct a value engineering study on the USGS's water quality monitoring processes and procedures. The team was comprised of individuals from sensor manufacturers, USGS water quality experts, and individuals from two USGS Water Science Centers (see Appendix A).

The study involved visits to two USGS field offices to evaluate their current process; Raleigh, NC, representing an estuarine environment, and Lawrence, KS, representing a large real-time network. Each visit required 3-4 days and involved activities outlined in the Team Charters.

Goals:

The primary goals of the project were to:

- Reduce the cost of data and the number of times data is 'touched' by identifying waste and efficiency improvement ideas within the current USGS process for collecting and processing continuous water quality data from field instruments.
- Identify opportunities to adopt new technologies to make the USGS water quality data collection and processing more efficient.
- Provide the USGS with the evaluation process in order to independently conduct future value engineering activities.

Results:

The value engineering team identified four general areas for the USGS to target in order to reduce waste, improve efficiency and adopt new technologies. See Appendix D (Action Item List and 9-Square) for more detail.

1. Automate Data Entry and Record Processing

- Streamline data entry
    - Highlights: eliminate duplication, implement CHIMP, modify ADAPS and GR-SAT
- Automate data collection and analysis
    - Highlights: implement CHIMP, GR-SAT, integrate NWIS & RMS
- Consolidate functionalities of multiple software programs into one solution
    - Highlights: Nine different software programs currently being used for data processing (see Appendix C, page 2)
- Improve yield in data processing
    - Highlights: implement CHIMP, modify SOPs, software development to automate records processing

2. Reduce Waste
    - Reduce consumables
        - Highlights: Testing and SOP modifications
    - Extend life of monitoring equipment
        - Highlights: Develop application specific processes, vendor cooperation
    - Reduce time needed to generate data
        - Highlights: Streamline processes, implement CHIMP, institute field meter swap-outs, utilize wireless devices and remote communications
3. Reduce Frequency of Visits to Field Sites
    - Adopt improved antifouling technologies
    - Evaluate field monitor swap out system
    - Adopt telemetry systems and remotely monitor diagnostics (2-way communication)
4. Continuous Improvement
    - Streamline work centers via 5S Process (Sort, Streamline, Shine, Standardize, Sustain)
    - Form sensor workgroup
    - Streamline technology evaluation and adoption
    - Streamline SOP updates

Conclusions:

The Value Engineering Team found a significant number of opportunities that, if implemented, will have a dramatic impact on the efficiency of water quality data collection and processing within the USGS. Detailed information on the team's findings can be found in an Action Item list (Appendix D) organizes action items into categories and identifies short-term and long-term goals along with responsible parties, a 9-Square diagram (Appendix D) is a visual tool for prioritizing action items.

The most significant opportunity is the transition to automated data entry and automated record processing, i.e. paperless. This transition has started with the emergence of the Continuous Hydrologic Instrumentation Monitoring Program (CHIMP) but a great deal more can be gained through further automation, software development, and broader

adoption throughout the USGS. Although an automation and paperless initiative will have a large impact the implementation effort is significant. Several other opportunities have been identified that have less potential impact but are relatively easy to implement and could be accomplished quickly, such as the reduction of consumable use and SOP modifications.

A strong suggestion from the Value Engineering Team is to initiate a continuous water quality workgroup, similar to the Hydroacoustic Work Group (HaWG), to take on issues related to water quality sensors and data processing. Involvement of the private sector is encouraged for issues related to technology and cooperation between other workgroups within the USGS is encouraged for common issues such as record working and monitoring platforms. Coordination with other sensor workgroups outside of the USGS is also encouraged such as the NWQMC Sensor Workgroup and the Alliance for Coastal Technologies. To be successful this group should be granted decision making powers and report directly to the Office of Water Quality. The group could play an important role in following through with several of the action items of this value engineering study as well as further developing a technology adoption process.

We would like to thank the USGS for opportunity to evaluate and provide input to water quality monitoring process and we look forward to continuing the work started in this project through the proposed sensor workgroup.

APPENDICES INCLUDED:

- **A: Value Engineering Project Team**
- **D: Action Items & 9-Square (tool for prioritizing action items)**

APPENDIX A

Value Engineering Team:

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APPENDIX D

#	CATEGORY	SITE	PROPOSAL	SHORT-TERM SOLUTION	LONG-TERM SOLUTION	WSCs	HIF	NWQMC SW	FICS	Vendors	NWIS	RMS	SWUG	OWQ	OSW	OWI	ESC	AI
1	**AUTOMATE**																	
1A	**Streamline data entry**	NC	Go Paperless through electronic data collection	Implement CHIMP (WSCs)	Automate data processing through connecting various software packages	X		X	x	X	x	x	x	x	X	x	x	
1B		NC	Modify ADAPS	Allow data corrections and processing for all meters in one window--save time, reduce errors/improve data quality					x		x		x	x	x	x	x	x
1C		KS	Ability to edit & process multiple parameters simultaneously	Modify GR-SAT	Develop New Software						x		x	x			x	x
1D		KS	Reduce Data Entry Time & Errors into RMS		Automate CHIMP data entry into GR-SAT and then to RMS				X	X	x		X	x		x	X	X
1E		KS	Streamline Software - Challenge to train and use multiple SW packages		Integrate and streamline funtctionality of multiple software and apps to single tool				x		x	x	x	X	X	X	X	
1F		KS	Eliminate Duplication in Data Entry		Connect NWIS to RMS to enter age status once						X	X	x	x	x			
1G		KS	Reduce Duplication in Record Working		Develop record processing in CHIMP, Site-Visit, GRSAT				X		x	x	X	X	X	X	X	
1H		KS	Reduce Data Entry Time in Field	CHIMP Implementation (FICS)	Automate Data Entry from Equipment to CHIMP				X	X	X		x	x				
1I	**Calculate Uncertainty in Time Series Data**	KS	Automate Uncertainty Calculation in Time Series Data	Vendors to Standardize Accuracy Specfications (Vendor/NWQMC Sensors workgroup)	Modify CHIMPS and NWIS to enter necessary data & Develop fouling corrections			X	x	X	X		X	X	X		x	x
1J		KS	Display Uncertainty in Time Series Data		Modify NWIS to store and Display uncertainty gradations						X		X	X	X			
1K	**Improve Yield of Final Data Review**	KS	Develop Future State Map (see SWUG Software Document)			X		X			x		x					
1L		KS	Reduce Data Entry Errors	Implement CHIMP (WSCs)	Automate Process in Ver.2 of CHIMP	X			X				x	x		x	x	
1M		KS	Eliminate Partial Days (P Days) in Data Record	Use Field Meter to fill in gaps in record during field visits (WSC, Tech Memo from OWQ)		X			x				x	X				
2	**REDUCE WASTES**																	
2A	**Reduce Consumables**	KS	Conduct testing and Modify SOPs to reduce rinsing with standards	Modify SOPs at WSCs	Modify SOP's-Separate Wagner from NFM and regular review of SOP's & Design sensors to require less standard	x	x			X				x				
2B	**Extend Life of Monitoring Equipment**	KS	Develop Documentation Specific to Long Term Monitoring (cal, maint, …)		NWQMC Sensor Workgroup to develop guidelines using current technologies	x				x				x				

2C	**Reduce Time**	KS	Reduce time for Pre and Post Field Site Visit Work	WSC Layout to Minimize Walking between Lab, Storage, Staging, etc..	Develop 'Cart' for streamlined loading/unloading of field equip and use as platform in Field	X				X				X	X			
2D		KS	Streamline Field Work		Develop 'Cart' for streamlined loading/unloading of field equip and use as platform in Field	X				X								
2E		KS	Improve Sensor and Sonde Reliability and Durability			x				x								
2F		KS, NC	Investigate Time Benefits of Sonde Swap-Outs	Pilot at KS-WSC		x												
2G		KS	Eliminate Duplication of Equipment Cleaning in Field	Edit SOP to instruct 1 field cleaning (WSCs)		X												
2H		KS, NC	Reduce Probe Rinsing	Test rinsing requirements and modify SOPs accordingly		X	X							X				
2I		NC	Wireless comm on Laptops/Phones to test telemetry before leaving Field	Provide wireless Field devices, modify SOP	Modify Field Guidelines, Approve wireless devices for field techs	X			x					X				
2J		NC	Employ DCPs with 2-Way Comm for Remote Comm, Troubleshooting, etc…	Technology exists, modify field site design (WSCs)		X	X			X				X		X		

3 REDUCE FREQUENCY OF SITE VISITS

3A	**Antifouling Technologies**	KS, NC	USGS Evaluate and Approve specific technologies	Identify USGS Entitiy to assume responsibility (OSW, HIF, WSC)	NWQMC Sensor Workgroup to develop guidelines using current technologies	X	X	X		X				x	X			
3B		KS	Improve Sensor Technology (stable, robust, less sensitive to fouling)		Vendors, NWQMC Sensor Workgroup			x		x								
3C		KS	Improve Sensor Diganostics to detect problems remotely	Research existing technologies (Vendors, OSW, HIF, NWQMC Workgorup)	Improve technologies		X	X		X				x	X			
3D		KS	Forecast Sensor Susceptability to Fouling/Drift in Specific Environments	Statistical Analysis of Historical Data (KS-WSC)	Time Series Analysis w/Field Visits	X				X								
3E		KS	Rate Sensors to Susceptabiltiy of Fouling Drift in Specific Environments		Standardized testing and reporting procedures		x	X		X								
3G		KS, NC	Develop a Sensor that detects Fouling		R&D on appropriate sensing technologies	x	x			X								

4 CONTINUOUS IMPROVEMENT

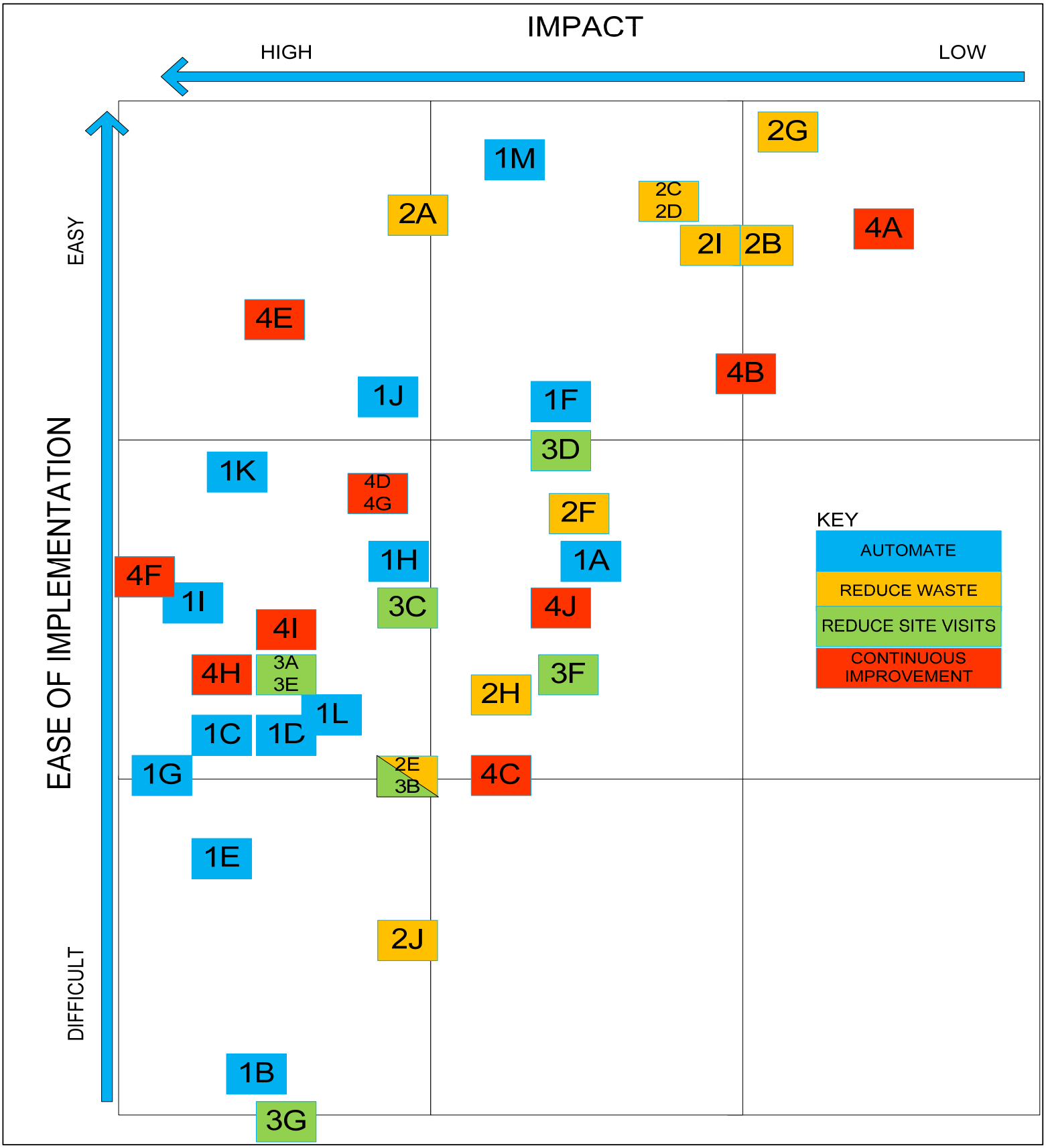
4A		NC	Develop training tools for 5S - Save Time, Eliminate Waste		OWQ incorporate into QW field courses	X		X		X				X				
4B		KS	Develop Water Qualtiy Sensor Workgroup	Intitate new work group with USGS and vendors, similar to HAWG for SW (P.Rasmussen)		X								x				
4C		KS	Streamline Integration of Sensors		Standard comm portocols, evaluate PUCK				x	X								

4D		KS, NC	Streamline Adoption of New Technologies		Future Value Engineering Team Exercise, Sensor Workgroup			x		X				X				
4E		NC	Improve DO Data Quality	Edit SOP to utilize water bath for DO calibration (see YSI Tech Note)		X	x	X						X				
4F		NC	Improve DO Data Quality	Edit SOP based on manufacturer documentation, current SOP based on old technology		X	x							X				
4G		NC	Process to Update SOPs Based on New Technology and/or Data		Address in Sensor Workgroup		x	x						X				
4H		NC	Edit Calibration SOPs for SC and pH to Improve Data Quality	SC--calibrate with high standard (out of noise range and env impacts), pH-eliminate calibrate at 10 (R. Mooney) only a check due to possible buffer problems		x	x			x				x				
4I		NC	Conduct Post Calibration in Lab to Improve Data Quality & Save Time			x								x				
4J		NC	Implement Overnight Calibration Check - Reduce liklihood of problems in Field	Modify SOPs at WSCs	Modify USGS Filed Guide	X	x							X				

ACRONYM INDEX

AI	Aquatic Informatics (Private Software Company)
CHIMP	Continuous Hydrologic Instrumentation Program
ESC	for the National Water Information System (NWIS)
FICS	Field Computing Integration and Support
GR-SAT	Aquatic Informatics Software developed for USGS (Graphical Rating and Shift Analysis Tool)
NWQMC	National Water Qualtiy Monitoring Council
NWIS	National Water Information System
OWQ	Office of Water Quality - USGS
OSW	Office of Surface Water - USGS
RMS	Record Management System
SWUG	Surface Water User Group
WSC	Water Science Centers

APPENDIX D


IMPACT
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