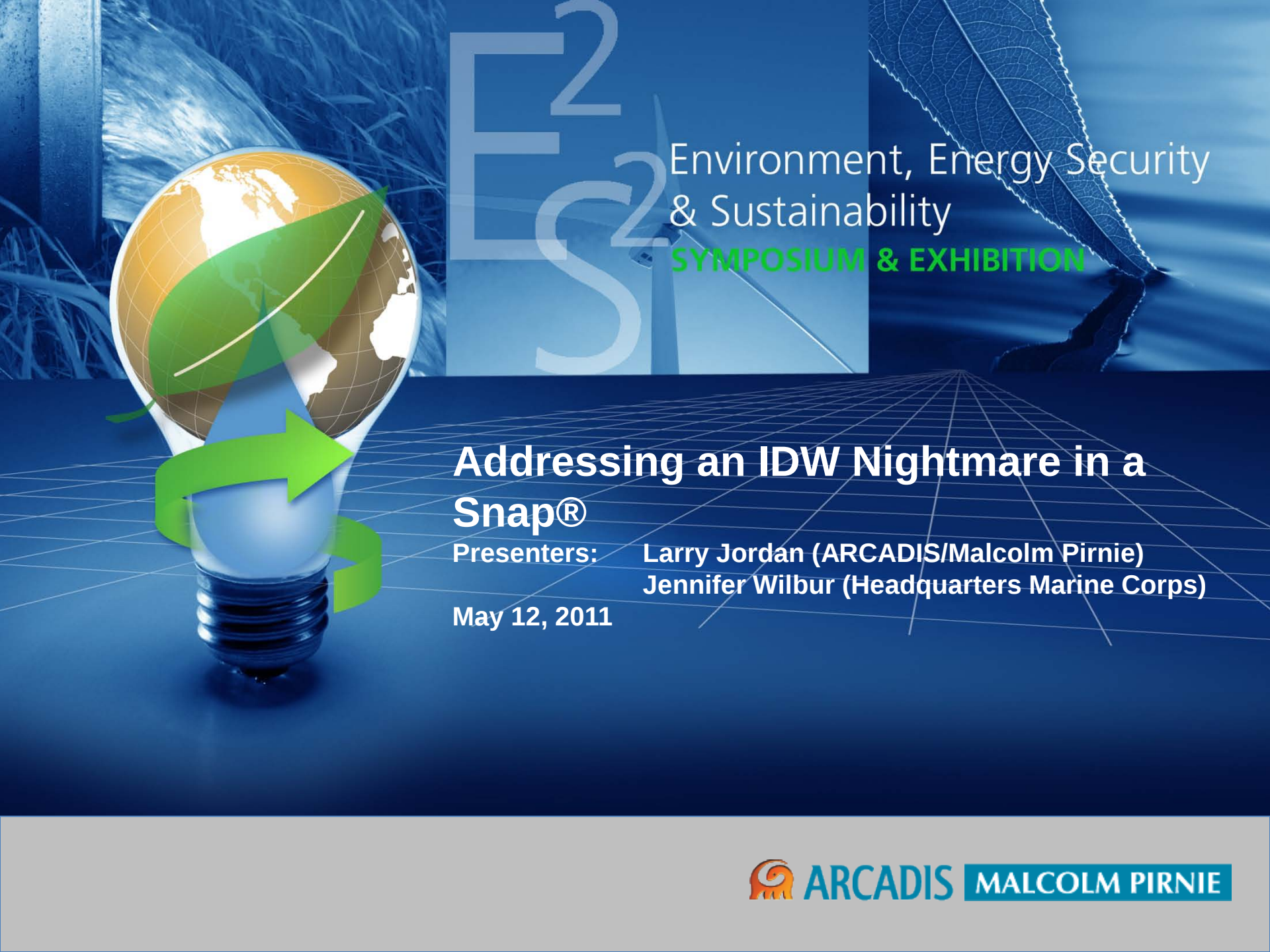




Environment, Energy Security
& Sustainability

SYMPOSIUM & EXHIBITION

Addressing an IDW Nightmare in a Snap®

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May 12, 2011

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE 12 MAY 2011		2. REPORT TYPE		3. DATES COVERED 00-00-2011 to 00-00-2011	
4. TITLE AND SUBTITLE Addressing an IDW Nightmare in a Snap?				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) ARCADIS/Malcolm Pirnie,630 Plaza Drive, Suite 200 ,Highlands Ranch,CO,80129				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 9-12 May 2011 in New Orleans, LA.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 12	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

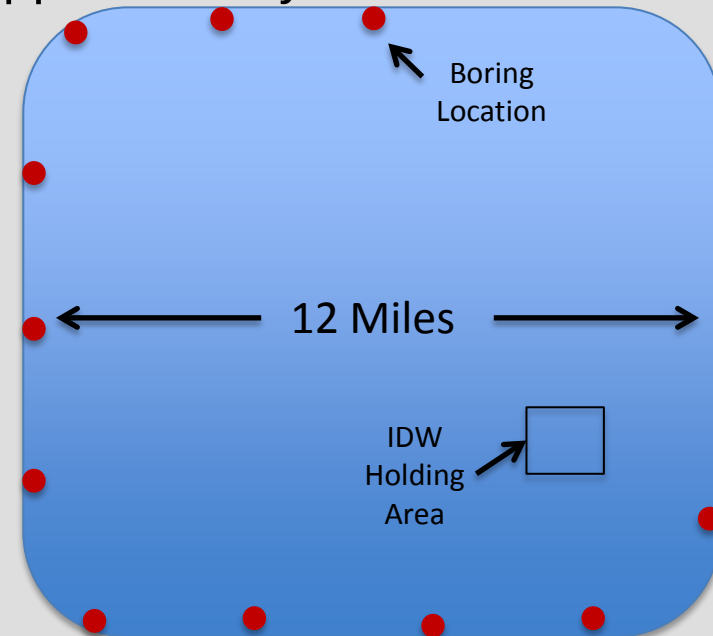
Project Overview

- Headquarters Marine Corps (HQMC) has been proactively assessing munitions loading areas as part of the Range Environmental Vulnerability Assessments (REVA)
- ARCADIS / Malcolm Pirnie completed an installation-wide assessment of the groundwater pathway of a large installation on the East Coast of the U.S.
 - Installed eleven 6-inch inside diameter open bedrock wells surrounding the perimeter of the installation
 - Well design replicates receptor wells off-installation
 - Wells were installed on-installation down gradient of potential loading areas and up-gradient of receptor locations
 - Conducted down-hole geophysical survey to identify water producing zones and to determine aquifer properties in the fractured bedrock aquifer

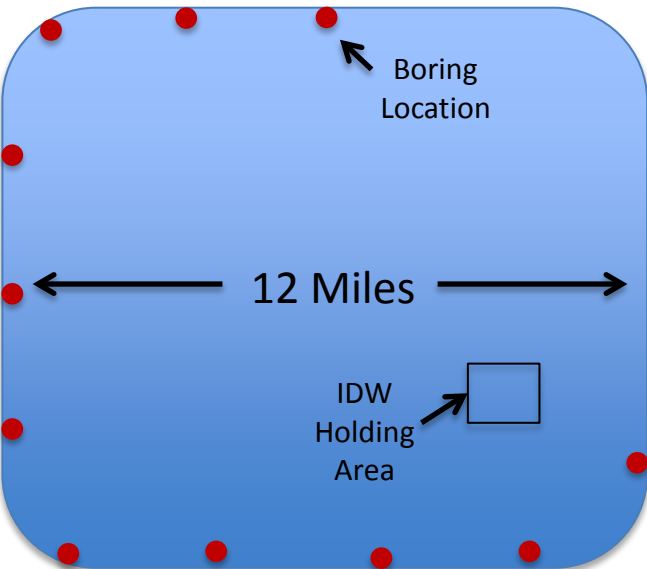


Project Overview Continued

- Project team was initially scoped to sample wells using traditional purge and sample method of removing three well volumes
- Installation requested that all purge water be containerized and stored in one location during characterization
 - Installation is approximately 12 miles in diameter and
 - 40 miles in circumference
- Team developed costs for various scenarios to deal with large volumes of purge water

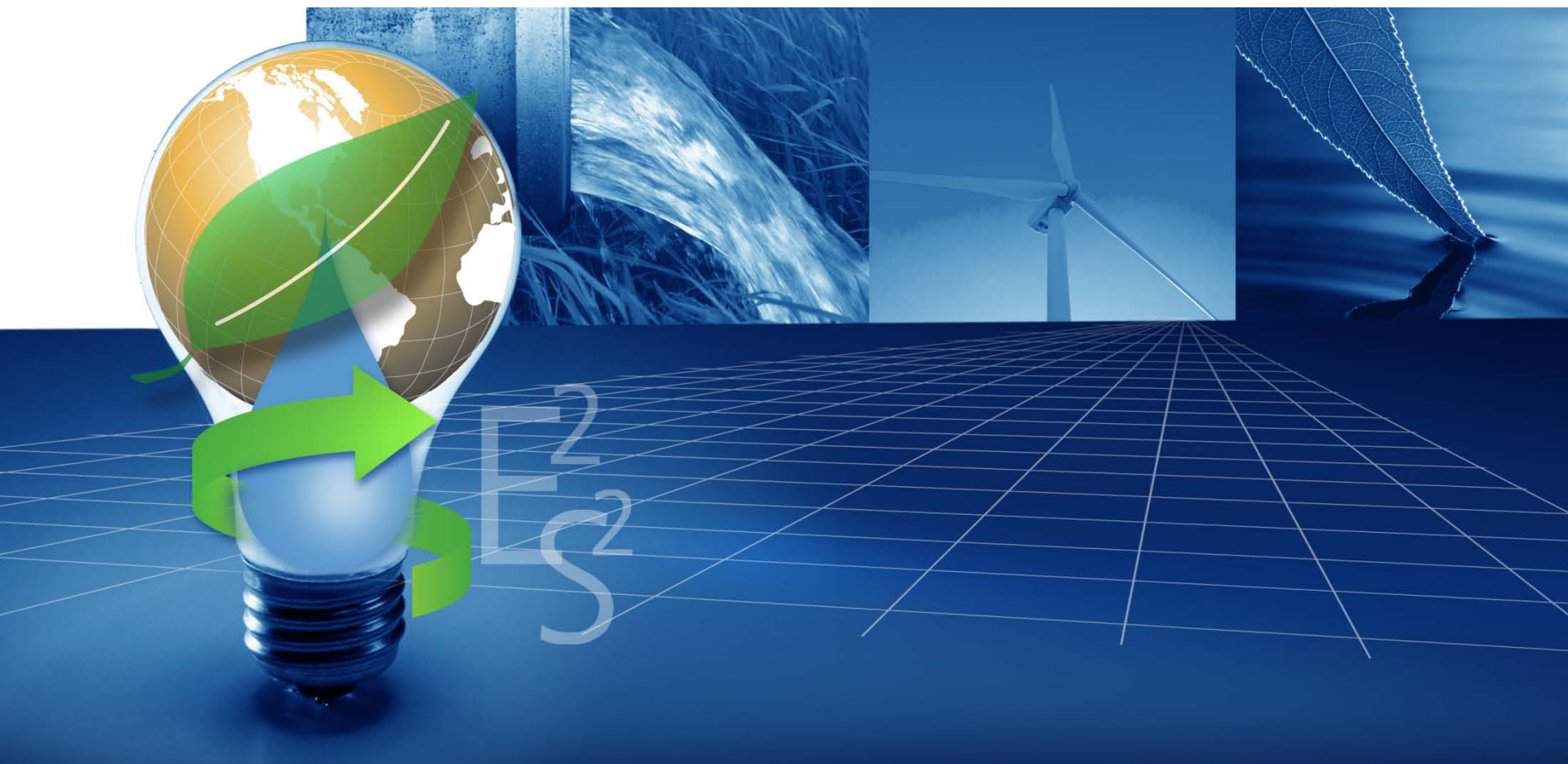


Project Overview Continued



- Numerous cost estimates were developed using different techniques to deal with purge water.
- All scenarios were considered cost prohibitive because
 - Access to the area would be difficult due to the large size of the installation and range and training activities which occur boundary to boundary
 - Individual runs to a centralized holding area would be up 40 miles round trip
 - Access to boring locations often limited equipment that could be utilized
 - Because of the size (6-inch I.D) and depth (200 to 502 feet) of the wells the volumes to be removed from each well varied from 720 to 2,100 gallons
- The minimum cost for one sampling event was estimated at ~\$120,000





Alternative Sampling Methods

- The ARCADIS / Malcolm Pirnie team conducted an evaluation of numerous passive and grab sampling options
- Sampling methods that were evaluated would need to meet numerous criteria for additional evaluation
 - Provide adequate sample volume
 - Because of the large suite of analytes and particularly explosives
 - Either be inexpensive to deploy numerous times or reusable if dedicated to a well and sampling interval
 - Provide defensible reproducible sample results for all anal a down-hole geophysical survey to identify water producing zones and to determine aquifer properties in the fractured bedrock aquifer ytes
 - Can be deployed in open bedrock wells under less than ideal conditions



Alternative Sampling Methods

- Based upon the evaluation conducted for the site-specific set of circumstances of this investigation, the ARCADIS / Pirnie team and project stakeholders narrowed the viable technology to grab-type samplers
 - The passive diffusion-based samplers evaluated were not considered as viable options for sampling the full analyte suite required for this project
 - The large molecule explosives may have difficulty passing through sampler materials
 - Longer equilibration times may be required necessitating additional mobilizations
 - May not produce enough volume for QA/QC samples
 - ARCADIS / Pirnie team has utilized grab-type samplers at other sites and completed reproducibility studies for regulators



Snap Sampler®

- The Snap Sampler® was chosen as the most appropriate grab sampling equipment for the project
 - Samplers are able to be connected in-line to provide adequate volume for the full analyte list
 - The sampler materials are compatible with all of the analytes
 - Sampling materials are robust enough to be utilized for repeated sample collection and also in a open bedrock well
 - Cost savings allowed two sampling events to be completed



Field Methods

- The ARCADIS / Pirnie Team developed standard operating procedures with input from ProHydro, Inc.
- Up to three sampling intervals were chosen from each well based on the results of the down-hole geophysical survey
- Samplers were placed in wells on the first day of the sampling event with the order and time being noted
- The samplers were triggered electronically the following day in the same order
- After being pulled from each well, the samples were decanted into containers and shipped to the laboratory
- At locations where QA/QC samples were collected, half the analytes were collected after the first 24-hour period. The samplers were replaced and the remaining analytes were collected the following day



Analytical Results

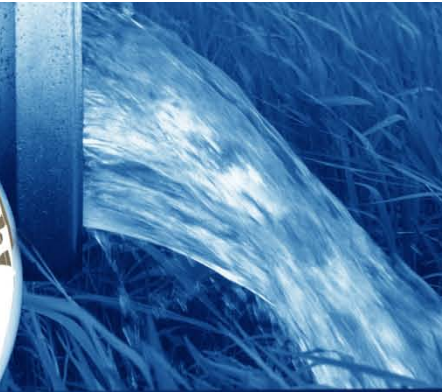
- Wells were sampled in August and October 2009
- Two explosives and perchlorate were detected at 5 of the 11 locations
 - All concentrations were approximately three orders of magnitude below screening values
 - Perchlorate was detected in the same wells at comparable concentrations during both sampling events
 - Explosives were only detected during the second sampling event
- Wells were sampled using purge methods in Summer 2010 with water discharged to the ground surface based on the results of the Snap Samples
 - Perchlorate results were comparable to previous sampling efforts



Conclusions

- ARCADIS / Malcolm Pirnie evaluated numerous passive-diffusion and grab samplers to provide a cost effective sampling alternative for sampling groundwater
- Based on the analyte list and other site specific conditions, grab samplers and particularly the Snap Sampler® was chosen for use at the site
- The total cost for two sampling events was approximately 1/3 the cost of the most cost effective traditional purge method with waste water handling
- Samplers were very easy to use in the field
- Data collected during two sampling events was defensible and reproducible





Questions?