

# ENVIRONMENTAL BUSINESS JOURNAL®

Strategic Information for a Changing Industry

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AI & Digitalization

Environmental Business International Inc.

## AI IS MAKING RAPID ADVANCES ACROSS ENVIRONMENTAL CONSULTING

*From Labor-Driven Services to Intelligence-Driven Delivery*

### Introduction: AI in the Environmental Industry

For humankind, artificial intelligence has been characterized as everything from an existential crisis threatening our quasi-natural way of living to the technology that will open the door to a utopian future, where work weeks are limited and human lives are increasingly devoted to leisure, adventure and creative self-expression. These are provocative long-term visions, but they are exaggerated and not especially practical for understanding where AI is today.

For the environmental industry, artificial intelligence has also been framed in near-existential terms, particularly for certain professional functions. Yet in practice, AI may prove to be another powerful wave of technology that enables qualified subject-matter experts to multiply and accelerate their efforts in delivering solutions for clients, communities and the planet.

In this review, Environmental Business Journal seeks to characterize where AI stands in its still-early stages of implementation across the environmental industry, with particular emphasis on the consulting & engineering segment. Executive interviews and recent EBJ survey results provide a benchmark of company initiatives and a comparative review of how industry leaders are approaching AI strategy, governance, workflow integration and enterprise adoption.

Digitalization consultants and AI platforms inevitably offer their own perspectives on the subject, including advice on

implementation phases, workflow redesign and enterprise deployment. But for environmental firms, several practical issues remain central: the depth and quality of captive databases; security protocols around internal and client datasets; the accuracy and traceability of AI-assisted outputs; and the level of human review required to assure quality before AI-enabled work is integrated into client delivery.

Expert advice, engineering designs, permit applications, environmental reports and related work products often require the signatures of project managers, environmental professionals or professional engineers. These outputs demand the confidence of clients and the management of firms ultimately responsible for reputation, quality assurance and, in some cases, legal liability. For transparency and defensibil-

## Inside EBJ: AI & Digitalization

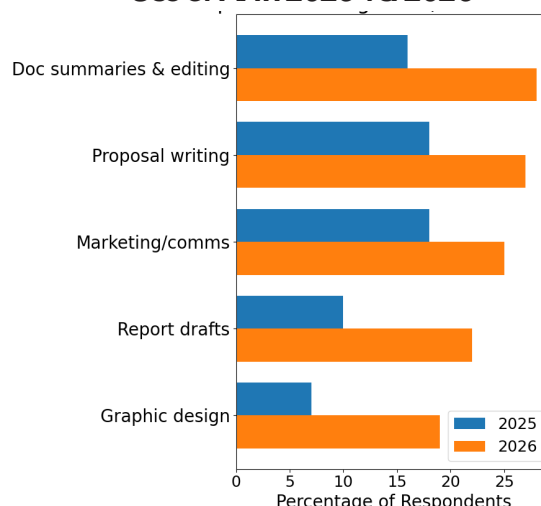
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### Use of AI in 2025 vs 2026

Use of AI	2026 Response	2025 Response
Document summaries & editing	28%	16%
Proposal preparation & writing	27%	18%
Website/marketing/comms	25%	18%
Document drafts for reports/permits	22%	10%
Graphic design & image creation/edits	19%	7%
Client communication & memos	18%	10%
Data QA & summary	14%	10%
Permitting & regulatory analyses	13%	n/a
Field data reporting & compilation	11%	n/a
Original code & code edits	8%	9%
Site assessments (Phase I/II)	6%	n/a

Source: EBJ Outlook surveys in 2025 and 2026; Question: Indicate how your company is using AI platform systems today (outside of default AI-tools embedded in search engines or inside mainstream software). Note: Average usage based on weighted factors of 8 options.

### Use of AI in 2025 vs 2026



Source: EBJ Outlook surveys in Q1 2025 and Q1 2026. Average usage by staff based on the responses presented in the table below.

### Use of AI in Environmental Services Companies in Q1 2026

	Forbidden	Not Using Yet	<10% of our staff using	10-30% of staff using	30-50% of staff using	50-70% of staff using	70-90% of staff using	90-100% of staff using
Proposal preparation & writing	3%	10%	30%	23%	17%	7%	3%	7%
Website/marketing/comms	0%	23%	23%	23%	13%	13%	6%	0%
Document summaries & editing	3%	7%	23%	37%	13%	7%	7%	3%
Original code & code edits	4%	50%	27%	12%	4%	4%	0%	0%
Graphic design & image creation/edits	3%	10%	38%	28%	17%	0%	0%	3%
Field data reporting & compilation	3%	24%	48%	17%	3%	3%	0%	0%
Site assessments (Phase I/II)	0%	50%	39%	7%	4%	0%	0%	0%
Permitting & regulatory analyses	7%	28%	31%	28%	3%	0%	0%	3%
Data QA & summary	7%	21%	34%	24%	10%	3%	0%	0%
Document drafts for reports/permits	7%	14%	21%	39%	4%	7%	4%	4%
Client communication & memos	7%	17%	34%	21%	10%	7%	3%	0%

Source: Environmental Business Journal: EBJ Annual Outlook Survey 2026. Q: Please indicate how you and your company are using or plan to use AI platform systems today (outside of default AI-tools embedded in search engines or inside mainstream software) and comment on expected use or workflows in the near future.

ity, the traceability of workflow outputs in combined human-and-AI endeavors cannot be ignored, even when it is not explicitly included in the final work product.

At the same time, these concerns cannot be used as an excuse for inaction. The environmental services industry is built on a wide and diverse base of scientific, technical, engineering, regulatory and project-management talent. AI creates an opportunity for creative experimentation across that human resource base, provided firms maintain appropriate governance, security and professional accountability.

By mid-2026, AI in the environmental industry is no longer in its infancy, but it has not reached maturity. The broad

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## GZA TECHNICAL SPECIALIST SEES AI TRANSFORMING REMEDIATION TO AN ADAPTIVE DATA-DRIVEN CONTINUOUSLY OPTIMIZED PROCESS

**GZA GeoEnvironmental Inc.** (GZA) is a leading multi-disciplinary, employee-owned firm providing environmental, ecological, water, geotechnical, and construction management services. Headquartered in Norwood, Mass., GZA has 35 offices throughout the country. GZA was ranked on EBJ's list of top environmental consulting & engineering firms in 2024 with environmental C&E revenues of \$129 million out of \$204 million gross revenues.

**Matthew Gozdor, Senior Technical Specialist.** Mr. Gozdor is a quantitative hydrogeologist focusing on groundwater modeling with MODFLOW/MODPATH/MT3DMS, and the PEST suite including ensemble solvers. He also uses machine learning techniques with Pastas to simulate groundwater and provides forensic evaluation of groundwater issues, water supply studies, contaminant hydrogeology evaluations, well hydraulics analysis, and data science with Python.

### **EBJ: How is AI enhancing groundwater flow and contaminant transport modeling compared to traditional approaches?**

Gozdor: Artificial intelligence (AI) is enhancing groundwater flow and contaminant transport modeling by augmenting traditional physics-based approaches with faster computation, improved data integration, and more flexible representation of subsurface complexity. While conventional models (e.g., MODFLOW) remain essential for their physical rigor and regulatory acceptance, they are often limited by computational demands, parameter uncertainty, and simplified representations of heterogeneity.

AI addresses these challenges by enabling the development of surrogate models that dramatically reduce runtimes, supporting rapid scenario testing and uncertainty analysis. In addition, machine learning techniques can assimilate diverse datasets such as borehole logs, geophysics, climate data, and water quality observations to better characterize hydraulic properties and refine predictions of groundwater flow and plume migration.

In practice, surrogate models are fast approximations of detailed numerical models like MODFLOW 6 that allow scientists and engineers to explore far more scenarios than would otherwise be feasible.

These are often built using machine learning techniques such as Random Forests, neural networks, or Gaussian process models, which learn the relationship between inputs (e.g., hydraulic properties, stresses) and outputs (e.g., heads or concentrations) from a set of model runs.

While approaches like physics-informed neural networks (PINNs) and data space inversion (DSI) are sometimes discussed alongside surrogate models, they are better thought of as complementary methods that either embed physics directly into the learning process or reduce the computational burden through alternative formulations rather than purely emulating model outputs.

The most significant advancement lies in hybrid modeling frameworks that combine physics-based models with AI. In these approaches, governing equations maintain physical realism, while AI improves calibration efficiency, parameter estimation, and predictive performance. AI is also advancing contaminant transport modeling by identifying patterns in concentration data, supporting source differentiation, and improving plume forecasting in complex hydrogeologic settings. Although challenges remain, including data dependency, interpretability, and regulatory acceptance, AI is transforming groundwater modeling into a more adap-

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*AI helps move remediation from a design-once approach to a continuously optimized, performance-based process.*

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tive, data-driven discipline. The result is a shift from static, computationally intensive analyses toward dynamic systems capable of supporting real-time decision-making and more effective environmental management.

### **EBJ: Are you seeing a shift toward predictive remediation strategies, where interventions are optimized before implementation?**

Gozdor: Most remediation systems in the field today are legacy systems that were designed under older paradigms often conservatively, and with limited flexibility for real-time optimization. Retrofitting these systems to support predictive or adaptive control (e.g., adding sensors, automation, or data infrastructure) comes with real costs, and those costs are not always easy to justify, especially for smaller sites or where regulatory drivers are minimal.

As a result, adoption is uneven. In the near term, the industry is more likely to see incremental integration that uses predictive tools to improve design and periodically refine operations rather than a wholesale shift to fully optimized, continuously adaptive systems.

Over the next few years, broader adoption will likely depend on a combination of factors: declining costs of monitoring and automation technologies, stronger regulatory acceptance of data-driven approaches, and clear demonstrations that predictive strategies can reduce lifecycle costs and shorten remediation time frames. Until then, predictive remediation should be viewed less as the current standard and more as an emerging capability that is beginning to influence how the most complex and high-stakes sites are managed.

### **EBJ: How reliable are AI-driven models today when dealing with highly complex subsurface conditions?**

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*Broader adoption of AI in remediation will depend on a combination of factors: declining costs of monitoring & automation technologies, stronger regulatory acceptance of data-driven approaches, and clear demonstrations that predictive strategies can reduce lifecycle costs and shorten remediation time frames.*

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Gozdor: AI driven models have demonstrated strong potential in handling complex subsurface conditions, particularly where large, high-quality datasets are available. In such settings, machine learning approaches can capture nonlinear relationships, integrate diverse data sources, and identify patterns in hydraulic properties and contaminant behavior that are difficult to represent explicitly in traditional models. When used in conjunction with physics-based frameworks, AI can improve calibration efficiency, reduce uncertainty, and enhance predictive performance.

For site-specific applications with dense monitoring networks or long-term datasets, AI-driven or hybrid models can provide reliable and actionable insights, especially for tasks such as plume forecasting, parameter estimation, and scenario evaluation.

However, their reliability is more limited in data-sparse environments or where subsurface conditions fall outside the range represented in the training data. Purely data-driven models may struggle to extrapolate and can produce physically unrealistic results if not properly constrained. As a result, the most reliable applications today are hybrid approaches that incorporate governing equations or are anchored to established numerical models.

These frameworks preserve physical consistency while leveraging AI's strengths in pattern recognition and computational efficiency. In practice, AI-driven models are best viewed as complementary tools that are highly reliable when applied within well-defined bounds and supported by adequate data, but still requiring expert oversight and validation in complex hydrogeologic settings.

**EBJ: How does AI help balance cost,**

**performance, and long-term liability in remediation strategy selection?**

Gozdor: AI helps move remediation from a design-once approach to a continuously optimized, performance-based process. This approach directly affects cost, effectiveness, and long-term liability. Traditionally, systems such as pump-and-treat or in-situ injection are designed using a limited number of design scenarios and then adjusted periodically. This can lead to inefficiencies and potentially longer remediation times. With the traditional design and operation approach systems can potentially be over or under designed. With AI-assisted workflows, supported by physics-based models such as MODFLOW 6, practitioners can evaluate thousands of scenarios during design and then continue optimizing system performance as new data are collected. This enables more precise targeting of contaminant mass, better control of plume migration, and improved alignment between system operation and site conditions.

**EBJ: What are the biggest data gaps that limit AI effectiveness in environmental remediation today?**

Gozdor: The effectiveness of AI in environmental remediation is fundamentally constrained by the availability, quality, and representativeness of subsurface data. One of the most significant gaps is the limited spatial and vertical resolution of hydrogeologic characterization. Data on hydraulic conductivity, porosity, and stratigraphy are typically sparse, unevenly distributed, and

biased toward accessible locations such as monitoring wells.

This makes it difficult for AI models to learn reliable representations of subsurface heterogeneity, particularly in complex environments with preferential pathways or discontinuous units. Similarly, contaminant concentration data are often temporally intermittent and collected at relatively few locations, limiting the ability of AI to accurately capture plume dynamics, reaction processes, and long-term trends.

Another major limitation is the lack of integrated, high-quality datasets that combine physical, chemical, and operational information. Critical inputs such as recharge, pumping histories, remediation system performance, and geochemical parameters are frequently incomplete, inconsistently measured, or stored in incompatible formats. In addition, there is often a shortage of labeled data for key tasks such as source identification or classification of contaminant plumes, which restricts the use of more advanced supervised learning methods. These gaps are compounded by limited long-term monitoring datasets, which are essential for training models to predict future system behavior under changing conditions.

Addressing these challenges will require more comprehensive data collection strategies, standardized data management practices, and greater integration of emerging data sources such as remote sensing and real-time monitoring systems.

**EBJ: How is AI changing the day-to-day work of hydrogeologists and environmental engineers in the field?**

Gozdor: AI is beginning to shift the day-to-day work of hydrogeologists and environmental engineers from manual, time-intensive tasks toward more efficient, data-driven workflows. Routine activities such as data processing, quality control,

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*The effectiveness of AI in environmental remediation is fundamentally constrained by the availability, quality, and representativeness of subsurface data.*

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and visualization which have historically required significant effort in spreadsheets or scripting can now be automated or accelerated using AI assisted tools. This allows practitioners to spend less time on data wrangling and more time interpreting results and refining conceptual site models.

In the field, AI is also enhancing real-time decision-making by integrating sensor data (e.g., water levels, water quality) with predictive models, enabling more responsive sampling strategies and adaptive management of monitoring and remediation systems.

At the same time, AI is changing how professionals approach modeling and analysis. Calibration, sensitivity analysis, and scenario testing can now be performed more rapidly using AI assisted optimization and surrogate models. This enables practitioners to evaluate a wider range of conditions and uncertainties within typical project timelines.

As a result, the role of the hydrogeologist or engineer is evolving toward one that emphasizes critical evaluation of model outputs, integration of diverse datasets, and clear communication of uncertainty and risk. While domain expertise remains essential, AI is augmenting it by providing faster insights and expanding the scope of what can be analyzed in both field and office settings.

**EBJ: How are regulators responding to AI-driven analyses?**

Gozdor: Regulators are generally approaching AI-driven analyses with cautious interest. At present, most agencies still require that groundwater flow and contaminant transport evaluations be grounded in established, physics-based models such

as MODFLOW 6. These models are well understood, transparent, and have a long track record in regulatory decision making.

As a result, AI is generally not accepted as a standalone basis for compliance decisions, remedy selection, or liability determinations. Instead, regulators view AI as a supplementary tool that is useful for screening, sensitivity analysis, or scenario exploration, but not yet a substitute for traditional modeling approaches. Establishment of the **Interstate Technology & Regulatory Council (ITRC) AI/Machine Learning Team** should help provide guidance to regulators.

**EBJ: Are you building proprietary AI tools, or leveraging external platforms?**

Gozdor: We are primarily leveraging established, open-source analytical tools and methodologies rather than developing proprietary AI platforms. Our work integrates domain-specific models and data-driven techniques using widely accepted libraries and frameworks.

For example, we are using time series modeling with Pastas, semi-supervised learning methods such as label spreading for plume differentiation, and multivariate statistical techniques like principal component analysis (PCA) and hierarchical clustering (dendrograms) for source evaluation. These approaches are implemented in reproducible environments (e.g., Python based workflows) and are fully transparent and auditable.

This strategy is intentional. In environmental consulting, defensibility and clarity are critical, particularly in regulatory and legal contexts. By relying on well-documented, peer-reviewed methods and open tools, we ensure that our analyses can be re-

viewed, reproduced, and clearly explained to regulators, stakeholders, and clients. While we may develop custom scripts and workflows tailored to specific sites, these are built on established techniques rather than proprietary “black box” AI systems, allowing us to balance innovation with reliability and regulatory acceptance.

**EBJ: What will remediation of a site look like in 2–3 years if AI adoption accelerates? And what other technologies could also have a huge impact?**

Gozdor: In the next 2 to 3 years, if AI adoption accelerates, remediation projects will likely become more adaptive, data-driven, and continuously optimized rather than relying on periodic evaluations and static designs. Site conceptual models will be updated in near real time as new monitoring data are collected, with AI-assisted tools rapidly assimilating groundwater levels, chemistry, and operational data from remediation systems. This will allow practitioners to adjust pumping rates, injection strategies, or treatment system operations much more frequently.

This could happen potentially on a weekly or even daily basis rather than waiting for quarterly reviews. Additionally, AI models could be used to change system operations based on predicted future events such as heavy rainfall or flooding. Modeling workflows built around tools like MODFLOW 6 will still anchor the physics, but AI-driven surrogates and optimization routines will enable rapid scenario testing and uncertainty analysis, leading to more efficient system designs and possibly shorter remediation time frames. P

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*Regulators view AI as a supplementary tool that is useful for screening, sensitivity analysis, or scenario exploration, but not yet a substitute for traditional modeling approaches.*

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