



MATRIX**NEW**WORLD

Engineering Progress

WELL DESIGN, CONSTRUCTION MANAGEMENT & TESTING

Matrix knows the drill.

Matrix New World Engineering (Matrix) is a full-service hydrogeological and environmental consulting firm. With more than 25 years of experience in groundwater hydrology, we offer a full complement of well-related services. Our professional engineers, registered geologists, and hydrogeologists are experienced in the siting, permitting, drilling, installation, and testing of all production well types, ranging from small diameter wells completed in bedrock to large diameter municipal wells completed in basin fill deposits more than 1,500 feet deep. Most projects require well siting studies and preparation of detailed technical well drilling and testing specifications for implementation by the drilling contractor.

Matrix professionals have managed hundreds of well installation projects throughout Arizona, using drilling methods that best meet the site-specific hydrogeologic conditions. Methods include dual rotary, reverse circulation, direct mud/air circulation, downhole hammer, cable-tool, and sonic. In addition, Matrix routinely integrates Arizona Department of Water Resources (ADWR) water well and hydrogeologic databases when siting and preparing preliminary/conceptual well designs. In the field, our project teams employ a variety of surface and downhole geophysical techniques to aid in the location and design of production wells. Surface methods include gravity, magnetic, and CSAMT and NSMAT surveys. Downhole methods include resistivity, gamma, neutron, sonic, temperature, caliper, conductivity, and flow (spinner) logs.

Matrix clients have included the State of Arizona, municipalities, Native American Tribal governments, utility companies, law firms, mining companies, master planned communities, engineering firms, private businesses, and individuals.

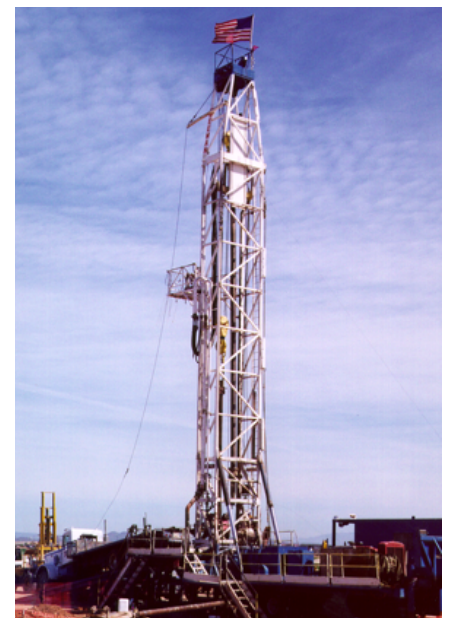
Services provided

- Well Siting Analyses
- Well Permitting
- Well Impact (spacing) Investigations
- Well Design & Installation – Production, Exploration, Monitor, & Recharge Wells
- Well Construction Oversight
- Lithologic & Geophysical Logging
- Zonal Groundwater Sampling
- Aquifer Testing & Analysis
- Spinner Flow Meter Surveys & Depth-specific Sampling
- Well Rehabilitation
- Well Abandonment

Contact

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WELL DEVELOPMENT & TESTING

Matrix passes the test.

Matrix New World Engineering (Matrix) is a full-service hydrogeological and environmental consulting firm. With more than 25 years of experience in groundwater hydrology, Matrix offers a full complement of well-related services, such as well development and testing, which are critical to the success of each well project. Conducted in both new and old wells to improve performance, well development involves the conditioning of a well. Well testing helps with the well performance evaluation, potential problem identification, and pump requirement recommendations.

Professional oversight of well development during installation optimizes initial well performance and leads to significant client cost savings, including savings in power costs, and extended well life. Well development is critical after the rehabilitation of older wells. The well rehabilitation process often leaves residual solids in the well, however, a thorough well development process ensures that these solids are removed. Matrix oversees work performed by the drilling and pump contractors to ensure that rehabilitation and development activities are optimized for the unique conditions at each well.

Well testing provides answers to specific questions. Testing of new wells provides a performance and water quality baseline, and is initially used to recommend pump setting and capacity. Testing older wells helps to examine specific well issues, including decreased well performance, water quality, or sand and/or air in the discharge. Matrix professionals use a variety of tools to test wells depending on the goals of each project.

Matrix clients have included the State of Arizona, municipalities, Native American Tribal governments, utility companies, law firms, mining companies, master planned communities, engineering firms, private businesses, and individuals.

Services provided

- Pumping and injection tests to evaluate conditions of the aquifer and well;
- Spinner flow meter surveys, temperature surveys, resistivity surveys, and depth-specific sampling;
- Hydrogeochemical analysis, stable isotope analysis, bacteria evaluation, and mass balance calculations;
- Video, televiwer and other geophysical surveys;
- Measurement of discharge parameters, including turbidity, silt, sand, and dissolved and entrained air.

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MATRIX**NEW**WORLD

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WATER SYSTEM ENGINEERING SERVICES

Matrix knows the drill.

Wells. Our professional engineers, registered geologists, and hydrogeologists have extensive experience in the siting, permitting, drilling, installation and testing of all types of wells ranging from monitor wells to high capacity municipal and irrigation wells. These projects can require well siting studies and preparation of detailed technical drilling and testing specifications for implementation by the drilling contractor. In the field, Matrix uses a variety of surface and downhole geophysical techniques to aid in the location and design of production wells.

Groundwater Treatment Systems Design/Build. In situations calling for remediation of groundwater contamination, Matrix's team of professionals can design/build groundwater pump and treat systems from the ground up, with expertise in soil vapor extraction, air stripping, liquid and vapor phase carbon, ion exchange, and filtration. System designs provide for capture and control, and include civil and electrical installation associated with sizing and developing of the equipment, piping, instrumentation, and system controls.

Water Storage, Treatment, and Distribution Systems. Whether it is clean water destined for potable use, or treated groundwater reinjected to the local aquifer or used in a green remediation initiative (golf course or municipal park turf irrigation), Matrix hydrogeologists, engineers, and certified water operators can deliver. To maximize system performance and protect public safety, Matrix provides 24-hour on-call services in the event of alarm shutdowns.

Services provided

- Siting, Permitting, Design, Installation, & Testing for Wells: Production, Monitor, Extraction, Injection, Aquifer Storage & Recovery (ASR)
- Preparation of technical specifications for well drilling and testing
- Lithologic & Geophysical Logging
- Aquifer Testing & Analysis
- Groundwater Sampling
- Pumping System Design & Installation Oversight
- Wellhead Completions
- Water Storage, Treatment, & Distribution Systems
- Water Distribution Lines – Permitting, Design, Installation
- Certified Water Operators
- 24-hr On-call Emergency Alarm Services
- Groundwater Remediation & Process Engineering Systems: Permitting, Design, Construction Oversight, Operation & Maintenance
- Effluent Reuse / Recharge
- Compliance Monitoring, Sampling, & Reporting

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MATRIX**NEW**WORLD

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WELL REHABILITATION

Matrix improves well performance.

Matrix New World Engineering (Matrix) has conducted hundreds of well rehabilitation projects over the past three decades – addressing wells experiencing production loss, declining water quality, and/or sanding. If the cause of the well problem can be identified, often rehabilitation can improve performance of the well. Typical tasks conducted in evaluating and rehabilitating a well are:

■ **Well Color Video**

Prior to well specific work, a color video survey is conducted in the well to confirm the condition of the well, static water level, depth of fill, and the extent and type of encrustation blocking the perforations.

■ **Well Cleaning**

The appropriate cleaning technique is selected to clean (open) the perforations and bail debris from the bottom of the well. Often the cleaning technique is brushing, swabbing, and bailing, but in some cases chemical treatment to break down the encrustation is required. A follow-up well video will be conducted to confirm effectiveness of the well cleaning, the percent opening of the perforations, and to see if there is any casing damage that may have been covered up by encrustation that may impact testing and sampling results.

■ **Well Development & Testing**

Once temporary test pumping equipment is installed, the well is redeveloped and tested for production and pumped water quality. Typically, multiple step-rate tests and constant-rate discharge testing is conducted, and when possible, the test results are compared to historic test data performed when the well was initially constructed.

■ **Spinner Logging & Sampling**

During well testing, spinner logging and dynamic sampling are conducted to distinguish the groundwater quality in the aquifer based on zonal sampling results collected during initial construction of the wells. The spinner log is recommended in order to identify the relative movement of groundwater into the well, and to establish the quality of that water at specific sampling points (zonal samples). This logging will help predict the long-term pumped water quality.

■ **Reporting**

Following testing and receipt of the laboratory results, a well rehabilitation report is prepared documenting all tasks conducted. Matrix provides recommendations as to the long-term viability of the well, future long-term pumping rate, and water quality.

Services provided

- Well Color Video
- Well Cleaning
- Well Development & Testing
- Spinner Logging & Sampling
- Reporting
- Well Siting
- Hydrogeological Analysis
- Well Spacing
- Well Impact Analysis

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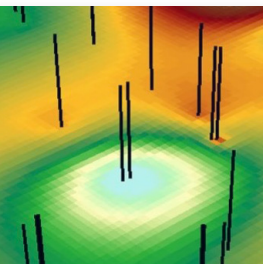
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COMPUTER MODELING

Matrix is a model service provider.

Matrix New World Engineering (Matrix) computer modeling capabilities include numerical and analytical groundwater flow modeling, aquifer test analysis and contaminant mass transport. Familiar with the latest versions of the published models and pre-processors accepted by federal and state regulators, Matrix has developed groundwater models to support applications for Assured and Adequate Water Supply (AAWS), Underground Storage Facilities (USF), adjudication of Water Rights Settlements and compliance with National Environmental Policy Act (NEPA) and Endangered Species Act (ESA) requirements. Projects range from local site-specific models of relatively small areas to models of regional and sub-regional hydrologic systems.

Matrix's highly-experienced hydrologists and computer modelers routinely use and adapt the latest regional groundwater flow models published by government agencies, including the U.S. Geological Survey (USGS) and the Arizona Department of Water Resources (ADWR). Our hydrologists and computer modelers discuss model details, assumptions, and upgrades with USGS and ADWR model authors. Matrix keeps regional models up-to-date; incorporating the most recent Assured Water Supply (AWS) approved demands. Having used the models for groundwater resource and 100-year impact evaluations, Matrix modelers are proficient at adapting the models to support the client project requirements.

We are committed to providing industry-leading hydrogeologic solutions that exceed clients' expectations. At Matrix, our hydrogeologists and computer modelers know what it takes to conduct successful groundwater flow and contaminant transport modeling projects that meet clients' needs.

Our suite of computer modeling services include those listed on the right. We implement state-of-the-art modeling techniques, enabling the use of the latest scientific advancements, such as EVS. EVS has become the foundation of Matrix's site characterization approach to evaluate complex hydrostratigraphic environments, potentiometric surfaces, water producing zones, contamination pathways, and contaminant volume.

Services provided

- Conceptual Model Development
- GIS Development & Spatial Analyses
- Numerical Groundwater Flow Modeling
- Analytical Groundwater Flow Modeling
- Aquifer Test Analysis
- Particle Tracking Analyses
- Advanced Model Calibration
- Nested & Unstructured Grids
- Predictive Uncertainty Analyses
- Advanced Flow Modeling
- Contaminant Fate & Transport Modeling
& 3D Modeling Capabilities with Earth Volumetric Studio (EVS)

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