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IHS Energy
IHS Energy is the industry's authoritative provider of analytics, insight and solutions, scaling across virtually any operation and enterprise, from ground level tactics to high level strategy.

IHS Engineering Solutions
As an integral part of our petroleum engineering and geological consulting work, IHS develops products and services that are sold, supported, and used extensively in global markets. Our innovative software incorporates the latest in technology, and provides practical and advanced solutions for reservoir engineering and production optimization projects. We remain on the leading edge of research in reservoir engineering, and implement “best practices” into our software and services.

IHS Fekete Reservoir Engineering
IHS offers strength of expertise in the interdisciplinary cooperation between our team of reservoir engineers, geologists, geophysicists, petrophysicists, production engineers, simulation engineers, and computer specialists, all with one goal to help customers to optimize production. We can provide both short-term and long-term consulting services to provide answers, analysis, and interpretation of drilling and operations results.
Well Performance Analysis Environment
A Comprehensive Desktop Engineering Application

Extract Maximum Value Out of Well Performance Data as Efficiently as Possible:
• Reads most industry standard data formats, can connect to any ODBC production database and easily exports forecasts to third party economics formats.
• Contains industry-leading data graphing and diagnostics tools.
• Contains comprehensive tools for the preparation, organization, reporting and querying of data.

Make Better Technical Decisions by Bringing the Power of Advanced, Rigorous Reservoir Models to Every Engineer’s Desktop:
• Provides sophisticated dynamic reservoir modeling in an easy-to-use interface.
• Contains industry-leading software tools for analyzing well performance from conventional and tight oil and gas, shale gas and coal-bed methane reservoirs.
• Quantify uncertainty in production forecasting and reservoir characterization using a probabilistic approach (i.e. stochastic process); commonly referred to as Monte Carlo Simulation.

Reduce IT Overhead by Combining Multiple Applications into One:
• IHS DeclinePlus, IHS RTA, IHS CBM, IHS VirtuWell.

Create a Customizable, Collaborative Environment Where Engineering Knowledge is Shared:
• Create custom templates and workflows for well performance analysis and reserves evaluation based on unique experience gained by working with your own field data.
• Access engineering knowledge from other areas within your organization through IHS Harmony’s comprehensive database back-end.

GIS:
• Select or group wells, add new well locations.
• Layer shapefiles and image files such as topographical maps or geological interpretations.
• Update existing wells directly from Enerdeq and Well Data (Canada) databases and import new wells from Enerdeq.
• Bubble map results from various analysis methods.
Analyze Production Data:
Analysis methods in IHS DeclinePlus include:

- Arps, including limiting decline.
- Stretched Exponential, Duong, and multisegment methods.
- Type Well.
- Volumetrics and Material Balance for gas and oil.
- Ratio analysis and associated forecasting.

Advanced Workflows:
- Mix and match appropriate analysis techniques into a single workflow.
- Force consistency of results between methods by linking analysis.
- Develop, save, and share hierarchies, plot templates, data grids, and custom workflows.
- Foster a consistent analysis approach across teams of analysts.

Reserve Evaluations:
- Assign reserve classifications to wells or group forecasts.
- Consolidate forecasts based on classification and hierarchy.
- Connect to industry standard economic tools.
- Quick to update, constituent changes automatically update consolidations.

Type Well Analysis:
- Normalize well production to create a type well.
- Average, P10, P50, or P90.
- Apply type wells to new locations or wells with limited data.
- Normalize rates on attributes like horizontal length, number of stages, or net pay.
Objectives:

- Identify appropriate analog wells for type well forecasting.
- Create type well decline curve for use in undeveloped locations.
- Apply type well decline curve to wells with limited production history and adjust to well performance.

Background:

- Tight gas play in Northeast B.C.
- 37 producing wells in area of interest, 2 with limited production history.
- 10 planned well locations requiring forecast for proved plus probable undeveloped reserves.

Analysis:

- Use type well decline to create average forecast for the area, EUR x Bcf.
- Apply type well forecast to wells with limited history and well locations.
- Create consolidation for field total production and compare to consolidation without locations.

Results:

- Type well decline based on the average performance of wells.
- Undeveloped locations added to GIS.
- Type well forecast applied to undeveloped locations and wells with limited production history.
- Consolidations based on reserve types for economics.
Rate Transient Analysis
Put Your Production and Flowing Pressure Data to Work

**Estimate Hydrocarbons in Place:**
IHS RTA provides multiple independent techniques for estimating original oil and gas-in-place (OOIP/OGIP) and expected ultimate recovery (EUR) without the need for shutting in the well.

**Reservoir Characterization:**
Access the most comprehensive collection of production-based methods available for determining permeability, drainage area and stimulation effectiveness. Methods range from straight-line analytics and type curves to analytical and numerical models with history matching.

**Operating Diagnostics:**
Use customizable diagnostics “dashboards” with built-in plotting functions to identify and account for data correlation problems, wellbore configuration changes, liquid loading in gas wells, measurement errors, changes in water/condensate yields and other important operational issues. Other diagnostic plots in IHS RTA can identify aquifer pressure support, well interference and well productivity loss.

**Unconventional Oil and Gas Analysis:**
Access practical, industry-leading tools for analysis of unconventional reservoir performance that combine proven empirical and analytical techniques. The Unconventional Reservoir Module (URM) is a simple yet robust tool for quickly evaluating reserves and providing bulk reservoir characterization.

**Advanced Reservoir Modeling and Forecasting:**
IHS RTA offers a comprehensive suite of easy-to-use analytical and gridded numerical models, ranging from simple single-layer bounded reservoirs to complex heterogeneous and multi-layer systems. Additional features include multi-staged fractured horizontal wells, dual porosity systems, pressure dependent permeability and rock compressibility, adsorbed gas capability and time-dependent skin. History match on rates and/or pressures using automatic multi-parameter regression and forecast future production for under a variety of different constraints.
Where Should I Drill my Next Well?

Objectives:
• Identify the optimal drilling location for an infill well.
• Determine if offset wells are interfering with the original producing well.
• Estimate total reservoir OGIP.

Background:
• Conventional gas reservoir in western Canada.
• Field had produced for one year.
• Limited shut-in data but good flowing rate and pressure data.
• Optimize production of producing wells.
• Three wells in study:
  • Primary well came on at 1.6 MMcfd.
  • First offset came on at 2.0 MMcfd.
  • Second offset was marginal producer.

Analysis:
• Traditional decline analysis (rate data only):
  • Identified ultimate recovery of ~ 1.4 Bcf.
  • Inconclusive about interference effects.
• Advanced decline analysis methods (using flowing rate and pressure data):
  • Estimated minimum reservoir OGIP of 4.8 Bcf.
  • Confirmed interference between original producing well and first offset well.
  • Defined drainage area and boundaries for each well.

Results:
• Provided justification to support the planned infill drilling program.
• Confirmed that one offset well was interfering with the original producing well.
• Generated estimate of reservoir OGIP that was substantially higher than predicted by traditional decline analysis.
• Identified optimal drilling location for new well.
Coalbed Methane Reservoir Analysis
Practical Toolkit for CBM Engineering Needs

Analysis of Production Data:
Use type curves and reservoir models to match the production data and flowing pressures. Use the matches to estimate properties such as permeability, skin, and drainage area and to diagnose problems such as liquid loading, interference and change in operating conditions.

Production and Field Optimization:
Forecast well performance using variable bottomhole flowing pressure and skin. Evaluate the benefits of compression, stimulation, and infill drilling. Quickly import reservoir properties into IHS Piper to design and optimize your gas gathering system.

Reserve Estimation:
Multiple analysis tools are available to estimate the original-gas-in-place (OGIP), expected ultimate recovery (EUR), and recovery factor. These include deterministic methods such as volumetrics, static and flowing material balance and traditional decline analyses as well as probabilistic risk analysis using Monte Carlo simulation.

Modeling Capabilities:
Analytical and numerical models can be utilized to characterize a reservoir. Apply single Vertical/Vertical Fracture/Horizontal numerical well models to history match the production or generate post-history forecast for multi-phase (Gas-Water) production. Apply single Vertical/Vertical Fracture/Horizontal/Composite/Multilayer well-reservoir models for single phase history match and production forecast.

Multi-Layer Capabilities:
Multiple layers of coal or sand can be included in a model. The model can then be used to generate a production forecast for each layer or history match the commingled production of a well completed and producing from several zones.
IHS CBM  Member of the IHS Harmony™ Environment

CASE STUDY

How Many More Wells Should We Drill?

Objectives:
• Forecast future production and reserves update.
• Optimize production of producing wells.
• Identify the infill drilling potential and devise development plan.
• Build a gas gathering model that could be used for field optimization.

Background:
• Large CBM field in the USA, with complex reservoir behavior.
• Large variation in reservoir properties.
• Changing gas composition due to presence of CO2.
• In excess of 25 years of production history.
• Several hundred wells are tied into a complex pipeline network.

Analysis:
• History matched production data (gas rate, water rate, wellhead pressures) from each well.
• Generated production forecasts for gas, water, and CO2 fraction.
• Accounted for unique CBM characteristics such as binary desorption and matrix shrinkage.
• Built and calibrated a gas gathering model using the history match results.

Results:
• The permeabilities obtained from history matching were found to be greater than 30 md in some areas and as low as 0.1 md in other areas.
• Locations where drainage areas were less than the well spacing were identified for potential infill drilling.
• Identified 100+ candidate wells for artificial lift.

Two-phase production forecast for a multi-layer (2 coal & 1 sand) reservoir.

History matching and post-historical data production forecast.

Use binary isotherms when fraction of CO2 in the produced stream becomes important.

Bubble map displaying well drainage area.
Wellbore Optimization
Efficient Flow from Sandface to Surface

**Model Complex Well Completions:**
- Create schematics for different well geometries.
- Consider tapered tubing and/or casing completions.
- Include single or multiple perforations.
- Access database of standard casing, tubing, coiled tubing and drill pipe sizes.
- Perform single or multiphase flow (gas, oil and/or water) calculations through tubing, annulus, casing or flowlines.
- Make use of static, production or injection data.

**Well Deliverability and Liquid Loading:**
- Use various sources to generate past, current and future IPR curves.
- Create TPC curves considering different production scenarios:
  - Change of tubing size, use of coiled tubing or velocity strings.
  - Alternate flow paths.
  - Effect of using artificial lift or compression.
- Identify and evaluate conditions such as:
  - Liquid loading.
  - Erosion.
  - Use of soaping agents for liquid removal.

**Advance Forecasting:**
IHS VirtuWell allows the user to create multiple wellhead forecast scenarios for an Analytical Model including future wellbore configurations within the IHS Harmony interface based on RTA analytical models. The IPR can be viewed for any of the scenarios being forecasted – at any point in time. This provides opportunity to investigate how the reservoir is depleting and identify any uplift potential.
This Well is Loaded Up. What Should I Do?

Objectives:
• Identify if the well is liquid loaded.
• Evaluate solutions to improve well performance.

Background:
• Vertical gas well in east Texas.
• Well has now produced for 4 months.
• 2-7/8” Tubing to 11,200 ft.
• 5-1/2” Casing to 11,540 ft.
• Perfs from 11,150 ft to 11,237 ft.
• No bottomhole flowing pressures measured.
• Well history:
  • Initial PR = 6,600 psia. Current PR = 5,840 psia.
  • Initial production was 1.20 MMscfd at 320 psia WH pressure. WGR = 15 bbl/MMscf.
  • Current gas rate is approximately 0.65 MMscfd and intermittent.

Analysis:
SF/WH AOF Module
• The initial surface rate and pressure are used to obtain the sandface and wellhead deliverability curves.

Gas AOF/TPC Module
• At a wellhead pressure of 320 psia and 15 bbl/d of water the rate required to lift liquids is 1.09 MMscfd.
• It is confirmed that at the current flowing conditions we have liquid loading problems in the well.
• Solutions to this problem are explored (use of a compressor, coiled tubing and a combination of both).

Results:
• 1-1/2” coiled tubing was installed and the well unloaded as expected. New wells in the area have since been completed with 1-1/2” coiled tubing from initial production.
**Analyze Build-Up and Drawdown Data:**
Load and plot data with easy-to-use import and filtering tools. Built-in wizards guide the user from data input through analysis, modeling and forecasting. Data from “Controlled” tests or “un-planned” build-ups on producing wells are easily prepared for analysis using the flexible data management feature.

**Analyze Mini-Frac Tests to Estimate Reservoir Pressure and Permeability in Tight Formations:**
Pressure fall-off data from mini-frac tests can be analyzed using pre-closure and after-closure analysis techniques to identify fracture closure, quantify leakoff coefficients and estimate reservoir pressure and permeability.

IHS WellTest has the ability to advance after-closure analysis beyond diagnostics and straight line analysis to include modeling capability. The models are consistent with the work of M.Y. Soliman and D. Craig and show good agreement with K.G. Nolte's solutions when radial flow is achieved.

**Predict Deliverability Performance:**
Using results determined from pre-frac tests, predict the deliverability performance for different frac properties to establish optimum frac design.
**Objectives:**

- To identify closure, establish reservoir flow characteristics and estimate initial pressure.

**Background:**

Vertical well. MPP = 10,000 ft.

- Pressures monitored at wellhead, converted to bottomhole for analysis.
- 18-minute injection at 1 bpm followed by 24 hour shut-in.

**Analysis:**

- Fracture closure is identified within the initial 3-hours of the falloff period.
- The semilog derivative, calculated with respect to shut-in time, exhibits a slope of -1 shortly after-closure, suggesting that radial flow has developed.
- The semilog derivative developed by K.G. Nolte, exhibits a slope of -1 shortly after-closure, suggesting that radial flow has developed.
- The model suggests radial flow was not quite achieved during the test period, and would likely develop after about 49 hours of falloff.

**Results:**

- The transition to radial flow is sufficiently developed to yield reliable estimates of formation pressure (5423 psi) and permeability (3.5 µd).
Integrated Asset Management
Flow Modeling from the Reservoir to the Delivery Point

Field Development Planning from Reservoir to Delivery Point Using:
- Geographical referencing.
- On-screen editing.
- Shape files.
- Image files.
- Analytical reservoir models.
- Compression modeling.
- Proposed development forecasting.
- Economic forecasting.

Production Optimization:
Diagnostics for easy identification of:
- Additional system losses.
- Liquid loading.
- Data errors.
- Bottlenecks.
- Uplift potential.

Production Forecasting and Development Justification:
Use IHS Piper to determine:
- Pipeline, compression and wellbore requirements.
- Impact of proposed development (i.e. infill wells, compression, pipeline expansion).
- If proposed development is economic.

Import IHS RTA and IHS CBM Models:
- Quantify flush production on a daily or monthly basis.
- Identify production back-out.
- Identify potential problems due to liquid loading.
- Evaluate impact of re-completion.
Evaluate Upside Potential in Debottlenecking

**Objectives:**
Determine if there is potential for system optimization and quantify the potential revenue.

**Background:**
- 44 wells.
- Average operating pressure of 230 psia.
- Total gas rate of 39 MMscfd.
- Compression is currently utilized.
- Bottlenecks upstream of compressors.
- Uplift curve reveals potential by lowering suction pressure and reducing frictional pressure losses.

**Analysis:**
- Add two miles of 6” pipe.
- Account for additional gas volumes through compressors; increase compressor capacity curves to reflect full load conditions.
- Input economic parameters.

**Results:**
- Reduced wellhead pressure by 50 – 100 psi.
- 1.9 MMscfd incremental rates.
- Cumulative incremental production of 1 Bcf over five years.
- NPV = $2,114,300 over 5 years.

**Other Studies:**
- IHS Piper is currently being used to model:
- 7,000 wells over 30 years.
- Shale gas developments in the Barnett, Marcellous, Montney and Woodford.
- San Juan CBM field development and monitoring.
- Gathering systems in tight gas basins such as Picenace, Washakie.
Ready for the Field:

Monitor Post-Completion Flow Backs and Limited Production Tests.

- Select a customizable template to represent the type of test being conducted.
- Production rates, volumes, and ratios are immediately calculated as data is entered.
- Quickly generate detailed plots and reports for submission to client and regulatory agencies.
- Calculate super compressibility using AGA 8 (detailed or simplified) or the Benedict-Webb-Rubin equation of state method.
- Calculate returning frac gas (CO₂, N₂ and propane) from reservoir gas.
- Separate fluid production into oil (stock tank equivalence), water and sediment.
- Identify swabbing sequences and recoveries.

Real Time Data Acquisition:

- Connect any surface or sub-surface instrumentation that supports standard Modbus Protocol.
- Set alarms to monitor tanks, separators, rates, etc., and automatically issue an email report.
- Data plots and tables are updated instantaneously to detail current operating conditions.
- Sample rates of one second during build-ups can provide valuable insight into the reservoir when used with IHS WellTest.
What is the Best Way to Record and Report Well Test Data?

**Objectives:**
- To determine the amount of injected gas recovered during the post-frac flow back.

**Background:**
- 1,600 mscf of nitrogen pumped into the well during the frac treatment.

**Results:**
- The plot represents a comparison between the amount of N2 (blue), total gas (red), and the net reservoir gas (green) produced. The black line represents the total N2 injected.
- By the end of the test, the amount of N2 that is returned from the formation is 1,473 mscf.

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**Objectives:**
- To determine the amount of frac liquid recovered during the post-frac swab operation.

**Background:**
- Perforated the first zone and performed an initial frac using 200 bbl of fluid.
- This was followed up 24 hours later with another frac using 940 bbl of fluid.
- Perforated the second zone and performed an initial frac using 673 bbl of frac fluid.

**Results:**
- The table illustrates a typical swab recovery template with the corresponding plot below.
- During this swab operation, they recovered 880 bbl of 1,666 bbl leaving 786 bbl for the production testers.
Tight and Shale Gas Development Planning
Make Better, Faster Field Planning Decisions

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**Determine Optimum Well Spacing:**
Answer the question “How many wells do I need to optimally produce this field?” by comparing and evaluating a wide range of development scenarios based on both recovery and profitability indicators. Test the sensitivity of results to uncertainty in various reservoir and economic input parameters.

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**Schedule On-stream Dates for New Wells:**
Determine when new wells need to come on-stream to maintain a predetermined maximum field production rate. IHS Evolution’s sophisticated analytical reservoir model predicts performance of new wells, properly accounting for depletion and well placement.

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**Optimize Surface Capacity:**
Use IHS Evolution to determine the most efficient usage of gathering system facilities in a “green field” development. Run multiple scenarios using different maximum field rates to find the most profitable results.

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**Evaluate Optimum Fracture Spacing in Horizontal Wells:**
Use IHS Evolution to generate production and cash-flow forecasts for different complex completions, including multi-laterals and multi-stage fractures.
New Tight Gas Field Development Study

Objectives:

To Determine:

• How many wells should be drilled to achieve a total field recovery factor of at least 70%, over 20 years?

• What is the most profitable well spacing scenario?

• What is the optimum field production rate, given that infrastructure will be expensive (letting the wells flow unrestricted will be cost prohibitive)?

• What is the optimum drilling schedule to achieve the desired field production rate?

Background:

• Operator X has acquired new acreage offsetting a large tight gas development.

Analysis:

• We began by populating the reservoir model and running field forecasts.

• Figure 1 shows that 18 wells are required to recover 70% of the original-gas-in-place (OGIP) over 20 years.

• Figure 2 shows a clear maximum value at 12 wells drilled, rather than 18.

• Figure 3 suggests that the optimum field development scenario consists of drilling 13 wells with a maximum rate limitation of 5 MMscfd for the field.

• Figure 4 shows the resulting well schedule.

Results:

• Operator X began with some basic reservoir, well and economic data, but little or no direction. Using IHS Evolution we were able to quickly and systematically find a theoretically optimum development strategy for their undrilled acreage.
The strength of our expertise lies in the interdisciplinary cooperation between our geological, petrophysical, and reservoir engineering staff. The integration of these disciplines produces a practical and technically rigorous reservoir interpretation.

The geoscience team’s interpretation of oil and gas reservoirs incorporates all pertinent stratigraphic, structural and petrophysical analyses. Gross and net pay analyses and the areal extent of reservoirs are determined through detailed correlations of hydrocarbon zones and surrounding strata. The stratigraphy, lithology, depositional environment, and subsurface structure are assessed. IHS determines reservoir parameters from petrophysical logs, core analyses, drillstem tests and well completion information. Mapping and modeling of reservoirs is completed utilizing all available information for a study area. Geophysical expertise is incorporated as required.

Software: IHS Fekete Reservoir Engineering software, IHS AccuMap®, IHS AccuLogs®, IHS Petra®, IHS Kingdom®, GeoGraphix, Petrel, IHS EDIN®, IHS Enerdeq®, IHS Navigate™.

Our project list includes:

• Petrophysical evaluation
• Sequence stratigraphy
• Sedimentology
• Geochemistry
• Static reservoir characterization - 2D and 3D
• Probabilistic resource assessment
• Expert witness
Using our IHS Piper software, IHS engineers build an integrated model of downhole and surface assets including:

- Reservoirs, including conventional reservoirs, tight and shale reservoirs, and coal seam gas
- Wellbores, including the ability to view inflow curves with outflow curves and predict when liquid loading will occur
- Surface gathering system, including all pipelines with elevation changes, displayed on a scale

GIS map capable of layering additional shape or image files

- Facilities, including compression, separation, dehydration and refrigeration

The model is tuned to existing conditions and then used to forecast production from individual wells or at any node in the system. Multiple production scenarios are evaluated to answer such questions as:

- How are bottlenecks in my gathering system impacting bottom line production?
- Where is pipeline capacity available for new well production?
- What is the impact of additional compression at my sales point?
- How much compression is needed?
- When will each well be subject to liquid loading?
- How much production can be hedged?
- What area of my field has the greatest uplift potential from system optimization?

IHS has worldwide Integrated Asset Management experience including multizone systems in Alberta, CBM in Wyoming, high pressure gas in Pakistan and tight gas in Australia and the USA (Piceance Basin).
Some clients choose to use specific IHS services to augment their reservoir understanding. Alternatively, we are hired to combine and coordinate all of IHS’s expertise in conducting integrated reservoir studies leading to master development plans for Greenfield or Brownfield developments.

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<th>Economic Analysis</th>
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<td>• Production data analysis</td>
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<td>• Reservoir drive</td>
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<td>• Material balance</td>
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<tr>
<td>• Populate 3D model</td>
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Our Production Engineering services complement geological and reservoir engineering studies by incorporating the practical aspects of field operations.

**Our services include:**
- Wellbore nodal analysis
- Artificial lift; rod pump, plunger lift, gas lift
- By-passed pay evaluation
- Workover recommendations and programming
- Fracture stimulation optimization
- Waterflood surveillance
- Water disposal
- Acid gas disposal
IHS prepares and submits drilling, production, and reservoir development applications to government regulators. Our applications are complete and technically accurate, ensuring a favorable evaluation by the regulatory authorities. When required, we support the client with expert witness testimony at government and court hearings. IHS has completed and received approval for thousands of applications.

**We routinely prepare applications for British Columbia, Alberta, and Saskatchewan as follows:**

- Downspacing
- Holdings
- Gas production in oil sands areas
- Commingled production
- Good production practice (GPP)
- Concurrent production
- Gas-oil ratio penalty relief
- WGR and ECF exemptions
- Pool delineation
- Enhanced recovery (waterflood)
- Water disposal
- Acid gas disposal
- Metering waivers
- Allowable calculations
- 0-38 submissions
- Primary schemes for heavy oil
- CEE / CDE new pool classification

**Texas Railroad Commission**

- Acid gas disposal
- Tight Gas Severance Tax Exemption
IHS’s qualified reserves evaluators use our considerable in-house experience and specialized expertise to truly understand your reservoirs, to accurately model and forecast production, and to provide reserves estimates with confidence. We prepare professional NI 51-101 documents and SEC compliant reserves reports for Canadian and United States regulators.

**We provide a variety of reports including:**

- Annual corporate reserves evaluations
- Individual property reports for acquisition/divestment
- Audit of company reserves to satisfy banking requirements
- Fair market value appraisals/estate valuations
- Submissions to regulatory authorities regarding issues that require economic evaluations
- Assessments of prospective undeveloped lands
- Energy pricing analysis and forecasting

**As we conduct our review of your wells and properties, we make recommendations on reservoir management issues which allow you to:**

- Increase well density to maximize recovery
- Provide alternative pipeline/compressor routes to alleviate deliverability restrictions
- Enhance recovery techniques
- Conduct a pressure buildup test to determine pool delineation or wellbore damage
IHS provides an integrated team of reservoir engineers, geologists, geophysicists, petrophysicists, production engineers, simulation engineers, and computer specialists. Our results combine static and dynamic modeling into a comprehensive reservoir model that yields additional reserves and successful drilling locations.

Simulation projects begin with a detailed review of data quality and a scoping analysis of data uncertainty. Simulation proceeds only after the analysis determines that the model is representative of the reservoir, that it will generate dependable results, and that it is economically justified.

In addition to its specific suite of services, IHS is often engaged to investigate unique reservoir situations for which no precedent exists and the solution path is unclear.

Software: IHS Harmony™, Eclipse (Black Oil and Thermal), CMG (IMEX, GEM, STARS and CMOST).

**Our project list includes:**
- Waterflood design and optimization
- Thermal oil recovery
- Tertiary EOR schemes
- Infill drilling and pool depletion strategies
- Shale gas/oil development and optimal well spacing
- Coalbed methane
- Gas storage
- Carbon sequestration
- Gas hydrates
By combining our well test (pressure transient) and advanced decline (rate transient) analysis services, IHS provides a comprehensive understanding of reservoirs, completion efficiency, and optimization potential.

**Well Testing (Pressure Transient Analysis)**

- Design and analysis of multi/single point flow and buildup for conventional and multi-fractured horizontal wells, injection and falloff (including mini-frac analysis), DST and perforation inflow tests
- Determination of near wellbore reservoir parameters (permeability, skin, fracture parameters)
- Estimation of reservoir pressure, distances to reservoir boundaries and/or heterogeneities
- Prediction of deliverability potential at various flowing conditions
- Recommend potential stimulation (for damaged wells) or optimization candidates (utilizing tubing performance curves and liquid lift calculations)

**Rate Transient Analysis**

- Reservoir characterization (permeability, skin, fracture half-length)
- Diagnose changing skin or permeability conditions
- Monitor well performance in competitive drainage situations
- Monitor productivity to ensure proper production allocation
- Analytical and numerical production modeling – single zone vertical to multi-frac horizontal wells
- Determination of stimulated reservoir volume, optimal well spacing and EUR/well for unconventional reservoirs
- Proof of “tight gas” for government tax credits
The Challenge of Unconventional Resource Development
The development of unconventional resources is a relatively new endeavour that is fraught with high risk and expense, but also delivers great rewards. As an industry, we have gained knowledge through direct experience, but we still have much to learn. The goal of our Community of Best Practice is to work with exploration and production companies to create a strong foundation of knowledge for unconventional assets based on well performance data. This will help to reduce risk, reduce cost, and improve results.

IHS Stewardship of Unconventional Knowledge
IHS is a trusted leader in the evaluation of well performance data from unconventional oil and gas reservoirs. IHS has analyzed hundreds of shale oil and gas wells with the primary purpose of determining reservoir characteristics, optimizing production and developing reliable forecasts. Our database of completed analyses has become an integral tool within IHS. As we analyze new wells, this database provides an invaluable source of analogs whether data is sparse or dense. Our clients will benefit from having access to this kind of database, which is why we created the Community of Best Practice.

Immediate Value
Each Community represents an active unconventional play and contains analyses performed by IHS’s experienced engineering team. IHS has made an enormous investment in engineering research, software solutions, and analysis methodologies specifically aimed at the unique challenges inherent in unconventional assets. This effort has positioned IHS as an industry leader. Our professional rigour is applied to each well submitted to a Community of Best Practice. All wells in each Community are analyzed with a consistent methodology ensuring a meaningful well to well comparison.

Continuing Value and Ongoing Dialogue
Every Community will evolve as an expanding resource of information. New members will constantly be joining Communities, every well will be updated regularly as new production data is available, and each member will contribute new wells annually. The community will grow in value year over year. IHS’s Community provides a framework for capturing and sharing what works and what does not. IHS engineers are available to discuss the reservoir, completion strategies, and well performance. Community gatherings facilitate intercompany discussion on the play.

Current Communities
Communities are currently only available in North America. Our existing Communities include the Eagle Ford and the Bakken / Three Forks Shale formations. We are in the process of founding new communities in the Duvernay, Montney and Permian Formations.
Taking a course from IHS will enhance your industry education and provide you further insight into optimization opportunities for your company's operations. Our courses not only provide you software instruction, but also access to our technical experts for engineering advice on your current projects.

An IHS course is an environment in which you learn new methodologies by analyzing real data from actual case studies conducted by IHS. This will give you the confidence to apply these new techniques in your day to day work.

**Software Courses:**
IHS Harmony™ | IHS DeclinePlus
IHS CBM
IHS FieldNotes
IHS Piper
Rate Transient Analysis Fundamentals using IHS RTA
IHS VirtuWell
IHS WellTest
Mini-Frac (DFIT) Analysis for Unconventional Reservoirs using IHS WellTest
Unconventional Production Data Analysis using IHS RTA

**Engineering Courses:**
Decline Curve Analysis
Production Allowables in Alberta
Oil & Gas Well Spacing in Alberta
Modern Production Data Analysis for Unconventional Reservoirs
Well Test Interpretation

**Additional Training:**
In addition to our regularly scheduled courses, we have developed a number of Lunch & Learn presentations and In-House Training courses to meet your needs. Please contact our course coordinator at fek-training@ihs.com.
ABOUT IHS

IHS (NYSE: IHS) is the leading source of information, insight and analytics in critical areas that shape today’s business landscape. Businesses and governments in more than 150 countries around the globe rely on the comprehensive content, expert independent analysis and flexible delivery methods of IHS to make high-impact decisions and develop strategies with speed and confidence. IHS has been in business since 1959 and became a publicly traded company on the New York Stock Exchange in 2005. Headquartered in Englewood, Colorado, USA, IHS is committed to sustainable, profitable growth and employs about 8,800 people in 32 countries around the world.