

Full Field Decision Support

FIELD PLANNING AND DEVELOPMENT FOR
UNCONVENTIONAL RESOURCES



Company Background

- Company founded in 2002
- Established as an Engineering Company
- Specializing in Geographic Information Systems
- Three core offices: Houston, Calgary, and St. John's
- Staff of Engineers, Geologists, Geographers, and Computer Scientists
- Esri Business Partner (Silver Tier International)



Context

Full Field development for unconventional resources:

- Companies faced with aggressive schedules and production expectations
- Limited lead time for planning which focuses efforts on near term
- Pace and uncertainty limits ability to address broader field lifecycle
- Unexpected incremental investments diminish potential prize

Conscientious companies are concerned about costs and conservation.

Establishing estimates and controlling costs through Full Field planning provides a path to extracting more value.

Quality of decisions and completeness of plans can differentiate between businesses being wildly successful and barely sustainable.



Goals for Full Field Planning

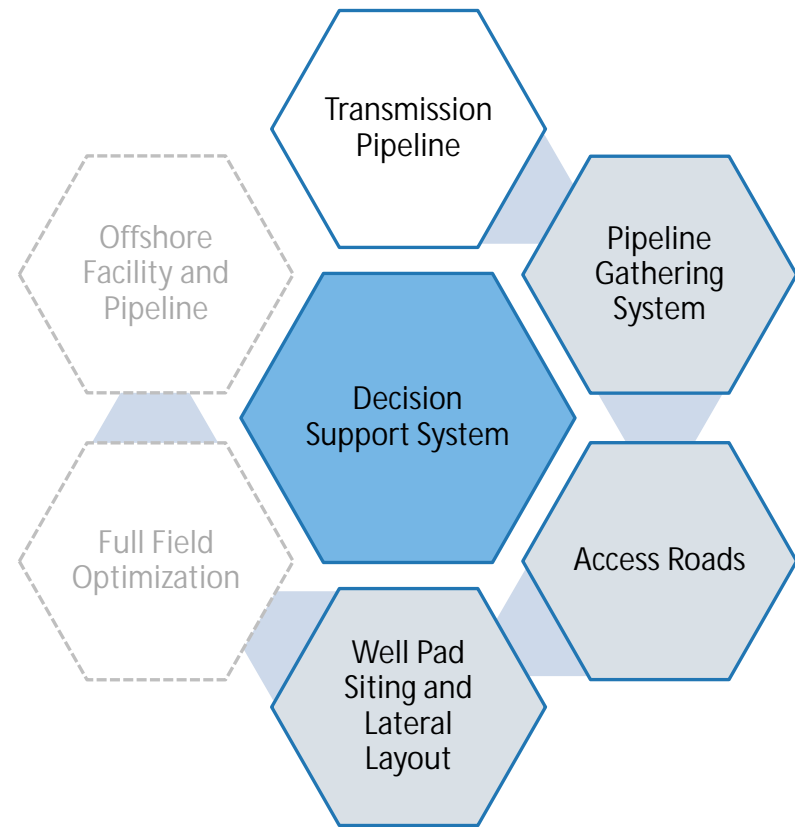
1. Generate results that reduce impact and investment
2. Establish baseline for impact and investment
3. Generate multiple options in place of single solutions
4. Reduce effort needed to evaluate options
5. Provide a means of performing what-if scenarios
6. Keep pace with (or ahead of) planning process
7. Increase lead times, broader view for planning and execution
8. Produce reliable and repeatable results
9. Increase consistency in the planning process
10. Improve documentation of siting choice rationale



Components to Support Full Field Planning

Decision support system must:

- Consider uniqueness of each **Asset Type** with respect to modeling
- Allow for inputs in terms of **Constraints and Constructability**
- Produce **Realistic Results**
- Incorporate input from and expertise of **Discipline Experts**
- Include specialized **Spatial Data Management** processes and **Analysis Techniques** (GA, NN, LP)
- **Retain Results and Analysis Artifacts** for re-use
- Flex to changing business needs

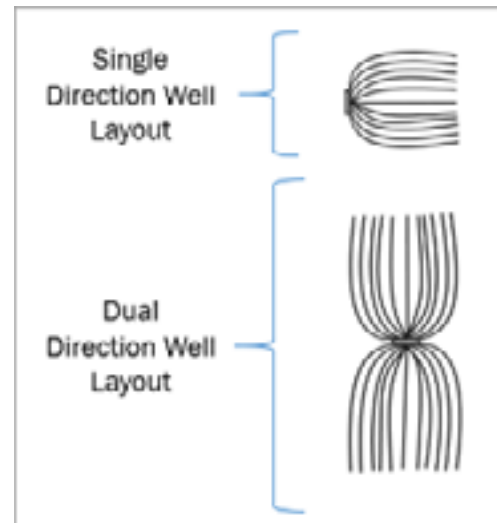
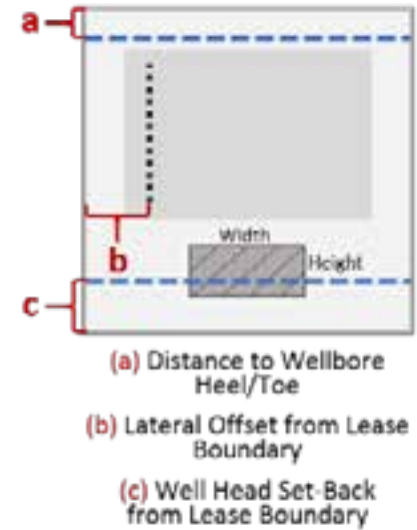
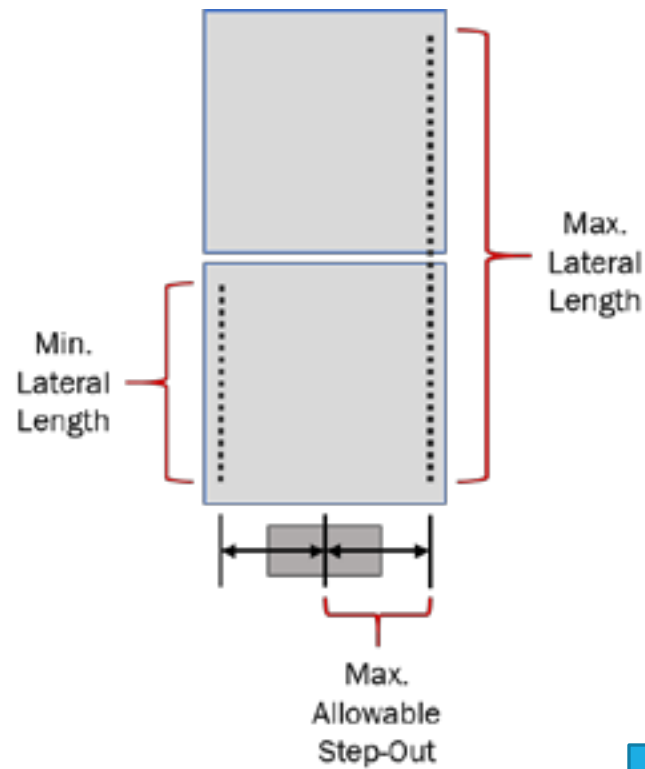


Constraints and Constructability

DEFINING THE SOLUTION IN TERMS OF AFFINITY, AVOIDANCE, AND ABSOLUTE BARRIERS



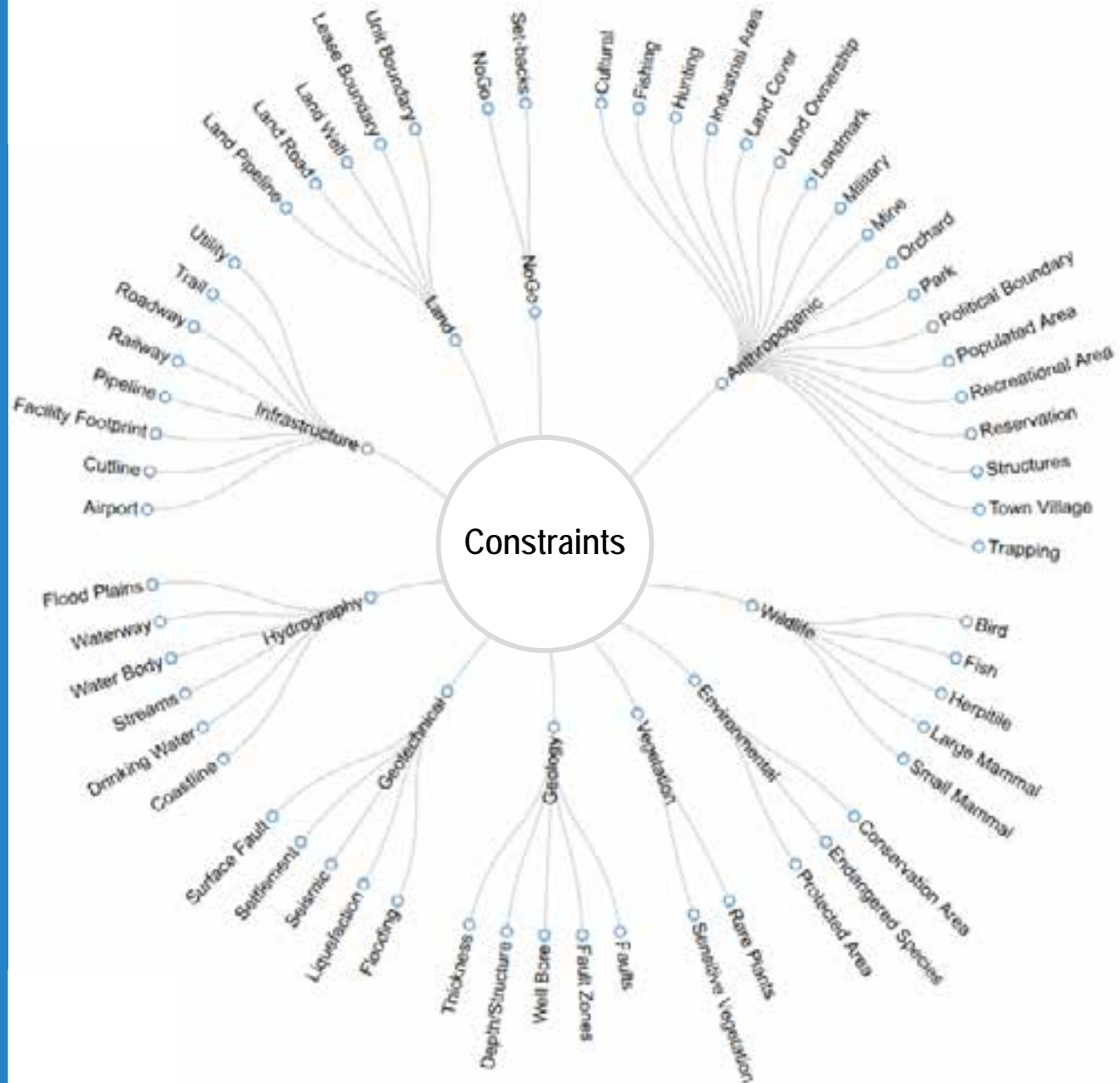
Geologic and Drilling Constraints



- Structure Depth
- Lateral Spacing
- Lateral Orientation
- Dog-leg Severity
- Wells per pad
- Cut and Fill
- Lease Location
- Set-backs

Constraints: Construction, Logistic, and Regulatory

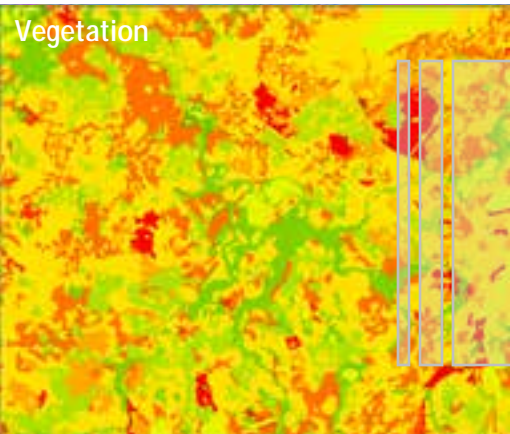
- Anthropogenic
- Environmental
- Geology
- Geotechnical
- Hydrography
- Infrastructure
- Land
- NoGo
- Vegetation
- Wildlife



Archeology



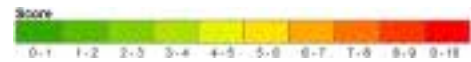
Vegetation



Land Use and Disturbances

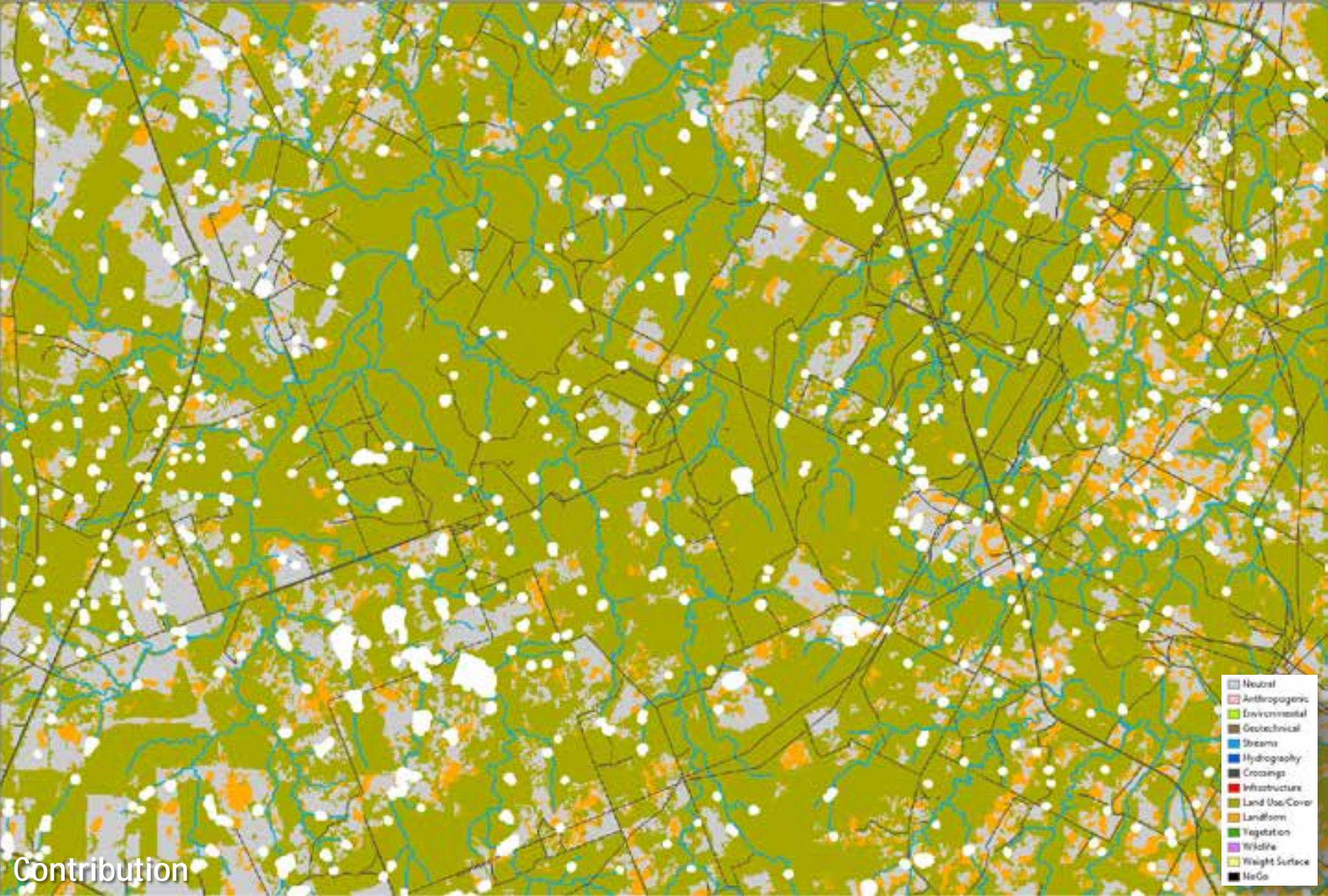


Constraints



Score

0-1 1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9 9-10



- Neutral
- Anthropogenic
- Environmental
- Geotechnical
- Streams
- Hydrography
- Crossings
- Infrastructure
- Land Use/Cover
- Landform
- Vegetation
- Wildlife
- Weight Surface
- NoGo

Contribution

Realistic Results

GENERATING OPTIONS AND OUTCOMES



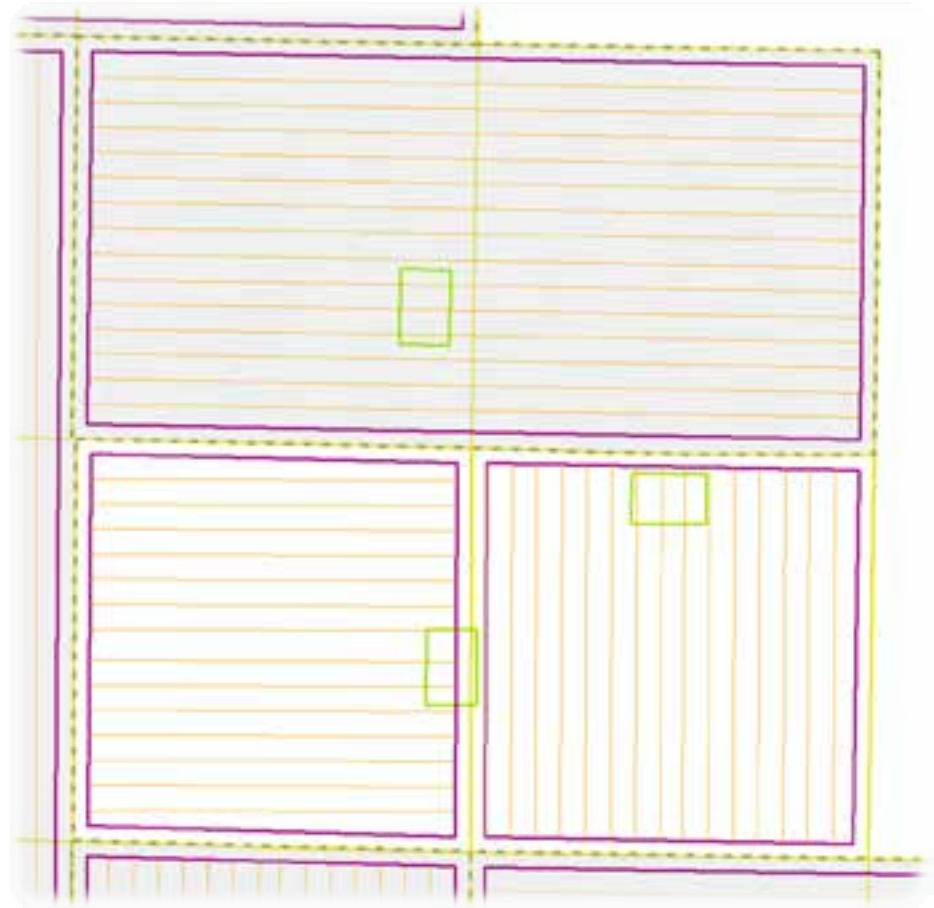
Well Siting

Well Siting analyses produce:

- Well Pad Locations
- Completable Areas
- Well Laterals
- Land Collectives

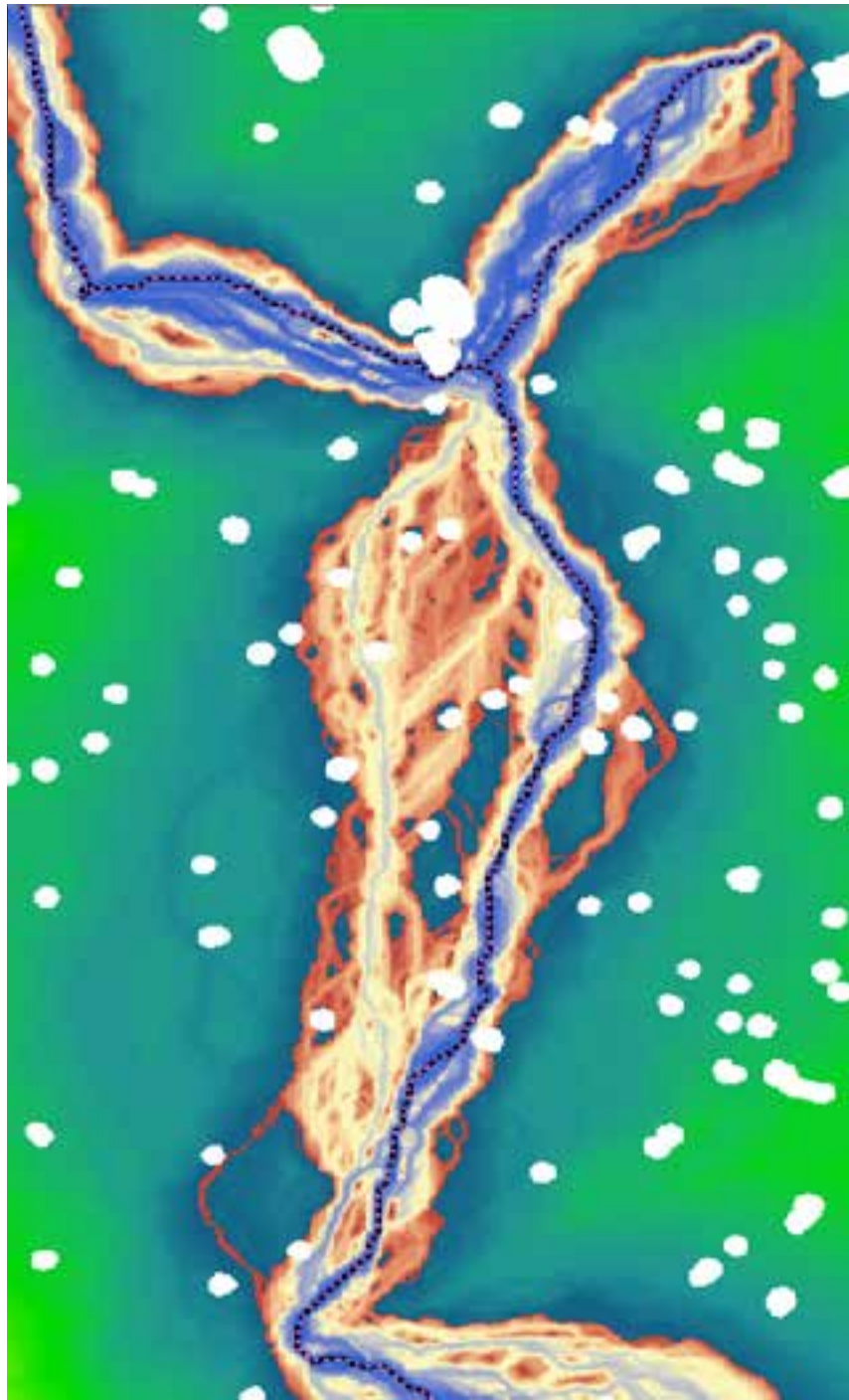
Land Collectives produce:

- Well Pad Locations
- Completable Areas
- Well Laterals



Road and Pipeline Solutions

- Continuous Solution
- Corridor Solution
- Centerline Solution



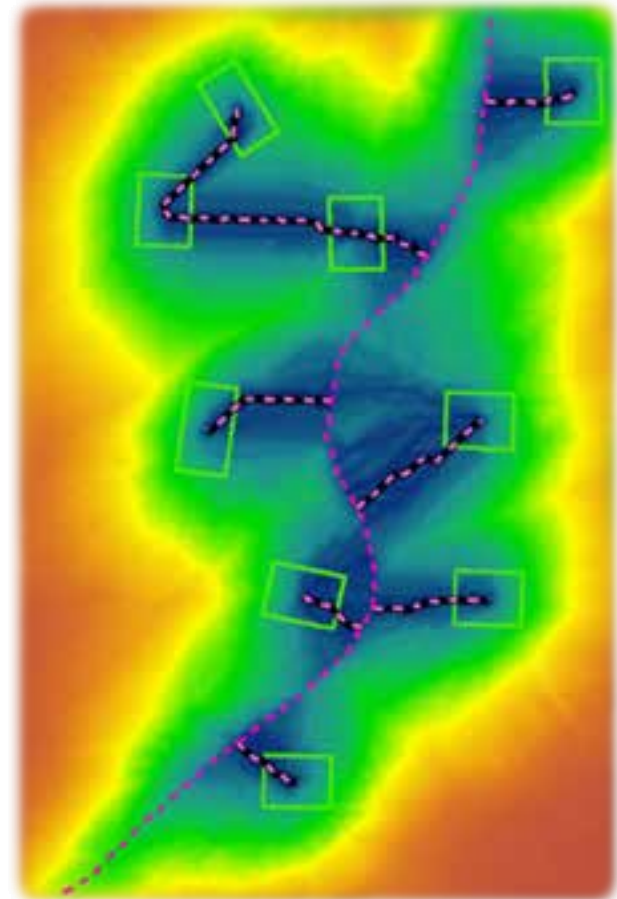
Connectivity

Layout for gathering systems and access roads have additional considerations such as:

- Minimizing overall length
- Varying diameters
- Varying traffic requirements
- Existing infrastructure

Building gathering systems and access roads must be able to account for:

- Existing infrastructure (ignore)
- Existing infrastructure (include)
- Proximity of facilities and Existing Infrastructure



Expert System

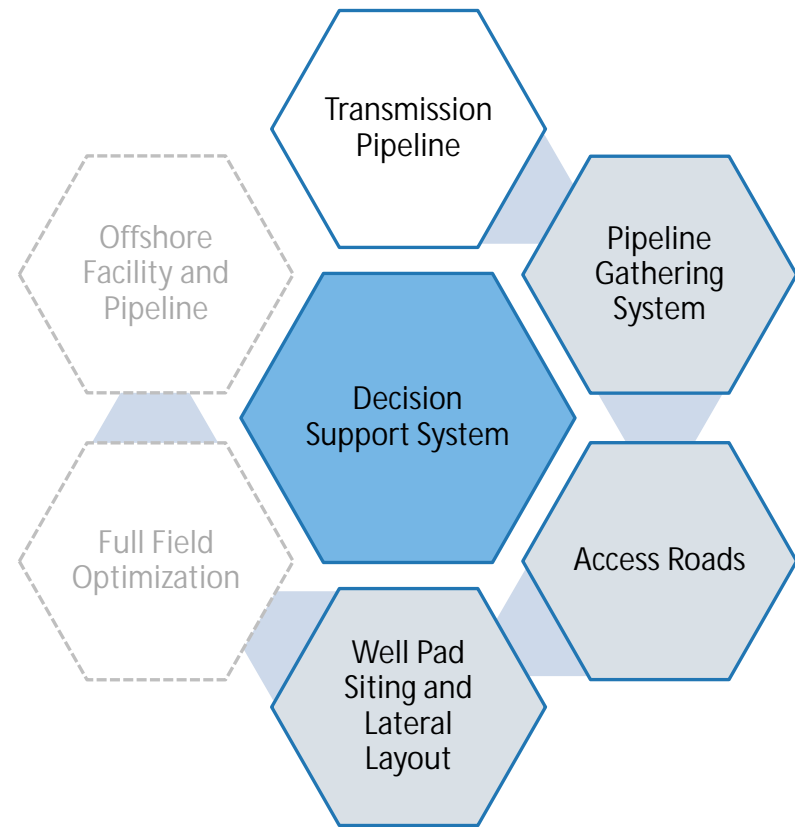
ENCAPSULATING EXPERT KNOWLEDGE FOR
DECISION SUPPORT



Components to Support Full Field Planning

Decision support system must:

- Consider uniqueness of each **Asset Type** with respect to modeling
- Allow for inputs in terms of **Constraints and Constructability**
- Produce **Realistic Results**
- Incorporate input from and expertise of **Discipline Experts**
- Include specialized **Spatial Data Management** processes and **Analysis Techniques** (GA, NN, LP)
- **Retain Results and Analysis Artifacts** for re-use
- Flex to changing business needs



ArcGIS Platform

- Common tool in Energy companies
 - Used across multiple disciplines (e.g. environmental, engineering, geosciences, etc.)
- Ability to model complex Business and Spatial concepts
 - Some additional smarts needed to make ArcGIS Energy-industry-centric
- Core spatial analyses missing some context and specialization
 - Extensible to include high-end analyses techniques like GA, LP, NN
- Data management capabilities great for managing large amounts of data
 - Additional capabilities needed for managing multi-criteria, constraints, settings, parameters, etc.
- Numerous options for extending and deploying
 - Services, Extensions, Toolboxes, Add-ins
- Natural choice as a platform for Full Field decision support systems
- ArcGIS allows for Simplified, Streamlined, and Specialized workflows



Simplified

- Familiarity
- Usability
- Terminology
- Validation
- Documentation

M
La
Le

Generate Well Pad Sites

Geomancy Decision Engine (Geomancy 2.0)
Copyright © 2000-2014, Integrated Informatics Inc. All Rights Reserved
[Contact Us](#) | [Feedback](#) | [Support](#) | [Privacy Policy](#)

Project Geodatabase
[Select Geodatabase]

Project Name
Shale Gas

Scenario Name
RegionalTrend : Optimization for Well Layout

Asset Type
Multi-Well Pad (WELL_MLTP)

Input Constructability Surface
Base_Regional_Structure : Corrected Handing for Structures

Include Cut and Fill

Description
[Text Area]

Land Parcel Dataset
Land : Lease Boundary : Constant Weight (SND_Lease) : Lease Holdings

Set-back Surface (optional)
[Text Area]

Siting Options

Lease Location
On Lease Only

Dog Leg Severity
33

Lateral Layout Orientation
Along Maximum Principal Stress and Up-Dip Direction

Direction for Maximum Principal Stress
0

Well Pad Design Parameters

Single and Multi-Well Pad
Well Count
3

Maximum Allowable Step-out
1320

Well Head Set-back from Lease Boundary
150

Distance to Well Bore Heel/Toe
200

Lateral Offset from Lease Boundary
330

Lateral Spacing
660

Minimum Lateral Length
4000

Maximum Lateral Length
8000

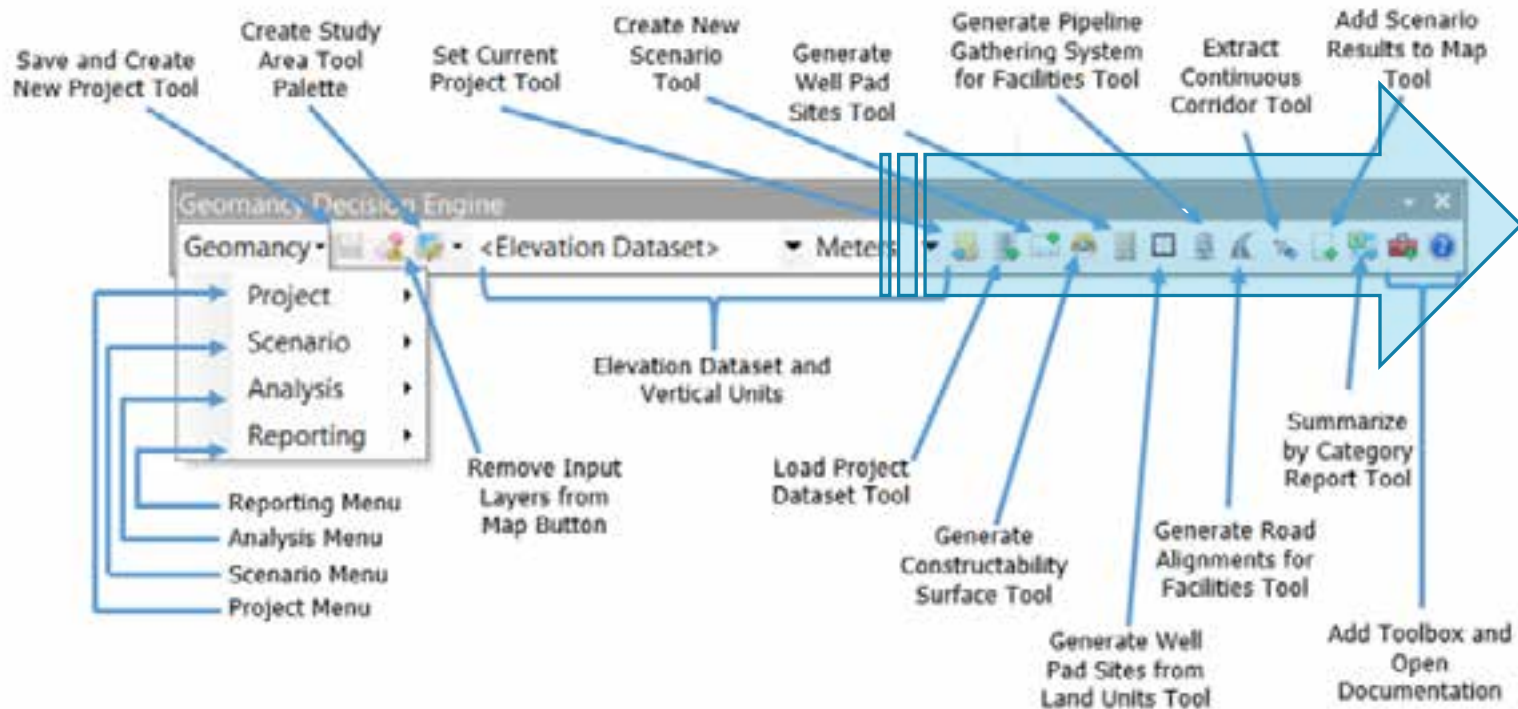
OK Cancel Environments... << Hide Help Tool Help

Lateral Layout Orientation

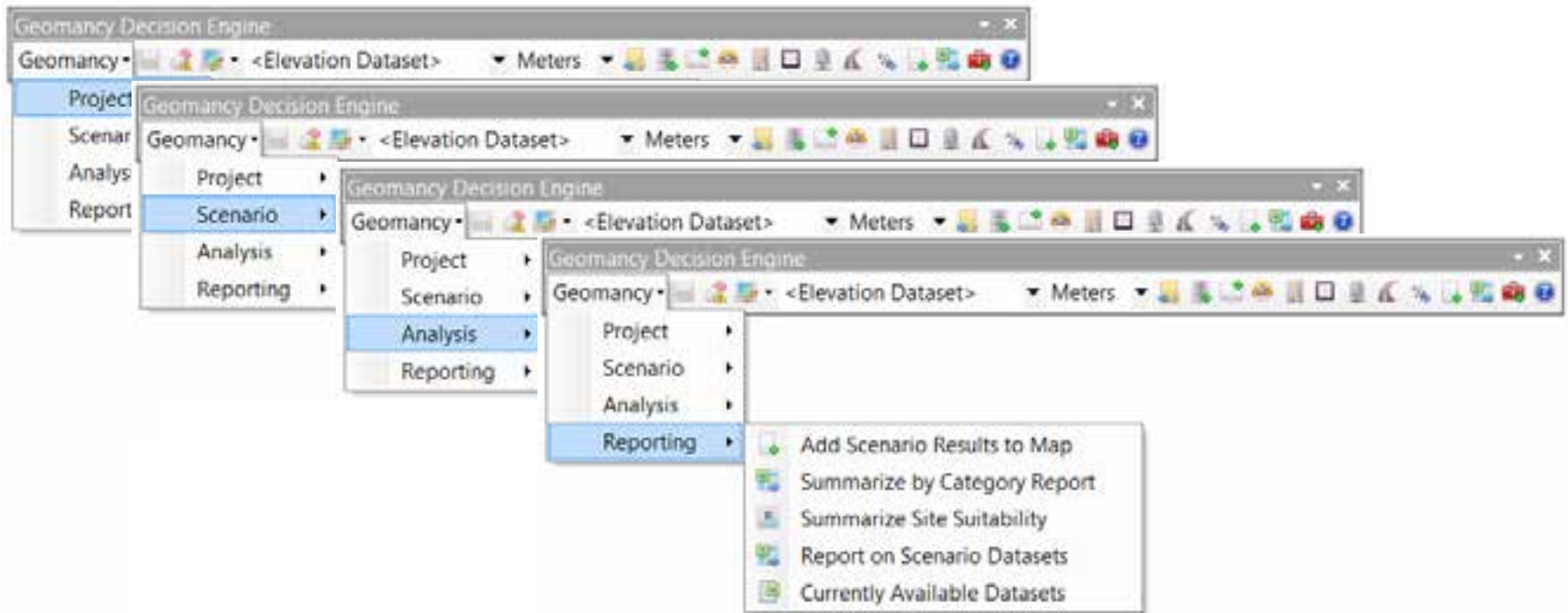
Choice for how the laterals should be laid out in the field based on geology or based on leases.

- **Along Maximum Principal Stress** - attempts to locate laterals in a manner that maximizes their potential for recovery and chooses the ends of the laterals that allow for the wells to be drilled up-dip. The Direction for Maximum Principal Stress must be specified and a structure depth surface must be available in the scenario.
- **Along Up-Dip Direction** - attempts to locate laterals in a manner that allows the wells to be drilled up-dip. This option relies on a structure/depth surface being available in the scenario.
- **Longest Laterals and Up-Dip Direction** - laterals are laid out in the leases in a manner that maximizes lateral length. This option relies on a structure/depth surface being available in the scenario.

Streamlined



Specialized

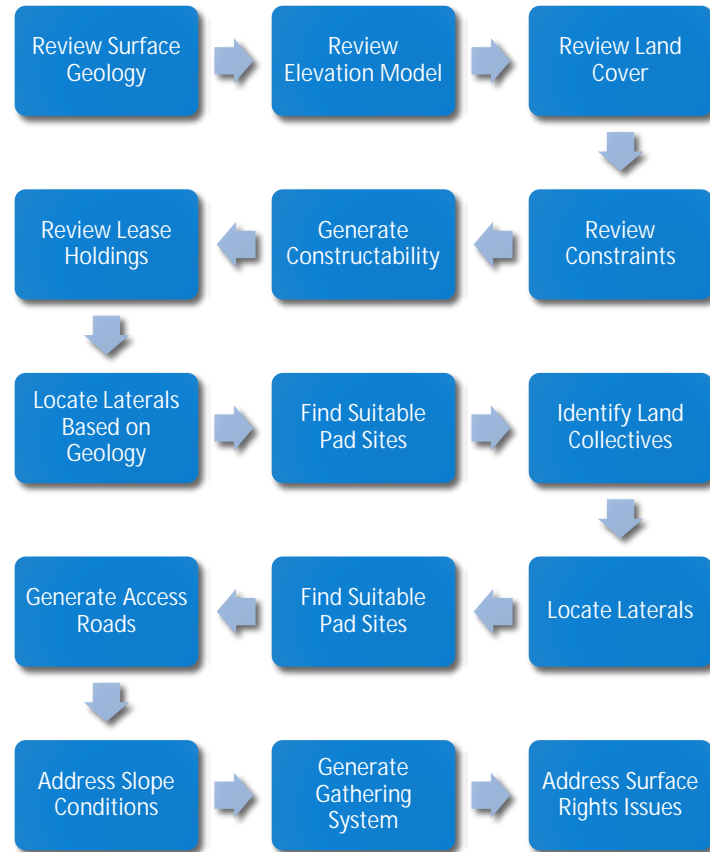


Shale-Gas in Developed Area

FIELD DEVELOPMENT IN RURAL AREA WITH
SIGNIFICANT POPULATION AND INFRASTRUCTURE



Shale Gas in Developed Area



- Geologic/Production parameters:
 - **Drilling in the Up-Dip Direction**
 - Minimum length 3600 ft (economic)
 - Lateral spacing is 330 ft
- Drilling parameters:
 - Max dog-leg severity of 10 degrees / 100ft
 - **Maximum length 7500 ft (technical)**
 - **Drill dual direction from pads**
 - Step-out is 900 ft (maximum)
- Well Pad parameters
 - **200 ft x 300 ft well pad**
 - **Locate 'On or Off Lease'**
 - **3 wells per pad (single) 6 wells (dual)**
- Field rules for the region:
 - 165 ft offset from lease line to well head
 - 165 ft offset from lease line to well heel
 - 165 ft offset from lease line to lateral



Full Field Decision Support

FIELD PLANNING AND DEVELOPMENT FOR
UNCONVENTIONAL RESOURCES

