# WETTABILITY ALTERATION FOR IMPROVED OIL RECOVERY

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ESAL, LLC

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# ABOUT ESAL (ENGINEERED SALINITY)

ESAL, LLC WAS BORN FROM WHAT DID NOT HAPPEN. SPECIFICALLY, WHY DIDN'T THE LOW SALINITY WATERFLOODING WORK IN THE MINNELUSA FORMATION OIL FIELDS OF WYOMING?

LOW SALINITY WATERFLOODING HAD WORKED FOR MANY SANDSTONES IN THE LAB. IT HAD WORKED IN THE FIELD TESTS IN THE KUPARUK SANDSTONE IN ALASKA. IT HAD WORKED IN SYRIA FOR SHELL. WHAT WAS WRONG WITH THIS SANDSTONE?

THE EVIDENCE WAS OVERWHELMING. DOZENS OF FIELDS FAILED TO PRODUCE ADDITIONAL OIL REGARDLESS OF THE SALINITY INJECTED. AND SOMETIMES IT IS WHAT DOES **NOT** WORK THAT LEADS TO WHAT DOES.

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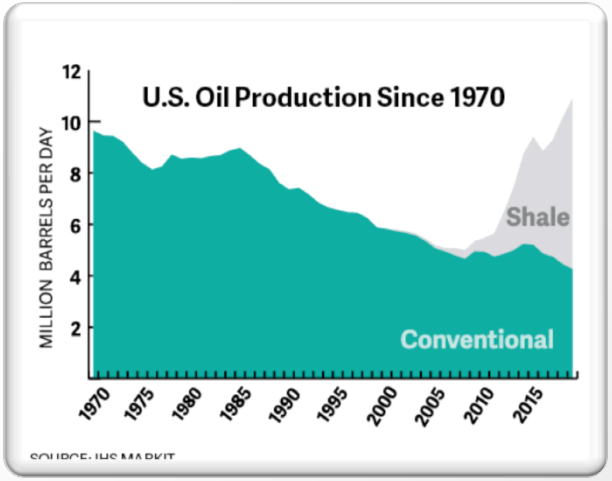
# CURRENT OIL MARKET




## DRILLING PARADIGM

- WATERFLOODING RECOVER ~35% OOIP AVG
- EOR PROJECTS NOT COMMONLY ADOPTED
- INDUSTRY HEAVILY FOCUSED ON DRILLING IN PROLIFIC SHALE PLAYS
  - MAJORITY OF DRILLING IS IN "SWEET SPOTS" THAT ACCOUNT FOR ~ 12% OF ACREAGE
- MOST "SWEET SPOTS" WILL BE FULLY UTILIZED IN MID 2020'S

**"We know exactly where it is, we have wells drilled to it, and we know how to get the next 20 percent. Cost is the big issue." —Russell Ostermann, Director of Petroleum, The University of Kansas.**

## CHALLENGES

- CONVENTIONAL EOR:
  - COST PROHIBITIVE FOR MANY OPERATORS
  - LOGISTICAL LIMITATIONS
- SHALE:
  - LOWER YIELD: 5-8% OOIP
  - HIGHER DECLINE RATES: 10-15%
  - HIGH WATER PRODUCTION: UP TO 2:1
  - HIGH CAPITAL EXPENDITURE

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# WHAT WOULD YOU DO IF YOU COULD -

- IMPROVE SHALE RECOVERY 2-4% OOIP
- CONVENTIONAL RECOVERY BY 5-15% OOIP
- LOWER WATER PRODUCTION
- DE-RISK E&P PROJECTS
- LITTLE TO NO CHANGE IN NORMAL OPERATIONS
- LITTLE TO NO CHANGE IN CAPEX
- FINAL COSTS $1.50 - $4.00 PER INCREMENTAL BBL

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# WHAT DO YOU GET FROM US?

OUR KNOWLEDGE

- WE KNOW THIS PROCESS DOES NOT WORK IN ALL RESERVOIRS AND CAN TELL YOU WHEN IT WILL
- WE PROVIDE A **SPECIFIC TARGET SALINITY** TO OPTIMIZE WETTABILITY
- WE ARE WORKING IN SHALE, SANDSTONE AND CARBONATE

OUR PROCESSES

- STEPPED PROCESS TO REDUCE RISK
- SCREENING OF CANDIDATE FIELDS TAKES WEEKS
- LABORATORY TESTING TAKES ONLY A FEW MONTHS
- TOTAL ESAL PROJECT TIME IS 9-15 MONTHS
- LOWERS PROJECT COST BY UP TO 10 TIMES

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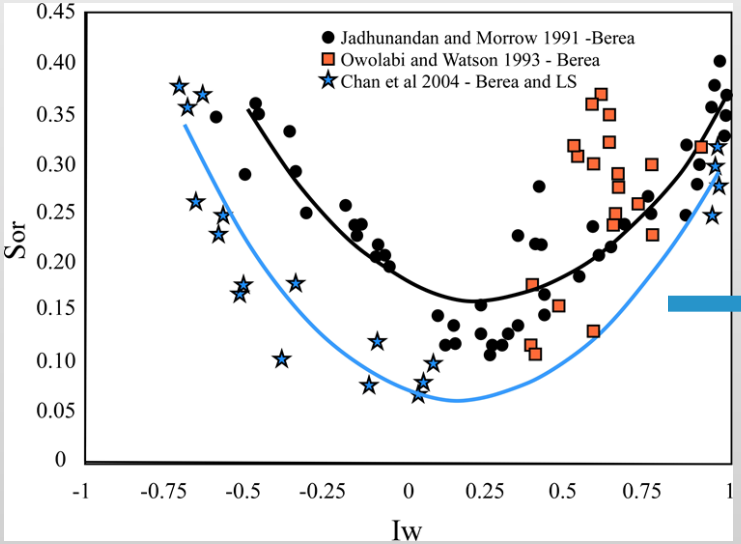
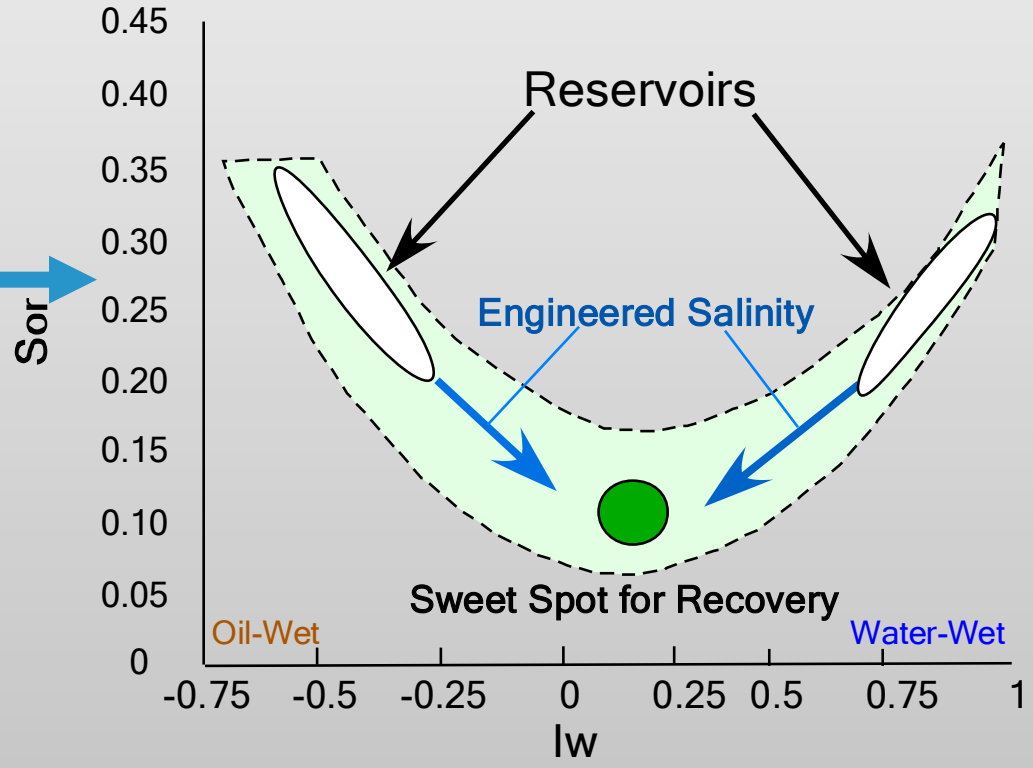
# WETTABILITY IS WHAT WE DO BEST

- RESERVOIR WETTABILITY IS THE ADHESION OF OIL TO ROCK
- THE BEST OIL RECOVERY IS AT NEUTRAL WETTABILITY
- CHANGING SALINITY WILL ALTER WETTABILITY IN MANY RESERVOIRS

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# ESAL™ TECHNICAL WORK FLOW

## Stage I Screening

- Determine potential of properties for wettability alteration

## Stage II Laboratory

- Confirm screening results
- Quantify wettability in the lab
- Determine optimal salinity

## Stage III Deployment

- Water Resources Evaluation
- Design injection water chemistry
- Generate water source or water treatment specifications
- Support and Quality Control

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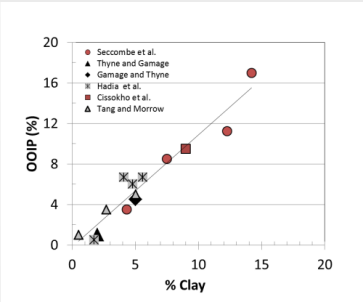
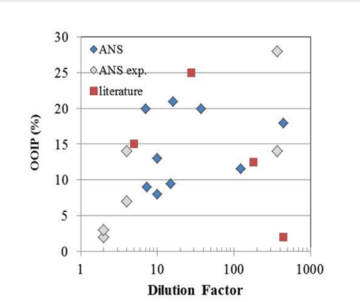
# Analytical Screening Tool

## Water, oil, rock and field parameters = score.

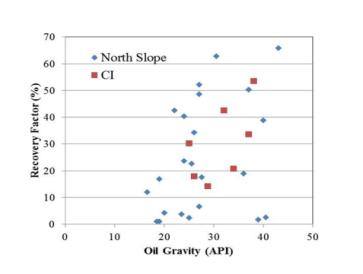
| | | |
|---|---|---|
| | Excellent | 92-100 |
| | Good | 78-91 |
| | Average | 60-77 |
| | Marginal | 50-59 |
| | Not recommended | <50 |



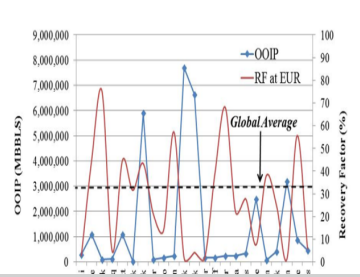

Rock



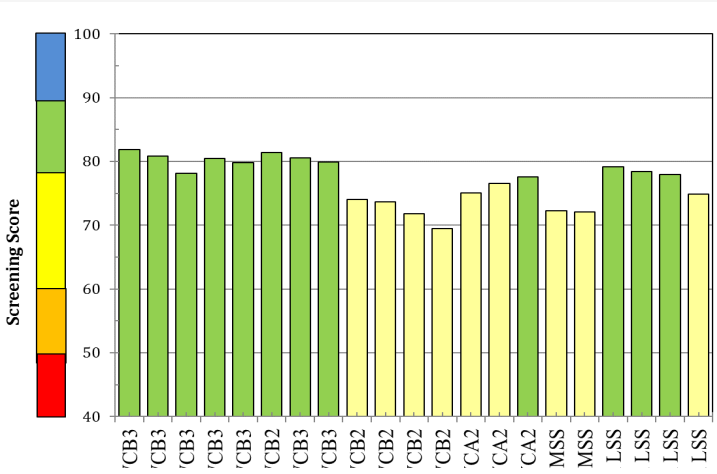

Water

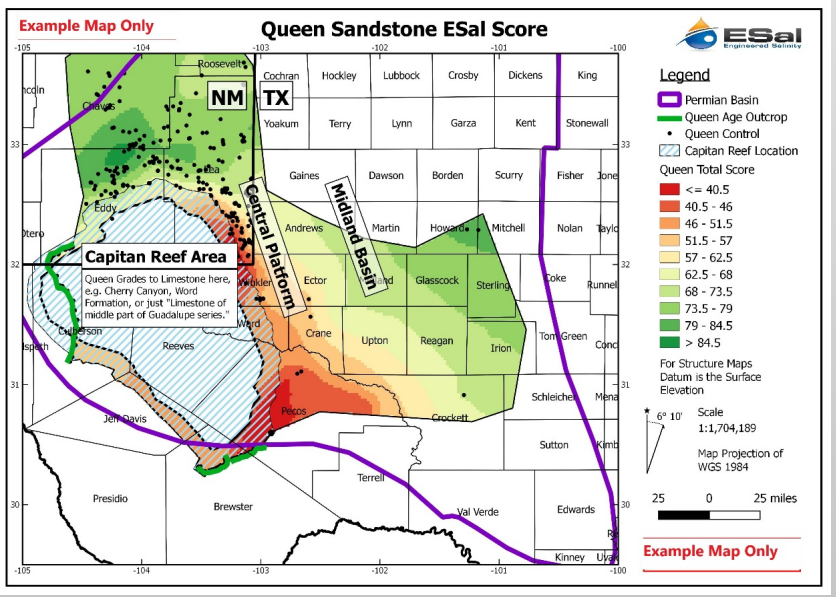



Oil




Field

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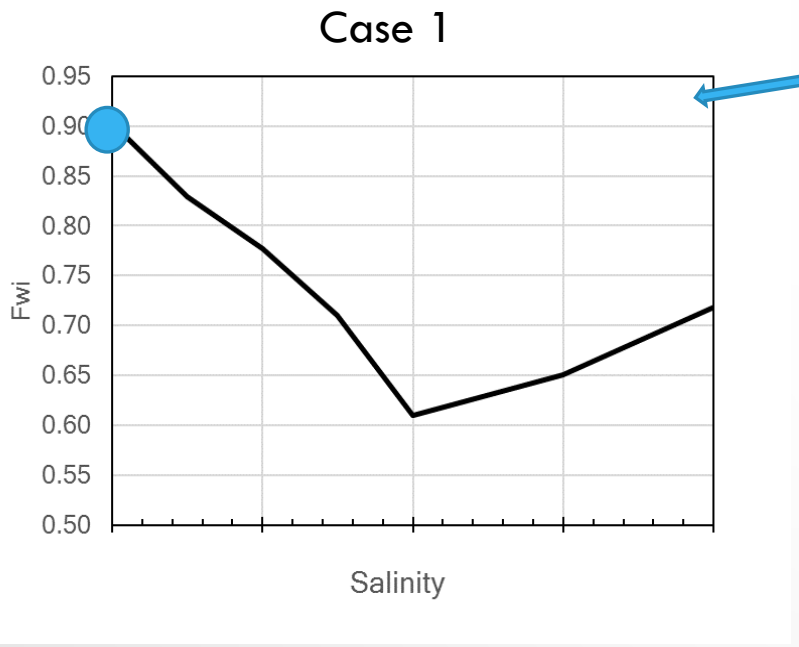
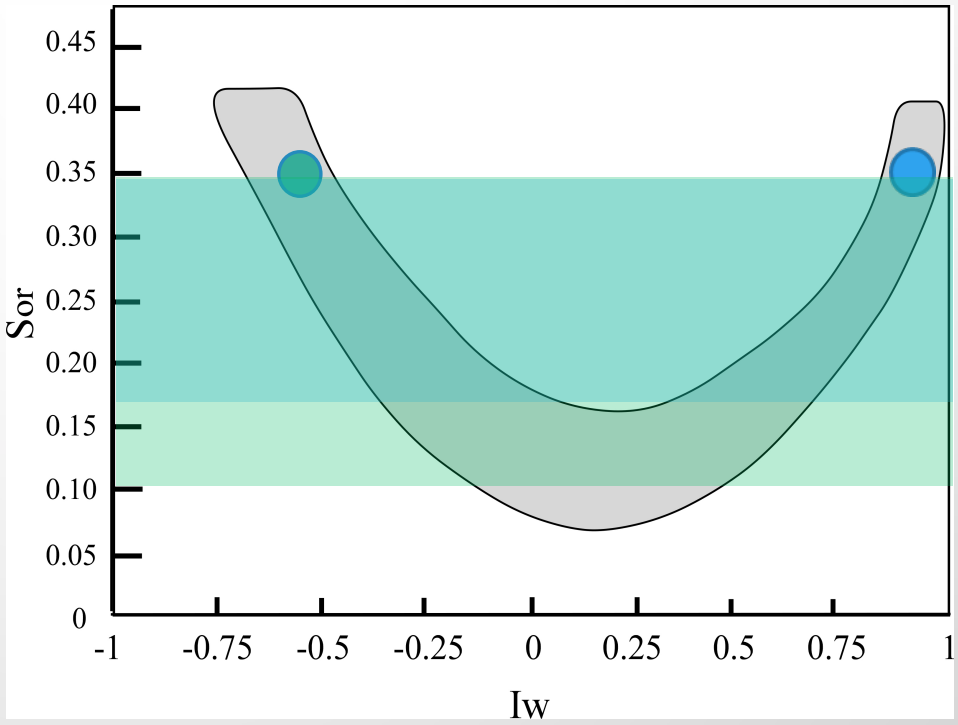
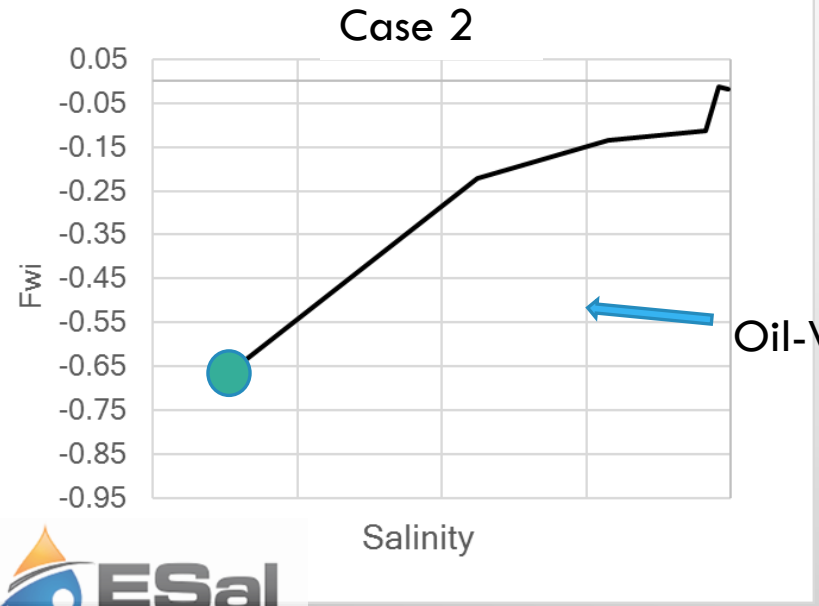



Water-Wet

Change in Sor: .18 units
Estimated increased production: up to 8% OOIP




Oil-Wet

Change in Sor = .25
Estimated increased production: up to 12% OOIP

Increased production is dependent on heterogeneity, well spacing, porosity, original saturation, temp and pressure.

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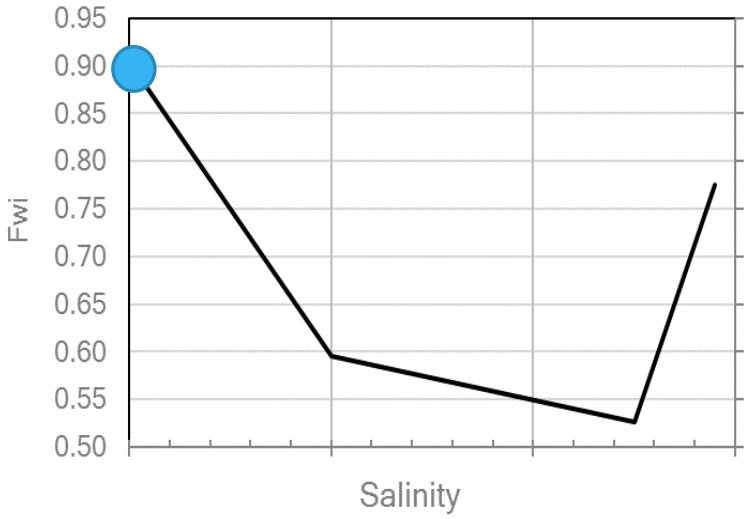
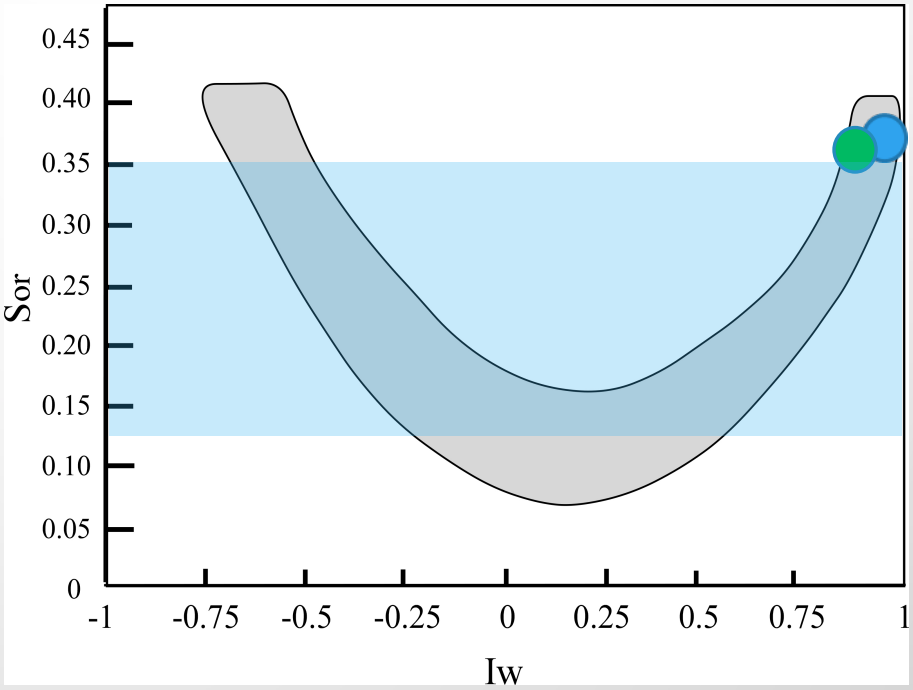
## Case 3

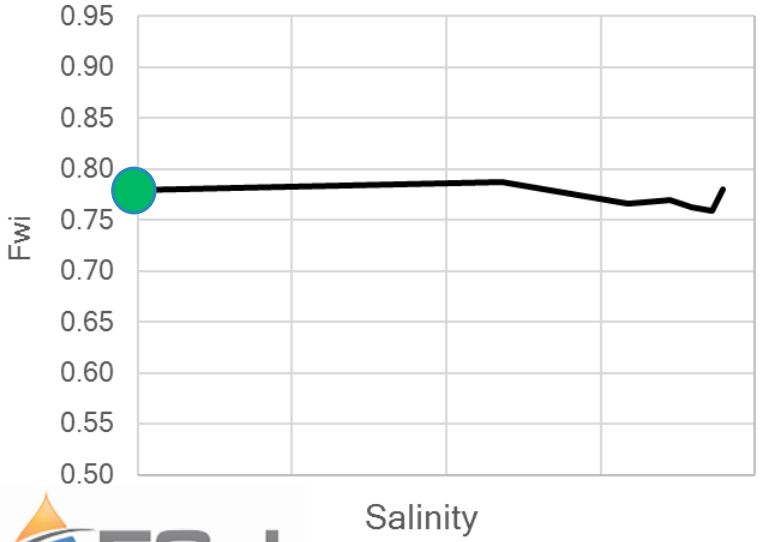



Change in Sor = .22

Estimated increased production: up to 10% OOIP




## Case 4




Change in Sor = 0

Estimated increased production: 0% OOIP

Increased production is dependent on heterogeneity, well spacing, porosity, original saturation, temp and pressure.

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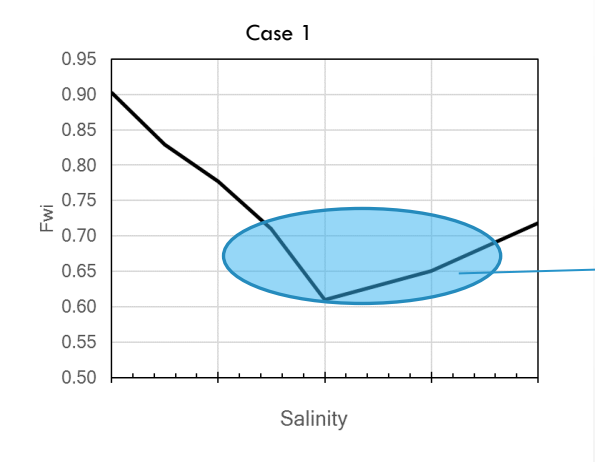
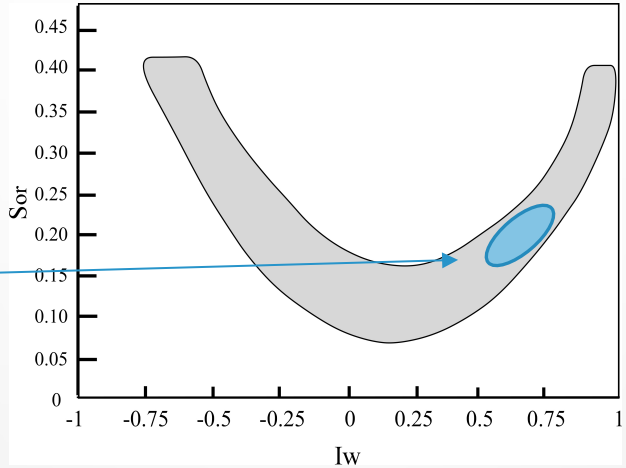
# FINANCIAL EVALUATIONS

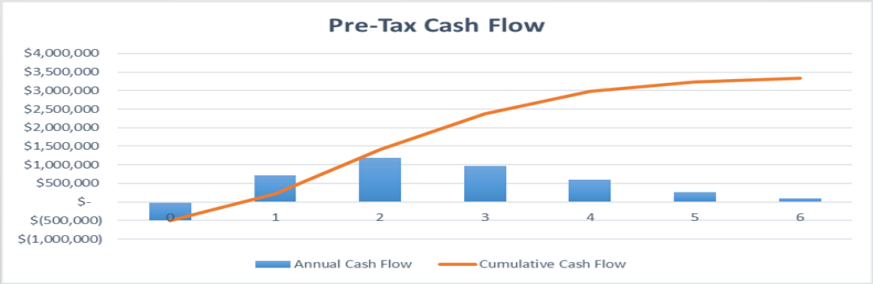



Our laboratory processes tell you exactly the right water solution for your individual reservoir

We give you various options to match your cost constraints and logistics for your maximum benefit

| | | Year | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Investment | $ | 500,000 | | | | | | |
| Production | | | 18,400 | 28,100 | 23,500 | 15,700 | 8,800 | 3,600 |
| Price Per Barrel | | | $ 50.00 | $ 50.00 | $ 50.00 | $ 50.00 | $ 50.00 | $ 50.00 |
| Total Revenue | | | $ 920,000 | $ 1,405,000 | $ 1,175,000 | $ 785,000 | $ 440,000 | $ 180,000 |
| Fixed Costs | | | $ 66,000 | $ 66,000 | $ 66,000 | $ 66,000 | $ 66,000 | $ 66,000 |
| Variable Costs | | | $ 235,400 | $ 254,800 | $ 65,600 | $ 50,000 | $ 36,200 | $ 7,200 |
| Depreciation | | | $ 93,782 | $ 143,221 | $ 119,776 | $ 80,020 | $ 44,852 | $ 18,349 |
| Total Expense | | | $ 395,182 | $ 464,021 | $ 251,376 | $ 196,020 | $ 147,052 | $ 91,549 |
| Pretax Profit | | | $ 524,818 | $ 940,979 | $ 923,624 | $ 588,980 | $ 292,948 | $ 88,451 |
| Net Pre-Tax Cash Flow | $ | (500,000) | $ 618,600 | $ 1,084,200 | $ 1,043,400 | $ 669,000 | $ 337,800 | $ 106,800 |
| Cumulative Pre-Tax Cash Flow | $ | (500,000) | $ 118,600 | $ 1,202,800 | $ 2,246,200 | $ 2,915,200 | $ 3,253,000 | $ 3,359,800 |

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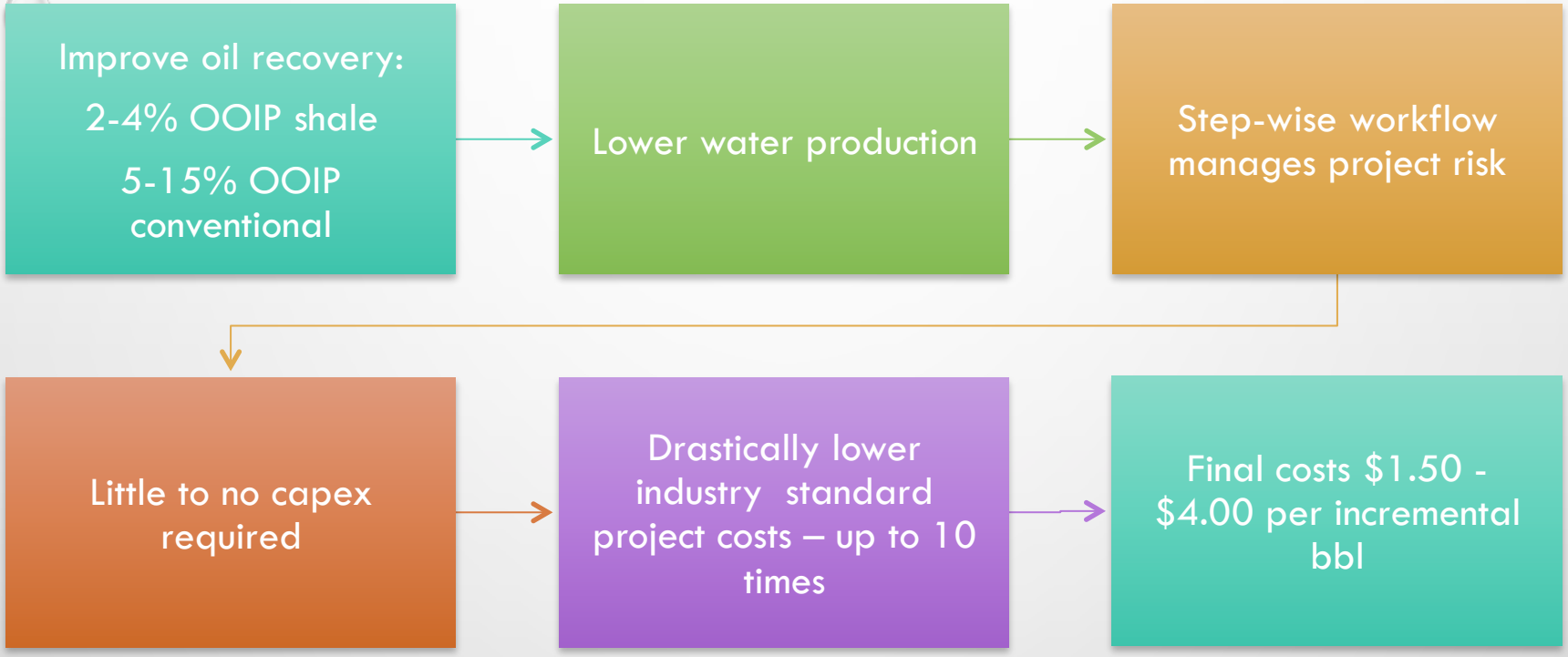
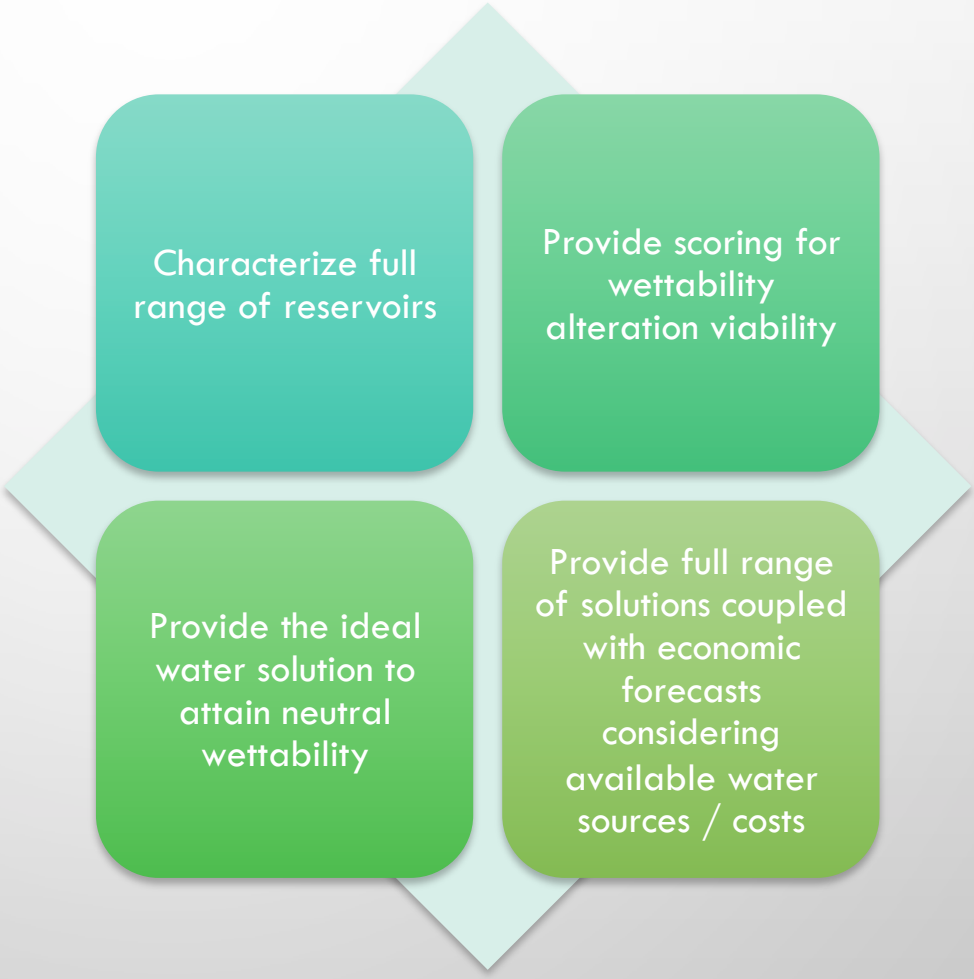



# BENEFITS OF USING ESAL

# Currently developing a full service software solution

## THE FUTURE OF ENGINEERED SALINITY

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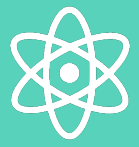
# QUESTION: WHAT DO WE NEED?



Additional partners to continue technology validation

Capital partners to increase market size and adoption

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# QUESTIONS?

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