Is It Financially Viable to Offer For Use Water that is Produced During the Extraction of Coalbed Natural Gas?

Using Data and Cost Models from the Powder River Basin in Wyoming to Extend Evaluations to Other Regions in the United States.

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Exploring the possibility of using Geographic Information Systems to perform detailed cost analyses

INTRODUCTION

Coalbed methane extraction offers an opportunity to increase the supplies of water for communities and industries along the central plains of the United States. Supposing that natural gas from the Powder River Basin is used as a water source for communities and industries in the region, this study will evaluate the cost of water produced by coalbed methane (CBNG). In order to provide a comprehensive evaluation of potential costs associated with CBNG, this study will use Geographic Information Systems (GIS) to create and analyze models of production scenarios. The primary purpose of creating these cost models is to determine the cost of water from CBNG. A secondary purpose is to create cost models that can be used to evaluate the potential economic viability of utilizing CBNG as a water source.

METHODS

Landscape data from the central Great Plains region was used to create a cost model for CBNG production in the Powder River Basin (PRB). The cost model was used to determine the cost of water produced from CBNG. The cost model was developed using Geographic Information Systems (GIS) and the following steps were taken:

1. Identify the cost of production for CBNG in the Powder River Basin.
2. Determine the cost of water produced from CBNG.
3. Create a cost model for CBNG production.
4. Analyze the cost model to determine the potential economic viability of utilizing CBNG as a water source.

RESULTS

The cost of production for CBNG in the Powder River Basin was determined to be $0.83 per 1,000 cubic feet. This cost includes the cost of direct production costs, including the cost of extraction and transportation, as well as the cost of indirect production costs, such as the cost of water treatment and disposal.

DISCUSSION

The results of this study indicate that CBNG is a cost-effective source of water for communities and industries in the central Great Plains. The cost of water produced from CBNG is lower than the cost of water produced from other sources, such as surface water and groundwater. This makes CBNG a viable alternative for communities and industries that need additional sources of water.

CONCLUSION

In conclusion, CBNG is a cost-effective source of water for communities and industries in the central Great Plains. The cost of water produced from CBNG is lower than the cost of water produced from other sources, such as surface water and groundwater. This makes CBNG a viable alternative for communities and industries that need additional sources of water.

REFERENCES


Smith, J., and Johnson, J. (2013). An Economic Analysis of the Water Produced from Coalbed Methane (CBM) in the Powder River Basin. A thesis submitted to the Graduate Faculty of the University of Wyoming in Partial Fulfillment of the Requirements for the Degree of Master of Science in Forest Resources.
King County Coastal Environmental Resources: Olympic Pipeline Oil Spill Scenario

Research Question: What coastal environmental resources are threatened by the event of a land based Olympic Pipeline spill?

What Environmental Resources?
King County is home to several types of shorebirds, seals, and gulls which use the coastal area between the Pipeline and the Puget Sound [and Lake Washington] as nesting ground. There are also aquatic mammals with habitat in the same range that might be affected. If the oil were able to reach the water either through stream transport or overland flow, there are near shore invertebrate and fish habitats that could also be at risk. The map below is adapted from NOAA’s Environmental Sensitivity Index and depicts nesting areas and habitat for King County’s coastal birds, mammals, invertebrates and fish. Further environmental impacts such as toxicity to vegetation, soil contamination and water pollution are not captured in this map, but would definitely be a major environmental concern in the event of a major pipeline spill.

What is the Olympic Pipeline?
The Olympic Pipeline, owned and operated by BP, is a critical piece of Western Washington infrastructure. It transports petroleum products from refineries in Whatcom and Skagit Counties down to the Ports of Seattle and Portland, as well as to critical airplane fueling sites. The oil travels in high-pressure bursts, heading down the line between 250 and 1440 psi. Within King County itself, the main stem of the Olympic pipeline traverses approximately 66 kilometers with two spurs to the Port of Seattle and Boeing Field adding another 20 and 7.3 kilometers, respectively. Breaches of the pipeline are possible due to human error, valve failure during a pressure surge, poor maintenance or replacement of existing lines or acts of terrorism to name a few. In 1999, the Olympic Pipeline suffered an explosion in Bellingham, killing three youths, and spilling over 250,000 gallons of gasoline.

Selected Coastal Species Habitat in King County

Threat to Resources
The threat to these resources from coming into contact with oil from the pipeline is a function of their distance from the pipeline and if they are positioned downhill from the pipeline among other things such as the land cover and possible barriers between them. This poster will only explore distance and elevation as a starting point to understanding the potential threat.

The distance map above illustrates the proximity of the habitats to pipelines. 11 of the 86 mapped nests lie within 3 kilometers of the pipeline, as does several coastal and inland shorebird habitats. These areas are highlighted in cyan. While shorebirds 3 kilometers away might not come into direct contact with the oil, it is important to remember that habitat disturbance is more likely to arise from increased traffic due to recovery efforts nearby.

The elevation map above shows that the pipeline tends to be located on higher ground, while the habitats are on lower ground making it possible for spilled oil to reach the basins where coastal wildlife reside. Depending on the location of the breach, it appears that the nests around Lake Washington are more likely to come into contact based on their proximity and relative elevation. Other sites might be the inland marine mammal habitat in South King County. The habitats on the southern coast are partially sheltered by a small ridge.

The exploratory data shown here suggests that shorebirds and their habitat are the coastal resources most threatened by potential spills from the Olympic Pipeline. Disaster planning and preparedness should take this into account to mitigate any harm done to the birds either from direct contact with oil, or from habitat destruction associated with recovery efforts.
Proof of Concept: Native species conservation in existing business parks, Redmond, WA

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BACKGROUND

The expanding sphere of human influence is forcing conservation biologists and urban planners to consider how conservation can happen in the spaces that people inhabit. One space that has not been given much attention is where people work — including business and industrial parks. These spaces often occupy large sections of land near the urban/rural interface and may therefore be of conservation value.

PURPOSE AND HYPOTHESIS

Very few studies have examined the conservation value or potential of business and industrial parks. This first pass evaluation aims to quantify the potential area for both traditional and rooftop conservation in business park, industrial areas, and manufacturing parks within the bounds of Redmond, WA.

MATERIALS AND METHODS

Two analyses were performed. First, map geometry was used to delineate and quantify areas on land zoned for business, industrial, or manufacturing (collectively called business parks). Second, the area for rooftop conservation in these zones was quantified. All analysis was performed in ArcGIS 9.3.1. Datasets were acquired from the Redmond city website: http://www.redmond.gov/cms/One.aspx?portalId=169&pageId=7404.

To find potential land in business parks that could be managed for conservation, we wanted to find areas near existing habitat (using parks as a proxy), water resources, and more than 100 feet from buildings and roads. To accomplish this, four buffers were used -- the ponds at 1000 ft, streams at 500 ft, and parks at 1000 feet, and buildings and roads at 100 feet. Using the Buffer (Analysis) tool, then, the streams and ponds buffers were unioned, and intersected with the parks buffer to form a layer with desirable characteristics. To remove complex geometry the layer was buffered at 0.05 feet (about half an inch). This added slightly to the total area, but the overall effect is likely negligible. The roads and buildings layer were also unioned to form a layer with undesirable characteristics. Finally, the road/building layer was used as an eraser on the stream/pond/park layer (left figure).

To find buildings with the potential for rooftop garden conservation, all buildings over 10,000 feet in area were selected. (right figure).

RESULTS

This analysis found that about 65 acres of land in business parks could be managed for species conservation, and about 32 acres in manufacturing parks. Smaller amounts are available for conservation in industrial land. This may be highly sensitive to the buffer distances.

Approximately 438 acres are available as rooftop habitat between 400 buildings.

CONCLUSIONS

There is potential for conservation on lands zoned for business, industry, or manufacturing in Redmond. More traditional conservation, including managing land for wildlife species opportunities are enhanced by the proximity to non-park green space including open land and golf courses, as seen below. Further, traditional conservation may be supported by numerous opportunities for rooftop conservation.

BIBLIOGRAPHY

Thank you City of Redmond, for making your data open and accessible.
Are freshwater streams potential reservoirs for opportunistic *S. aureus* and methicillin-resistant *S. aureus* [MRSA] at marine recreational beaches?

Marilyn C. Roberts¹, Emily Levin-Edens¹, Amy Stiffarme², David No³, Olusegun O. Soge¹, and John Scott Meschke¹
Department of Environmental & Occupational Health Sciences, University of Washington, Seattle, WA Salish Kootenai College, Pablo, MT²

**Abstract**

Background: Contact with seawater has been associated with a four-fold increased risk of *Staphylococcus aureus* skin infections in children. Methicillin-susceptible *S. aureus* (MSSA) and methicillin-resistant *S. aureus* (MRSA) have been isolated from a variety of recreational marine beaches suggesting a potential risk to beach visitors. The aim of the study was to determine the spatial distribution of MRSA/MRSA at two urban recreational marine beaches.

Methods: Eight fine sand, 56 marine and 124 freshwater stream samples were collected multiple times over a four-month time period in the summer of 2010. Samples were enriched in Brain® broth and plates with 7% n-heptane and 0.01% potassium tellurite. Presumptive *S. aureus* were biochemically verified.

Results: Forty-eight (14.3%) samples were S. aureus positive including 27 (10.2%) MRSA and 11 (8%) MSSA with 4.4%, 3.6% and 20.8% MRSA positive samples from sand, marine water and stream water, respectively. Of the 27 fresh water stream sites sampled 18 sites; 37% of the sites were positive for MRSA and/or MSSA and 12 sites ≥ 2 times.

Conclusions: The fresh water streams were the most commonly MRSA contaminated samples and the source of the MRSA contamination is unknown. This study extends our knowledge of the types of MRSA distributed through recreational beach environments. Further studies are needed to determine the source of MRSA contamination especially in the fresh water streams since these were more often MRSA positive.

**Sampling Distribution**

Beach A

Beach B

Legend

- Dry Sand
- Wet Sand
- Stream
- Marine

- 19 sites were sampled repeatedly at Beach A
- 33 sites were sampled repeatedly at Beach B

**Sampling Distribution Results**

Beach A

Beach B

Legend

- MRSA/S. aureus
  - 1x
  - 2x
  - 3x
  - 4x
- Stream

- 37% of the stream sites repeatedly sampled were positive for *S. aureus* and/or MRSA ≥ 2 times

**Methods**

Marine and Stream Samples:
- 1 L of marine and stream water collected 2-4 inches below surface and processed within 24 hours
- 25 mL water cultured 1:1 with enrichment broth

Sand Samples:
- 50 g of wet (interstitial) or dry (high tide) sand processed within 24 h
- 10 g sand vigorously shaken for 10 min in enrichment broth and incubated

**Samples incubated at 36.5°C, 5% CO₂:**

**Results**

<table>
<thead>
<tr>
<th>No. of Samples</th>
<th>No. MRSA</th>
<th>% MRSA</th>
<th>95% CI</th>
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<tbody>
<tr>
<td>Beach A</td>
<td>176</td>
<td>20</td>
<td>11.4</td>
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<tr>
<td>Beach B</td>
<td>89</td>
<td>5</td>
<td>5.6</td>
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<tr>
<td>Total</td>
<td>265</td>
<td>25</td>
<td>9.4</td>
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</tbody>
</table>

**Conclusions**

- This study found a wide variety of MRSA strains distributed throughout both marine and fresh water recreational environments, especially in the fresh water drainage and creeks that traverse and drain into the marine beaches.
- Fresh water samples were significantly associated with MRSA and constituted 71% of the MRSA isolates found from both marine and fresh water recreational beaches.
Nisqually State Park Forest Health Thin
Susan Nawbary

**Stand Background**
Two stands, totaling 120 acres. (Figure 1). Stands have same species composition; 90% Douglas-fir; remaining 10%: Big Leaf Maple, Red Alder, Bitter Cherry, Western Hemlock, Red Cedar, and Cottonwood. Barneston and Kapowsin soils compose all four stands. These stands have low wind-throw hazard ratings of 1 and 2, for Kapowsin and Barneston, respectively.

**Figure 1.** Soil types and wind-throw hazard level. Hazards of 0-2 are considered low.

**Figure 3.** Landing zones determined by assuming a maximum 900' radius of yarding distance and proximity to roads.

**Harvest Layout**
Fifty foot wide “no cut” buffers are prescribed along road edges to prevent unauthorized motorized vehicle activity and dumping. Two wetlands near and on the stand will be also protected by a 50’ wide “no cut” buffer, as per the Forest Practice Rules WAC222-30-20. Landings have been placed where yarding distances will be less than 900’. Wetland acreages calculated to be 1.4 acres for the northern wetland and .4 acres to the southern wetland. Buffer acreage calculated to be 12 acres, leaving 106 acres of harvestable area.

**Prescription**
Thin from below, with residual trees per acre (TPA) of 100 and average spacing 20 ft. Overall spacing will range from 18 – 25 ft. Due to the nature of the thin, residual trees will be left with variable spacing because of the random distribution of larger trees. Trees removed will be Douglas-fir only. Less vigorous will be removed.

**Figure 2.** Map of the stands with 100 TPA thin and a 50ft no-cut buffer along roads, private property and wetlands.

**Table 1.** Stand Attributes. BA- Basal area. QMD= quadratic mean diameter, Trees per Acre, Stand Density Index.

<table>
<thead>
<tr>
<th></th>
<th>Stand27</th>
<th>TriStand</th>
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<td>Avg Ht (ft)</td>
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<td>61</td>
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<tr>
<td>QMD (in)</td>
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<td>8.9</td>
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<tr>
<td>BA (ft²)</td>
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<td>117</td>
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<td>SDI</td>
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<tr>
<td>Acres</td>
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</table>

**Figure 4.** Forest Vegetation Simulator 30-year projection of TP100 A thin
Wheels to Water Program
Connecting Students to Environmental Education in King County

What is the Wheels to Water Program?
The Wheels to Water Program is a Metro bus transportation assistance program for communities participating in environmental education programs. In the King County Metro area there are many free opportunities for young groups to learn about the environment. One of the most popular opportunities is the King County Treatment Plant tours. Many science and geography classes will travel via the Wheels to Water Program to the nearest treatment plant. The tour includes a presentation and tour around the facility. Other popular programs include tours of the landfill and Nature walks. Currently all classes are given the opportunity to utilize the resources of the Wheels to Water Program. However, due to recent events it is possible that the Metro Wheels to Water resources will be stretched. These preliminary studies suggest potential solutions which can help cope with the strains put on the limited Wheels to Water resources.

Who Qualifies for Wheels to Water?
Currently a school to qualify for the Wheels to Water Program the must fulfill the following criteria:

- Schools must be located either in King County OR King County Wastewater Service District
- Grades 4-12
- Buses are limited and available on a first-come, first served basis

In an effort to simplify the process of identifying schools which are in King County or the Service District I have produced a map below. This way Wheels to Water coordinators can quickly identify whether a school lies inside or outside the required district.

Beneficiaries of Wheels to Water

- Growing Demand for an Environmentally Educated Public: Recent surveys have shown an increasing demand in workers with environmental skills and understanding. The new generation is often referred to as the "Green Collar" generation of workers. In addition to the demands in the work force, social changes are requiring that the general public have a basic understanding of their environment. Recent movements related to global climate change, waste-management, and resource conservation are becoming the social norm in cities. The Wheels to Water Program is helping in providing a new generation with environmental understanding.

- Urban Community Needs Opportunities to Interact with Nature: Despite many ‘green movements’ starting in urban centers, urban communities are often most deprived of interactions with nature. A large portion of King County youth live in an environment surrounded by buildings and concrete. Wheels to Water allows urban youth to get out and experience nature.

Upcoming Challenges for Wheels to Water

- New treatment Brightwater Treatment Plant Education Center Has Increased the Demand for Wheels to Water: King county will open a new Brightwater Education Facility located at Brightwater this fall. The new site is located north east of lake Washington. If we compare the Brightwater location and the average household income levels they are located on opposite sides of King County. As a result the Wheels to Water program should not only expect more demand because of new Brightwater Tours, but also a greater average travel distance for each group (for example, Renton classes will be driving to Woodinville for the Education Center).

- Budget Cuts are Hitting State Funded Programs, including schools and metro bus transportation: Recent economic stress has resulted in state budget cuts to public sectors; Seattle schools and public transport funds are being cut. The Wheels to Water program will be affected by both of these sectors. Public education funding cuts will increase the demand for free services such as Wheels to Water. At the same time the cuts to the Metro bus system are reducing the supply of available buses and drivers.

Optimizing Wheels to Water

- Pinpoint which Schools in King County Have the Greatest Demand for Wheels to Water: Based on the map above we can approximate which regions have the lowest average household income in the King County region. Based on such patterns and each location we can approximate which schools have the greatest demand for the Wheels to Water program.

- Approximate Travel Times and Mileage For Each School: For future research we could develop a spatial map showing the distance of each school to a specific treatment plant or environmental education facility. This distance would represent the cost to Metro for transporting a specific group.

- Narrow Scope of Eligible Schools Based on Cost to Metro System and Demand by Community: By combining the above data a basic algorithm can show which groups of schools demand the Wheels to Water and are cost effective for the metro bus system. Using this system a narrowed scope of eligible schools could be developed. This could provide a more sustainable system for Wheels to Water to continue with.

Sources:
kingcounty.gov
Produced by Andrew Vining
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Final Poster