

# **Next Generation Hydroelectric & Transmission Viability Study - Screening & Ranking Process**

26 November, 2014

- Team Midgard is a group of energy industry leaders
- Each Team member brings specific expertise and experience needed to address complex energy infrastructure issues with a Yukon focus

TEAM MEMBER	ROLE
<i>Midgard Consulting</i>	<ul style="list-style-type: none"><li>• Project Management</li><li>• Hydroelectric and Renewable Energy Development</li><li>• Transmission Planning and Design</li><li>• Long Term &amp; Strategic Planning</li><li>• Economic Forecasting, Market Assessment and Financial Analysis</li><li>• Business Case Development</li></ul>
<i>SLR Consulting</i>	<ul style="list-style-type: none"><li>• Socio-Economic and Environmental Management</li></ul>
<i>Hatfield Consulting</i>	<ul style="list-style-type: none"><li>• Environmental Technical Support</li></ul>

TEAM MEMBER	ROLE
<i>Kawa Engineering</i>	<ul style="list-style-type: none"><li>• Hydroelectric Design and Layout</li><li>• Field Verified Construction Costs and Techniques</li></ul>
<i>J.D. Mollard &amp; Associates</i>	<ul style="list-style-type: none"><li>• Transmission Line Route Selection</li><li>• Reservoir Erosion Modelling</li></ul>
<i>George Steeves</i>	<ul style="list-style-type: none"><li>• Hydroelectric Design and Development</li><li>• Debt and Financing</li></ul>
<i>Yukon Peer Review Panel</i>	<ul style="list-style-type: none"><li>• Internal Review Panel of Senior and Respected Yukoners</li><li>• Yukon Voice</li></ul>

- TEAM: Expertise in hydroelectric and transmission development with a Yukon focus

# **Yukon Challenge**

Electricity is important to our daily lives.

Electricity is an essential part of participating in the modern economy

- Therefore, we want electricity to be available on demand

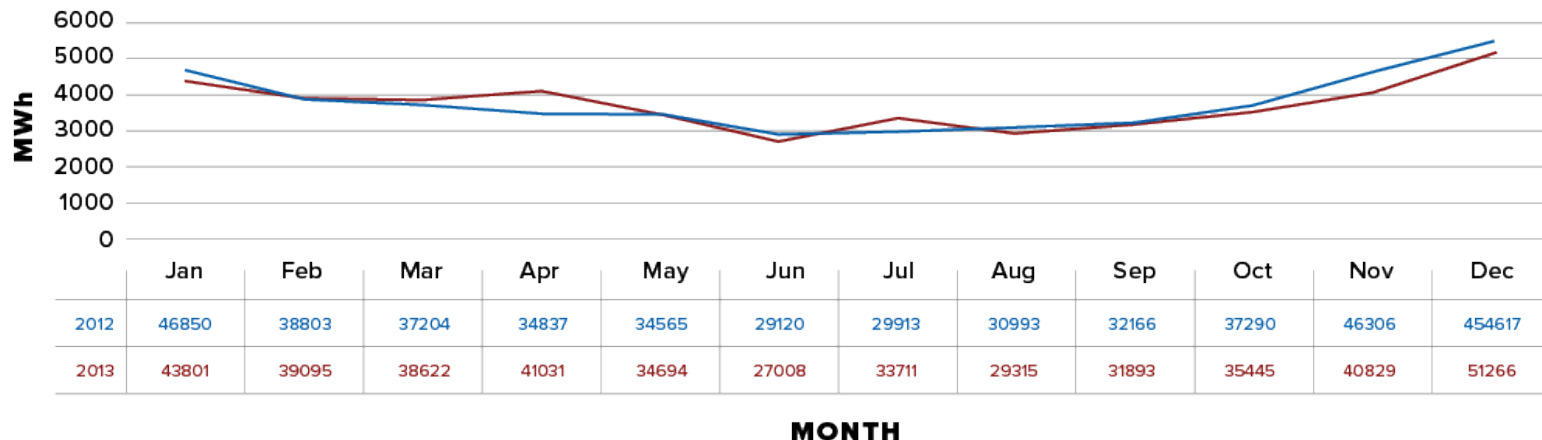
Let's explore two time frames

- Seasonal
- Daily/Hourly
  - NOTE: There are other time frames that matter when operating an electrical grid

## Seasonal

- Warm in summer, cold in winter
- Longer days in summer, shorter days in winter
- Snows accumulates in winter, snow melts in summer
- River flows higher in summer, lower in winter

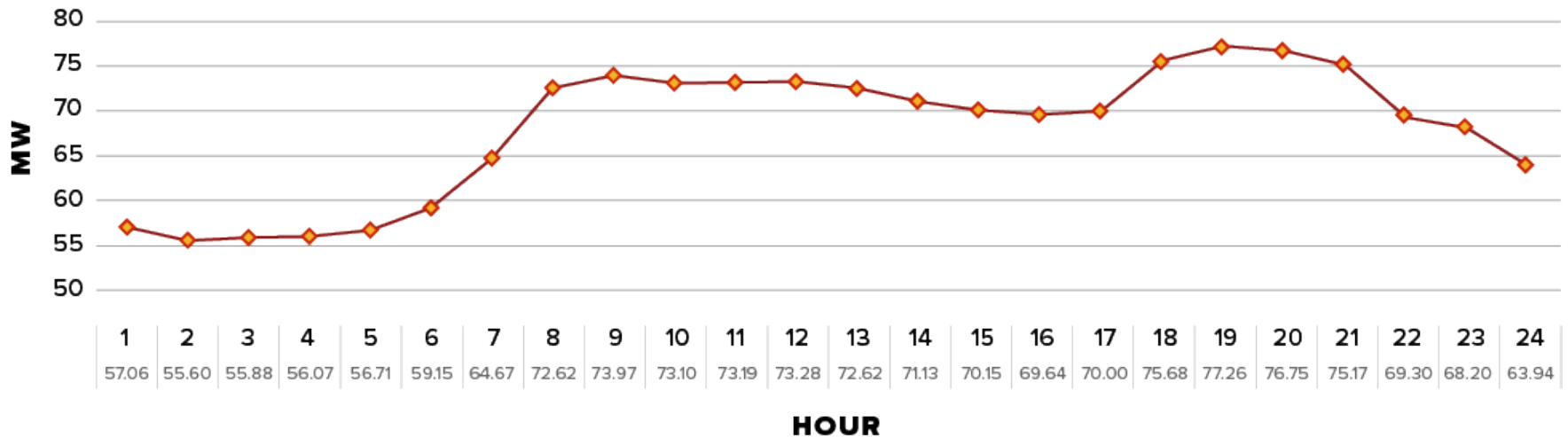
## MONTHLY ENERGY GENERATION 2012 AND 2013

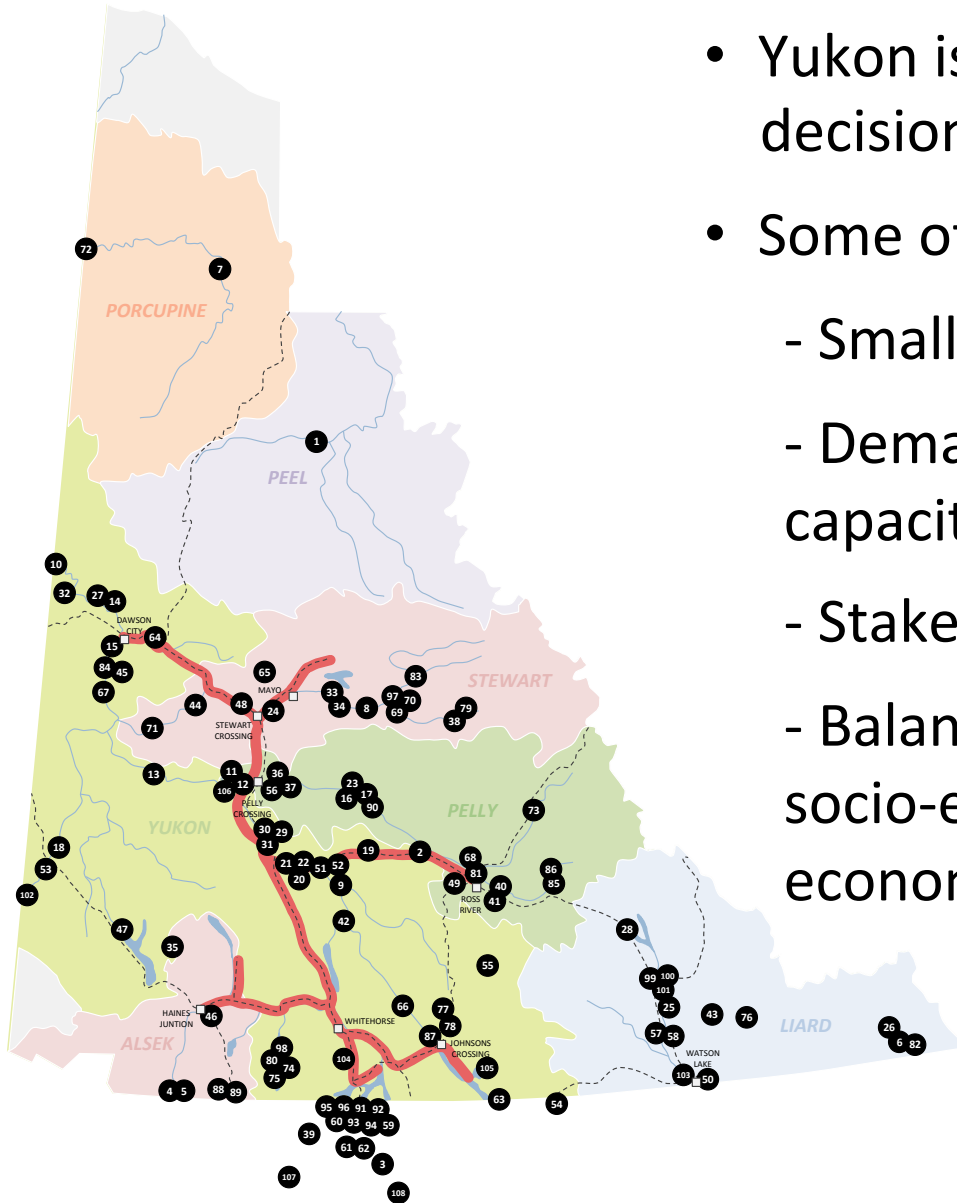


## Daily

- Sleep at night, awake during the day
- Prepare & eat food each day (e.g. breakfast & dinner)
- Work during the day, home in evening (to chores & TV)
- Turn lights, heating, appliances on & off

January 28, 2013

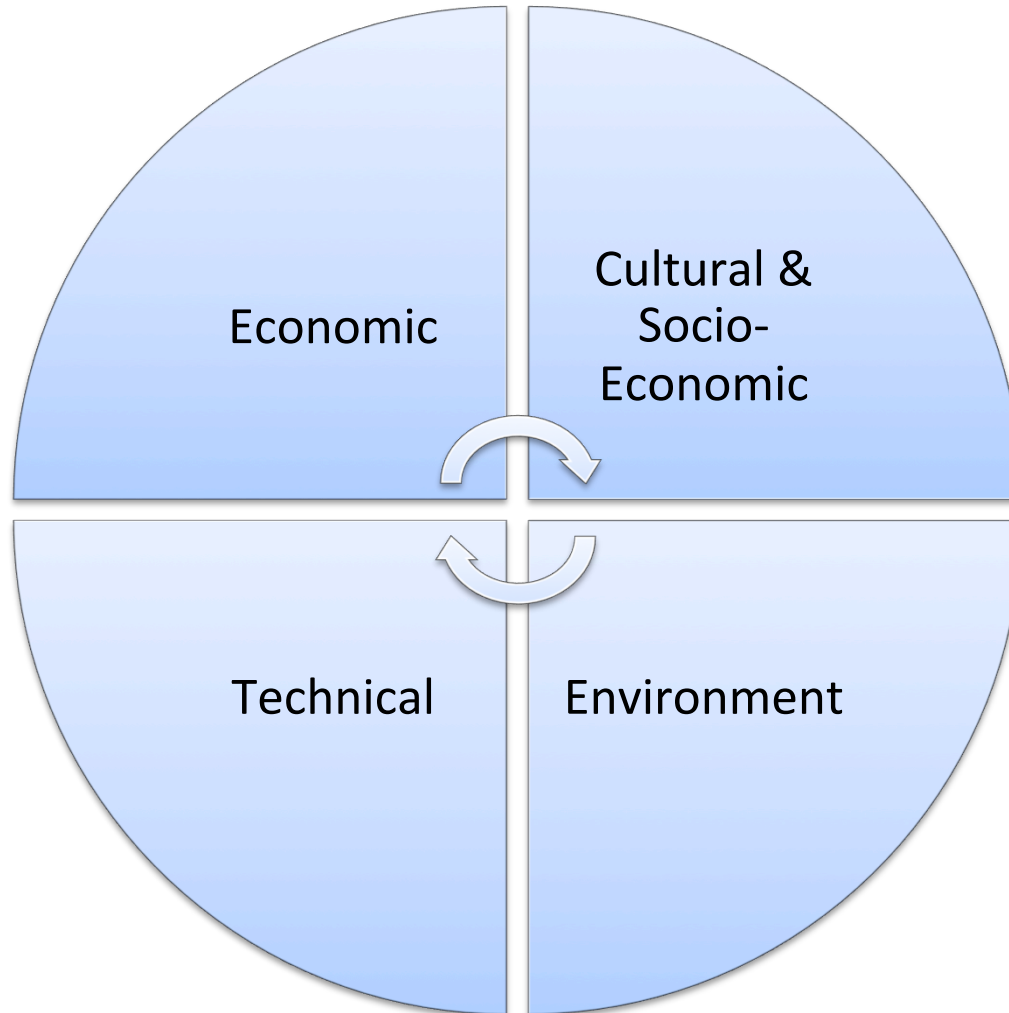




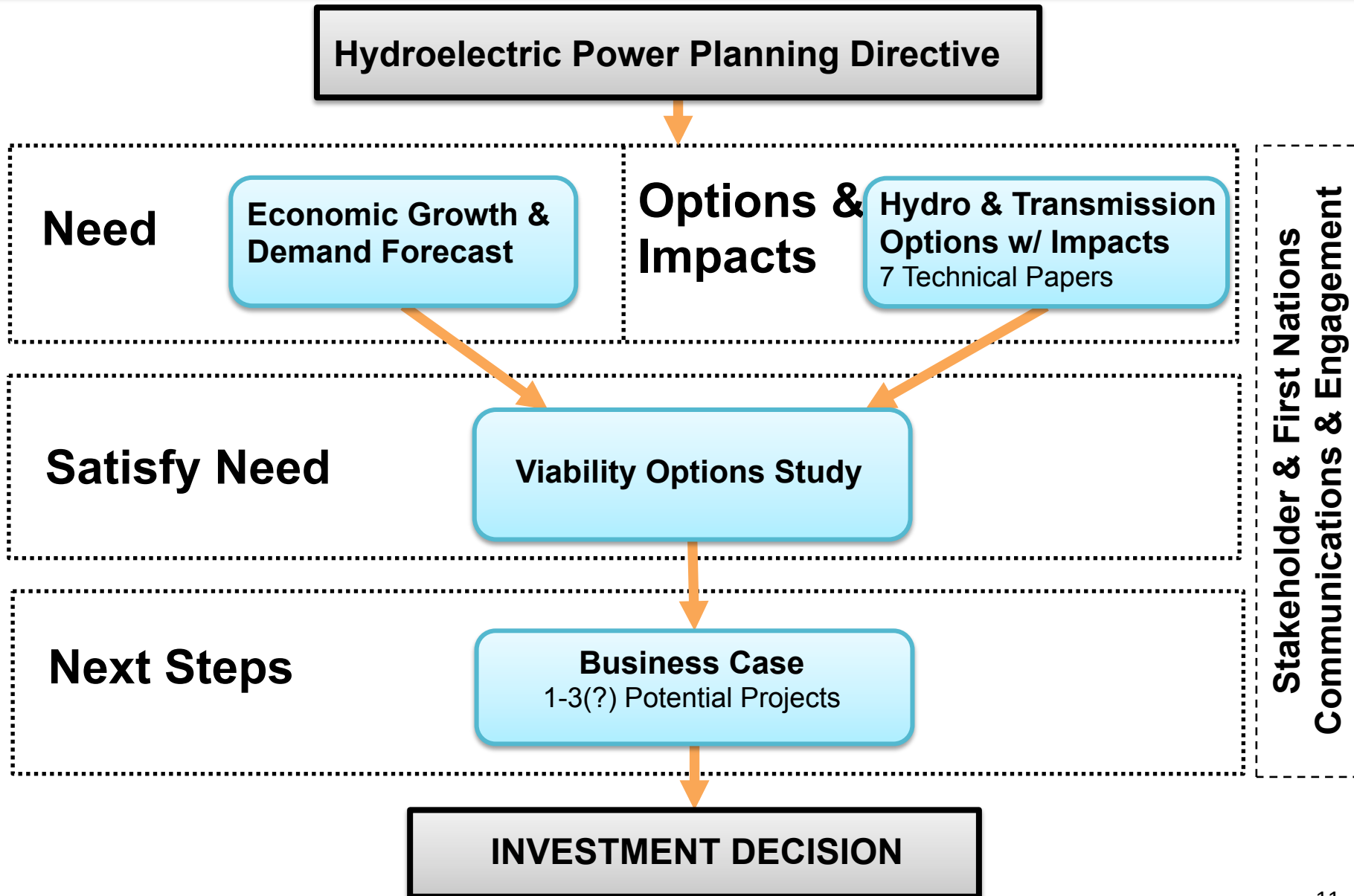
- Yukon is facing a difficult investment decision
- Some of the key challenges include:
  - Small islanded grid
  - Demand for winter energy and peaking capacity
  - Stakeholder and First Nation concerns
  - Balancing environmental, cultural and socio-economic impacts with technical & economic constraints

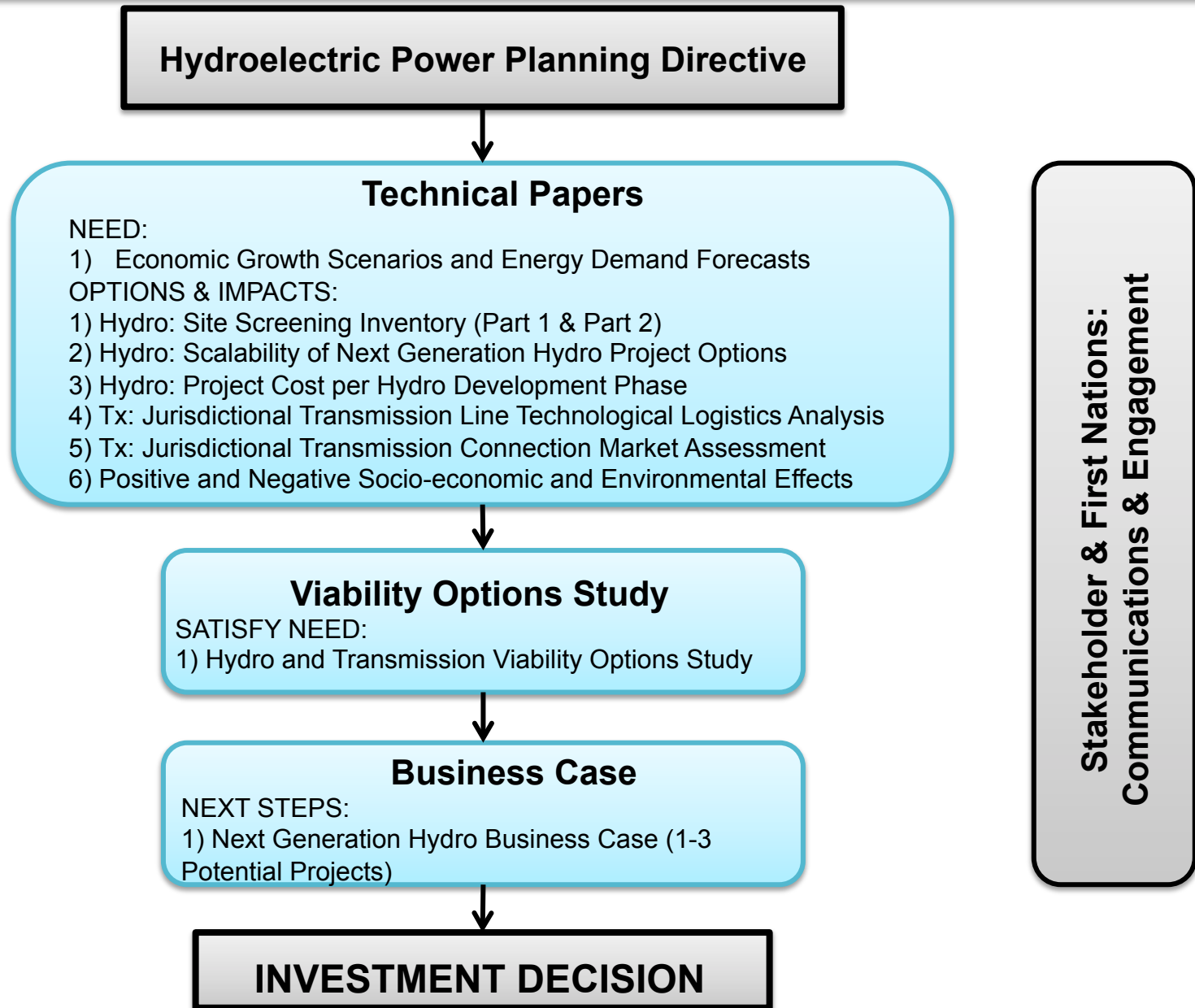


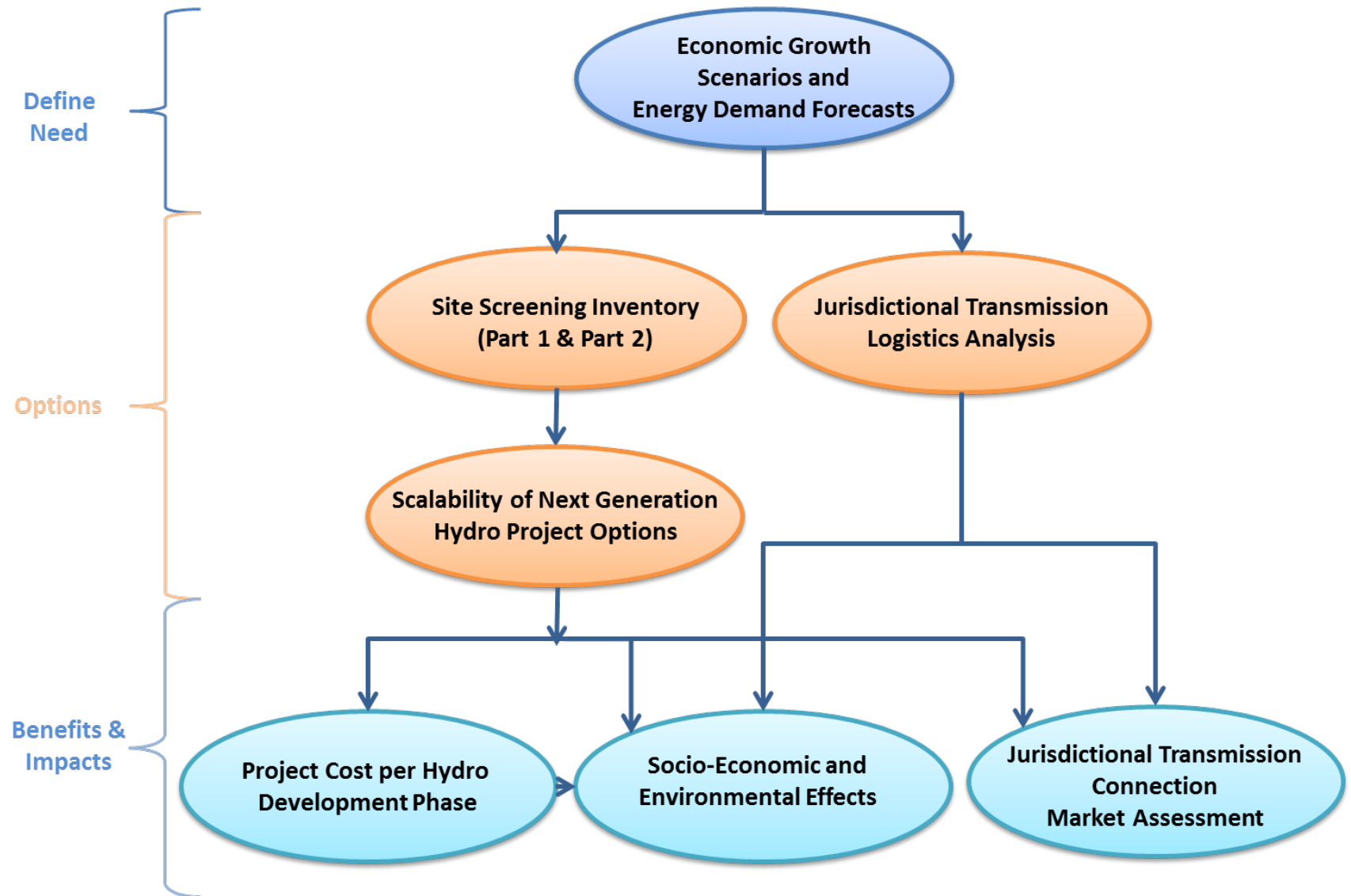
- Help inform the first steps in a conversation about the benefits & impacts of hydroelectricity in the Yukon



# **Approach & Methodology**







# **Forecasting The Need For Electricity**

## Economic Growth Scenarios and Energy Demand Forecasts

- 20 to 50 Years Into the Future
- Scenarios (High, Expected, Low)

### 3 Steps

#### 1) Electricity Demand

- Residential & Commercial: Population
- Industrial: Mining

#### 2) Electricity Supply

- Existing & Committed Assets
- LESS Retirements

#### 3) Electricity Gap (“Need”)

- Demand LESS Supply

#### **Electricity Demand**

*Residential +  
Commercial + Industrial*

*Less:*

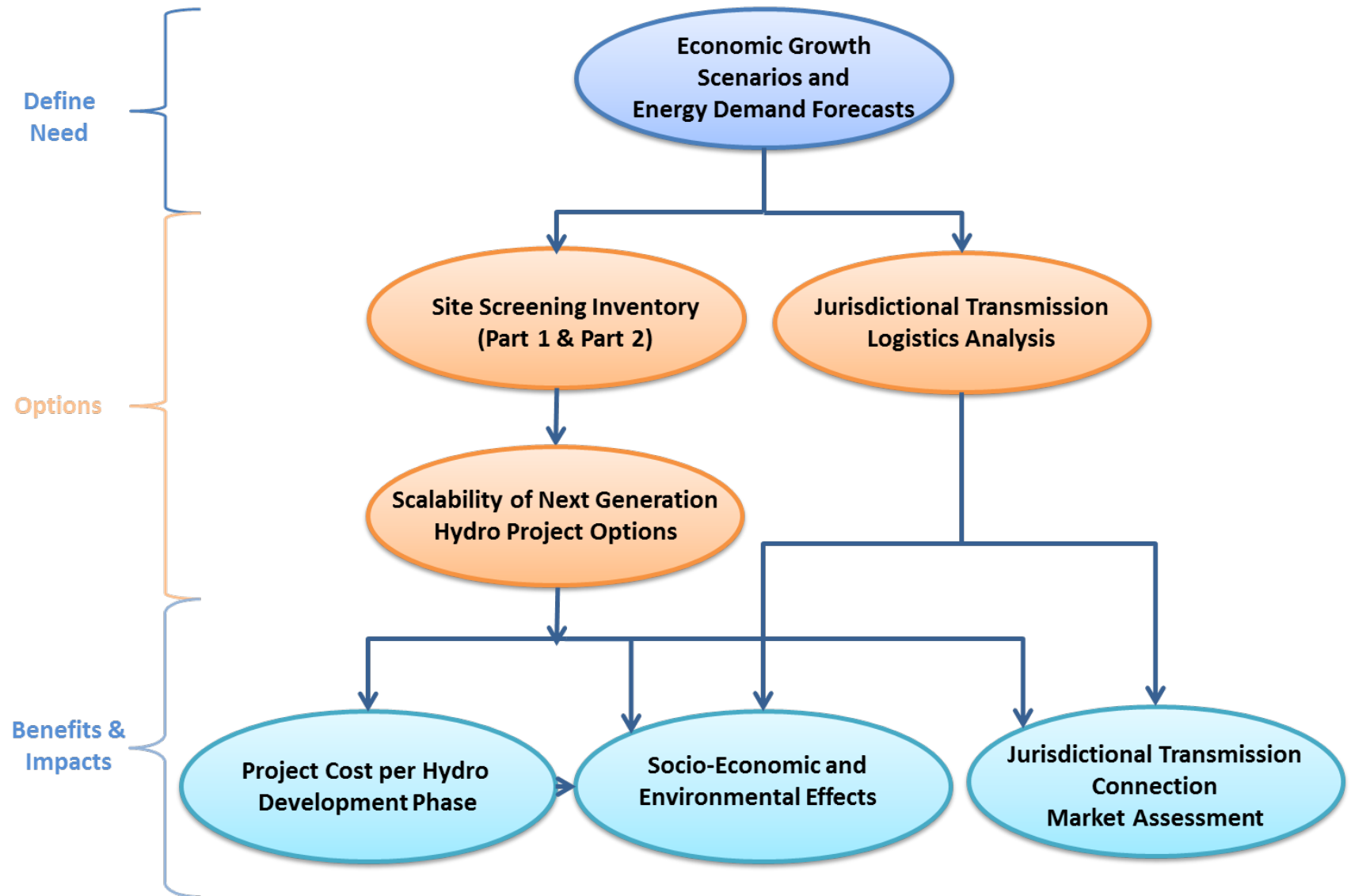
#### **Electricity Supply**

*Equals:*

#### **ELECTRICITY NEED/GAP**

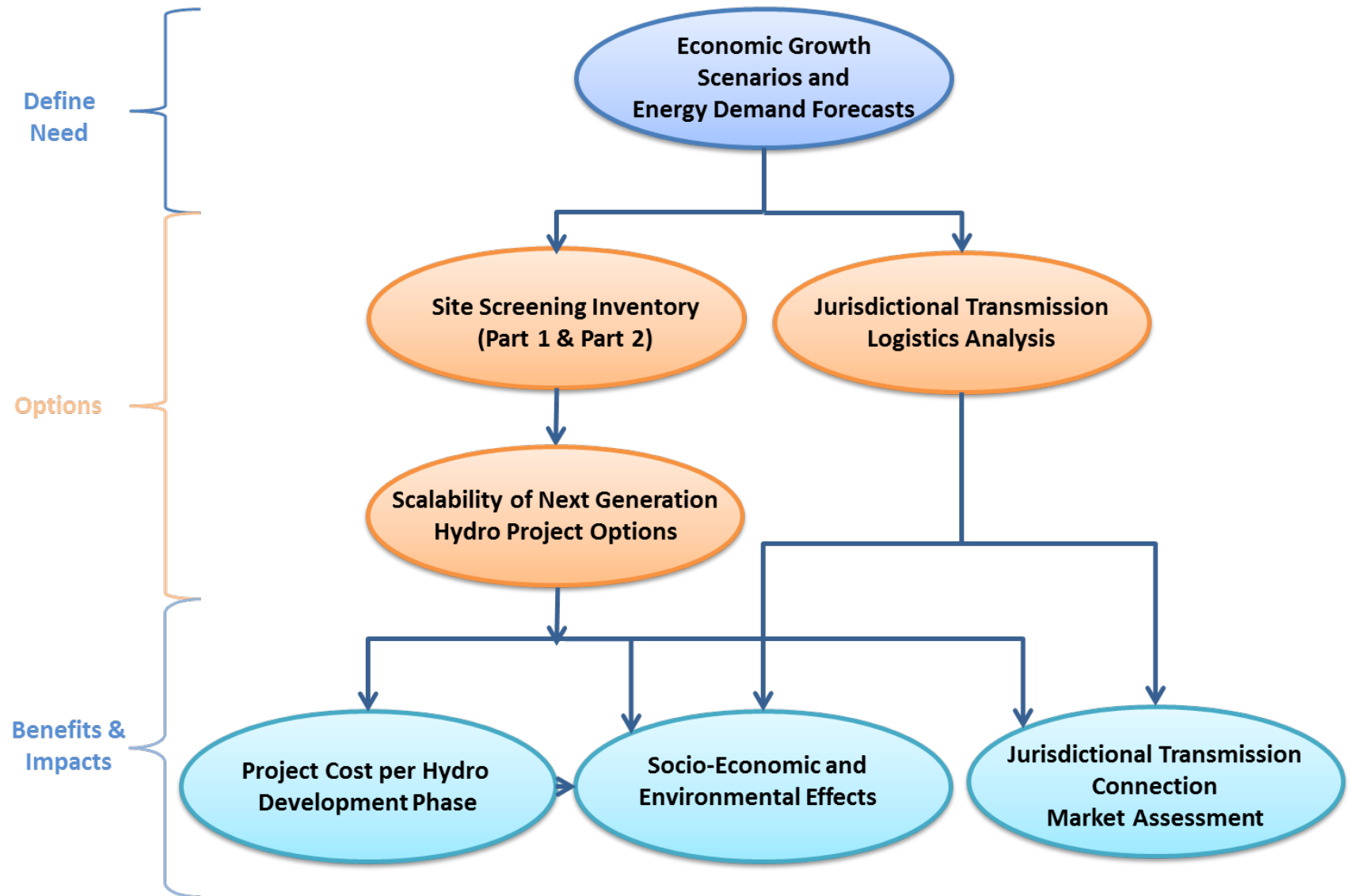
# **Options & Impacts – Hydroelectricity & Transmission**



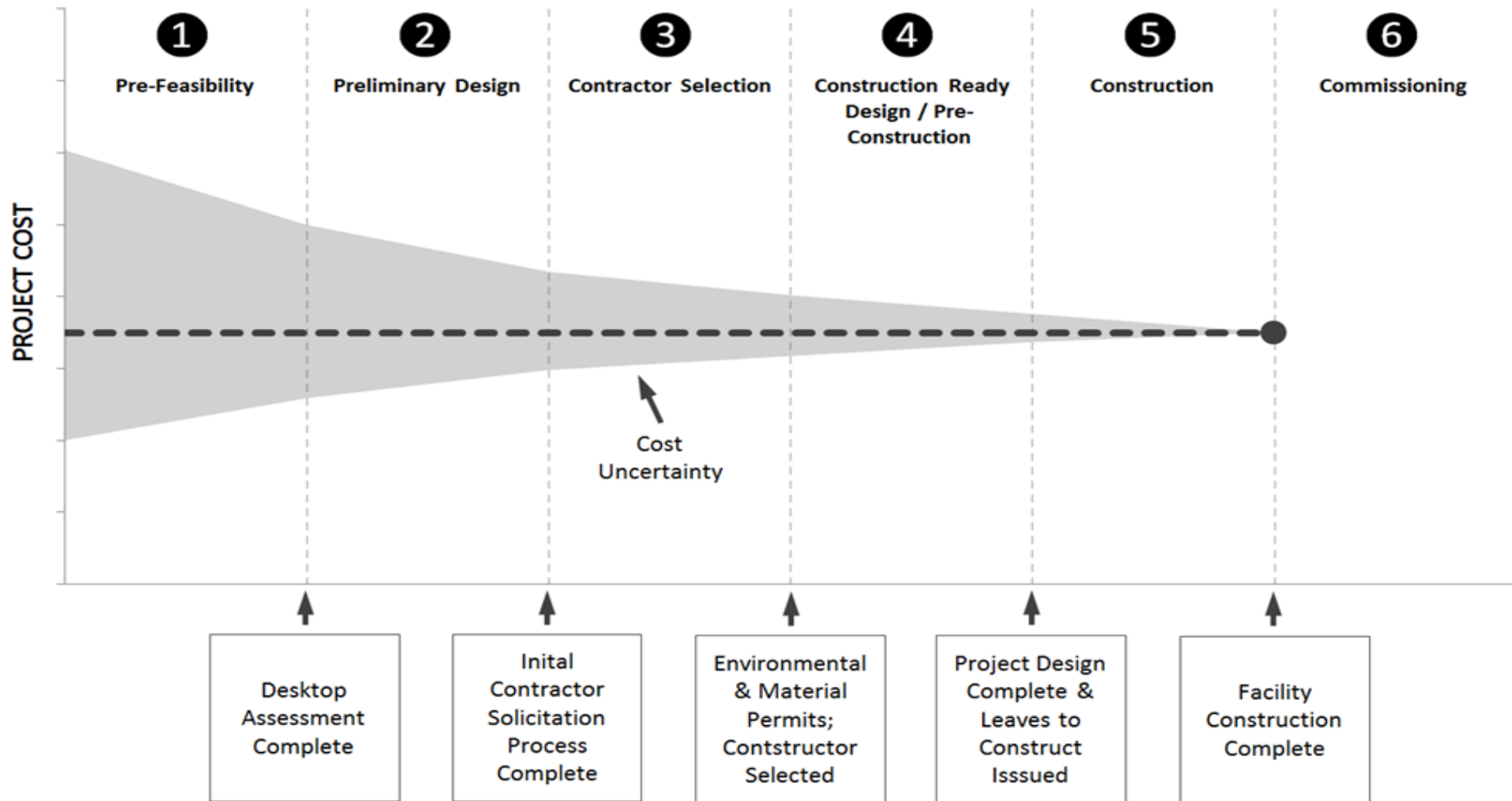


- Site Screening Inventory (Part 1 & 2)
  - Goal: Screen All Known Sites to Create a Ranked “Short List” of Preferred Potential Sites
  - Part 1 is Complete
  - Part 2 is planned for January 2015
- Scalability of Hydroelectric Project Options
  - Scale/Expand “Short List” to Better Match “Need”
- Jurisdictional Transmission Analysis
  - Analyze potential connections to BC and Alaska (Skagway, Fairbanks)

## **Benefits & Impacts**



# Hydro Development Costs



Goal: Maximize the benefit to First Nations & Stakeholders while minimizing adverse effects and mitigating unavoidable negative impacts

## Environmental

- Atmospheric Environment
- Aquatic Environment
- Terrestrial Environment

## Socio-Economic

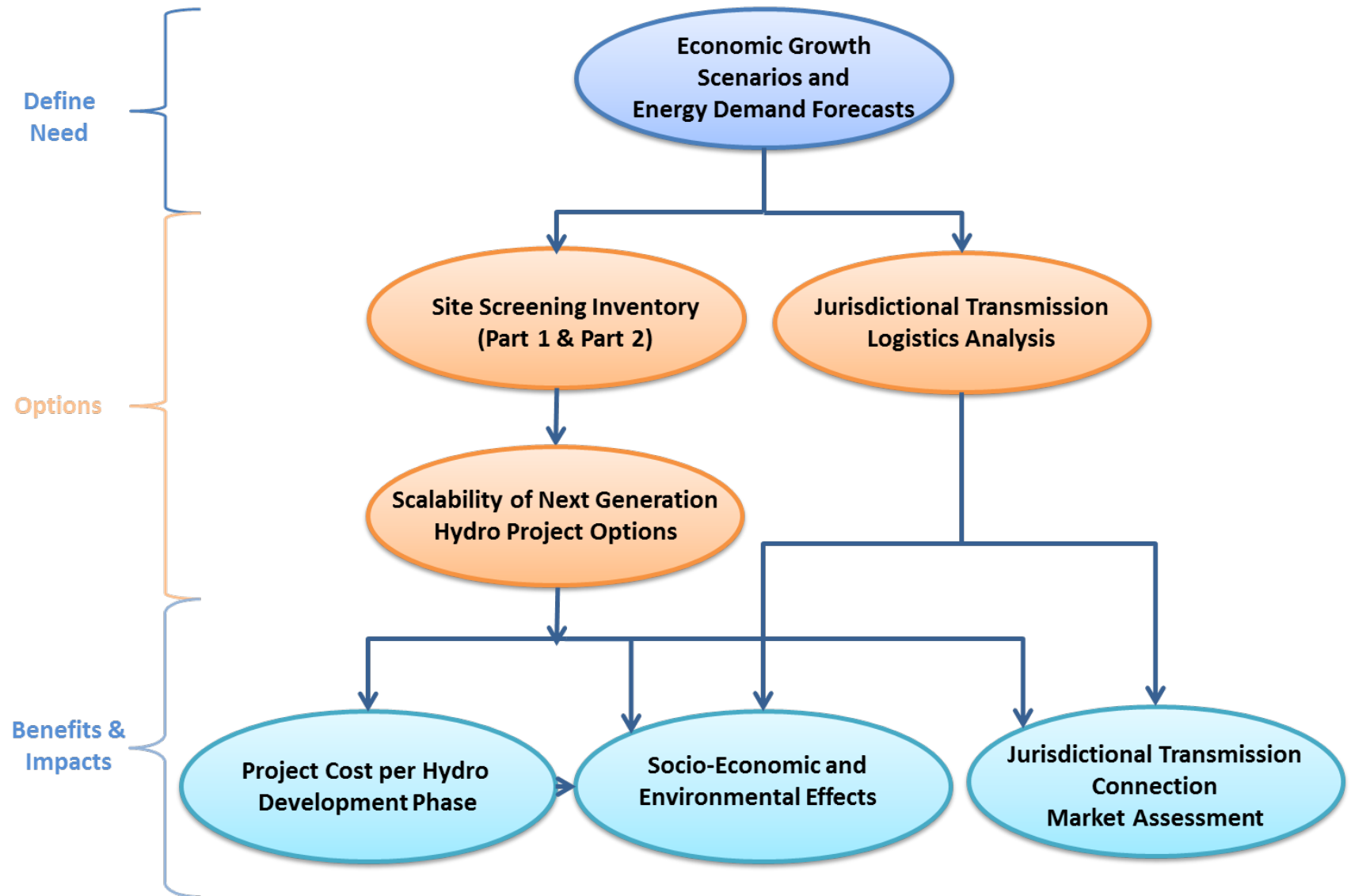
- Land and Resource Use
- Heritage and Cultural resources
- Economic Resources
- Community structure and dynamics

This is only a first step in a multi-year conversation

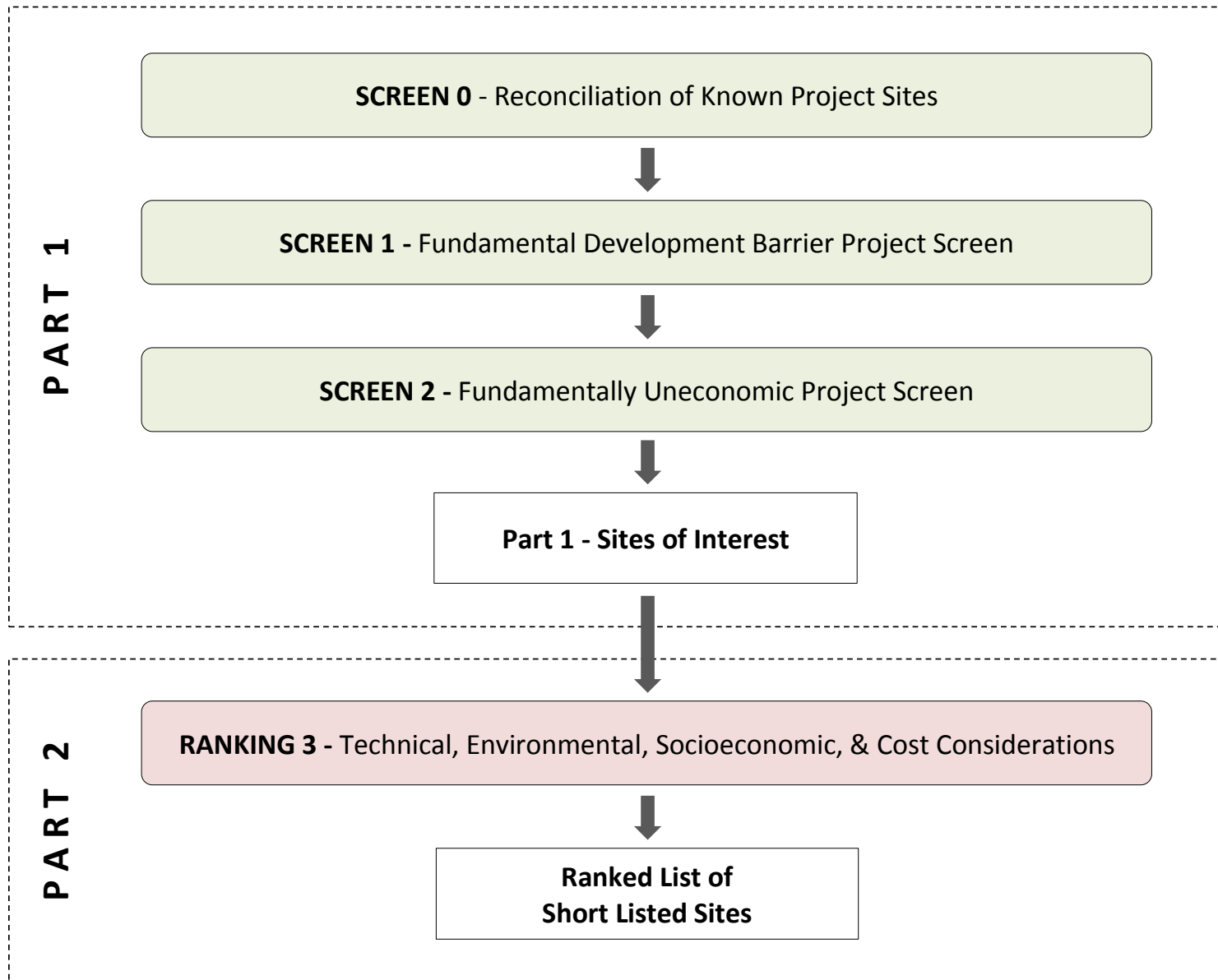
- Analysis of the expected benefits of trade between jurisdictions
  - Ability and willingness to sell energy and capacity
  - Need and willingness to purchase energy and capacity
  - Cost of potential transmission build out options
  - Impact upon hydroelectric options under consideration
- Risk Analysis
  - Factors such Regulatory, Market and Renewal Risks

# **Site Screening Inventory (Part 1)**





# Site Screening Inventory (Part 1)



# Screen 0 - Reconciliation

## Reconciliation of Know Project Sites

- Studies since 1960's
- 200+ Sites reduced to 124 through removal of:

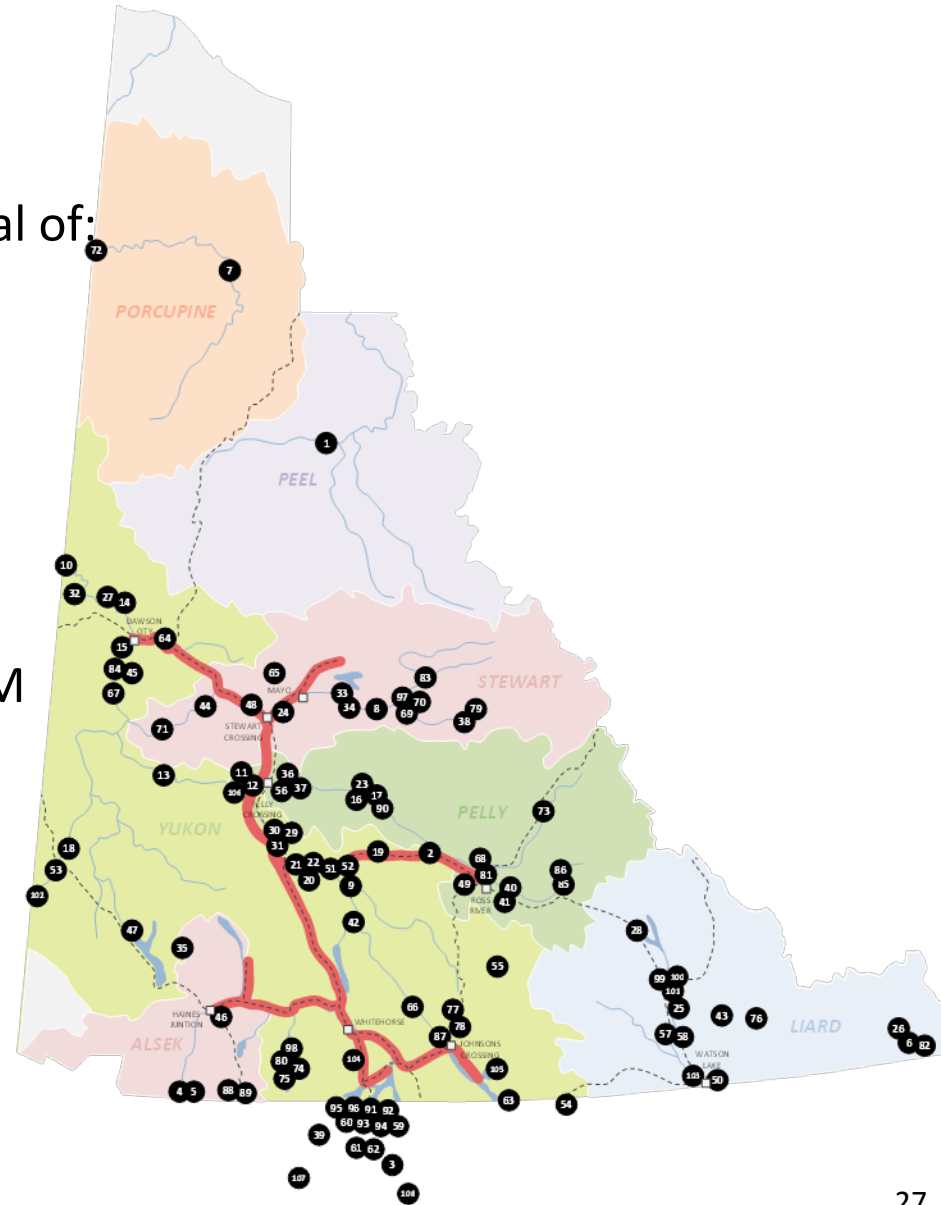
- 1) Duplicate Sites
- 2) Indeterminate Sites
- 3) Northwest Territories Sites

## Pre-screening: 124 to 108 Sites:

- 1) Indeterminate Sites from 2010 AECOM Report
- 2) Insufficient Level of Design

## Remaining Sites Given Unique Identifier

- Basin, River, Elevation & Variant



# Screen 1 - Showstoppers

#	Showstopper	Showstopper Descriptions
1	Minimum Project Size	Project, or cluster of scalable projects, is less than or equal to 10 MW in size.
2	National Park	Project located in, or inundates (floods), National Park Lands.
3	Urban Flooding	Project inundates a titled property or private dwelling within the boundaries of any of the 36 Census Subdivisions (as defined by Statistics Canada) in the Yukon.
4	Main Stem of Yukon River Exclusion	Project is located on the main stem of the Yukon River.
5	Incorrect Project Type	Projects that are non-hydroelectric generation projects (i.e. water diversion only, water storage only, pumped storage).

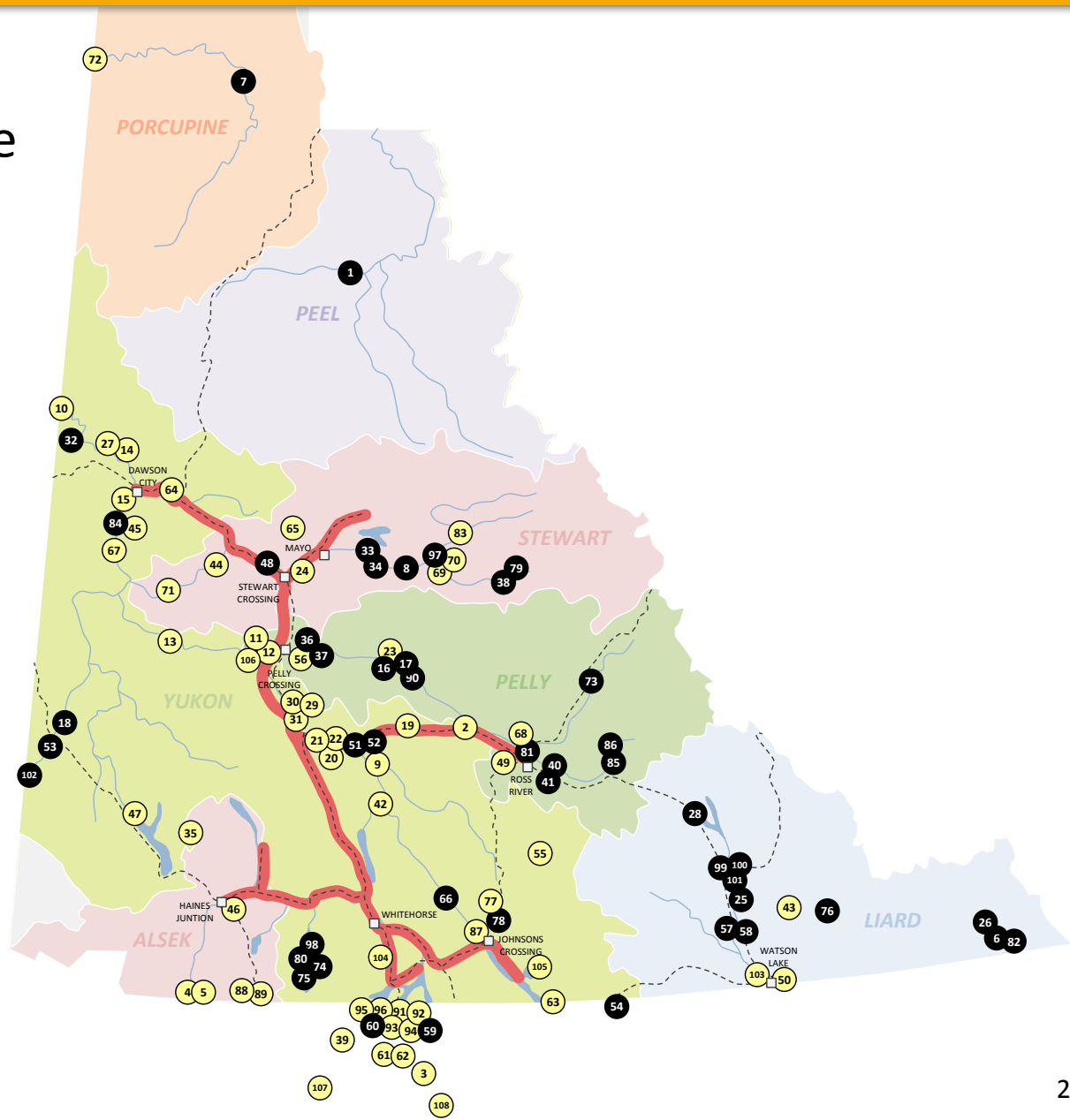
# Screen 1 - Showstoppers

61 Sites Removed Due to “Showstoppers”

- Yellow Dots

47 Sites Remaining

- Black Dots
- Located Through Yukon & Northern British Columbia
- Widely Distributed



## Removal of Fundamentally Uneconomic Sites

- No reasonable expectation of being economic relative to other sites

## Economic Analysis

### 1) Parametric Cost Model based on Key Design Attributes

- Installed Capacity
- Dam: Length/Size
- Conveyance: Penstock & Tunneling (if Applicable)
- Transmission: Length
- Access: Length
- Balance of Plant

### 2) Key Assumption

- Pre-existing Transmission Corridor

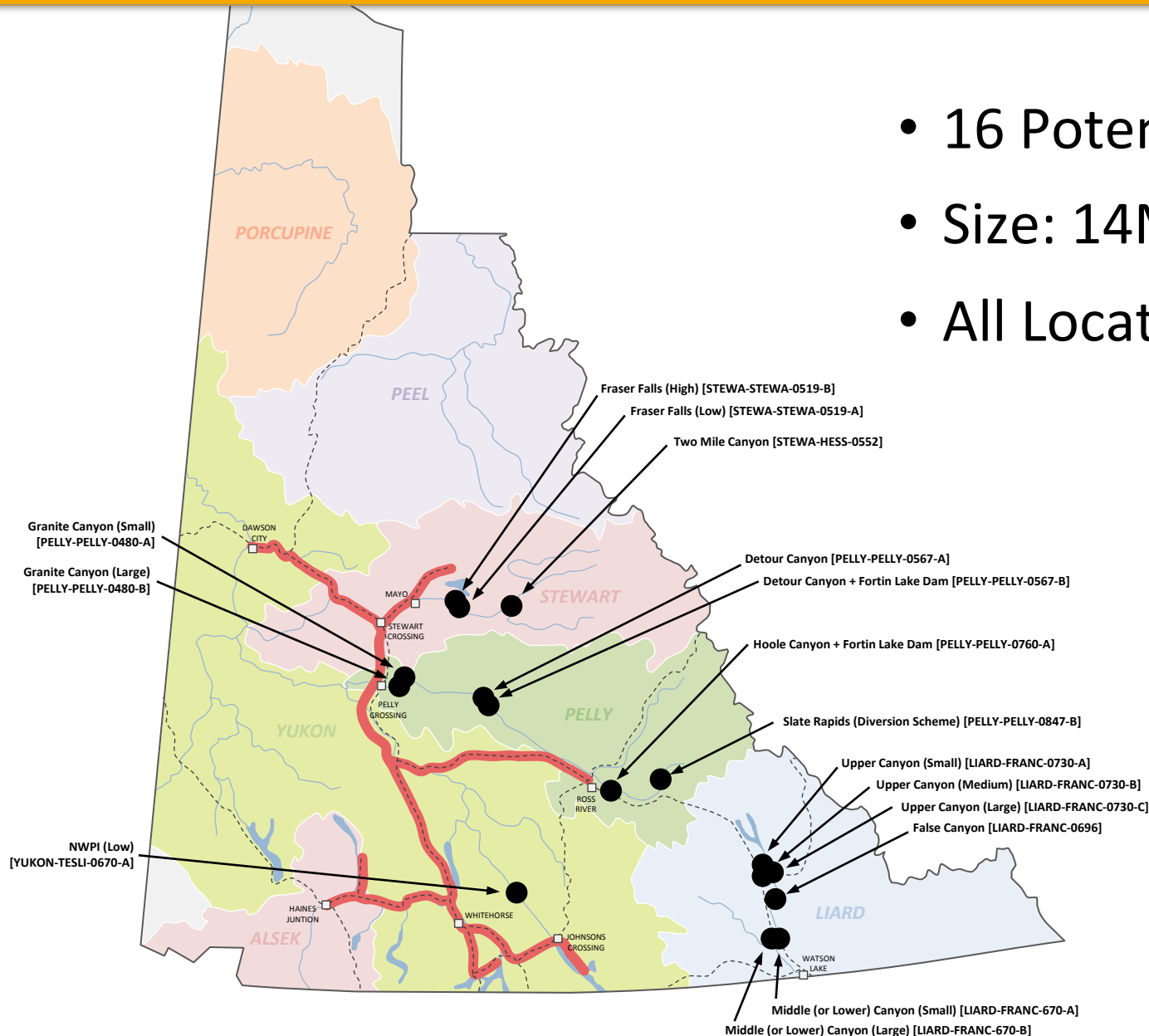
### 3) Basis of Comparison

- Thermal Generation Based on Recent (Liquefied) Natural Gas Estimate

# Site Screening Inventory (Part 1): Results



- 16 Potential Sites
- Size: 14MW to 300MW
- All Located in Yukon



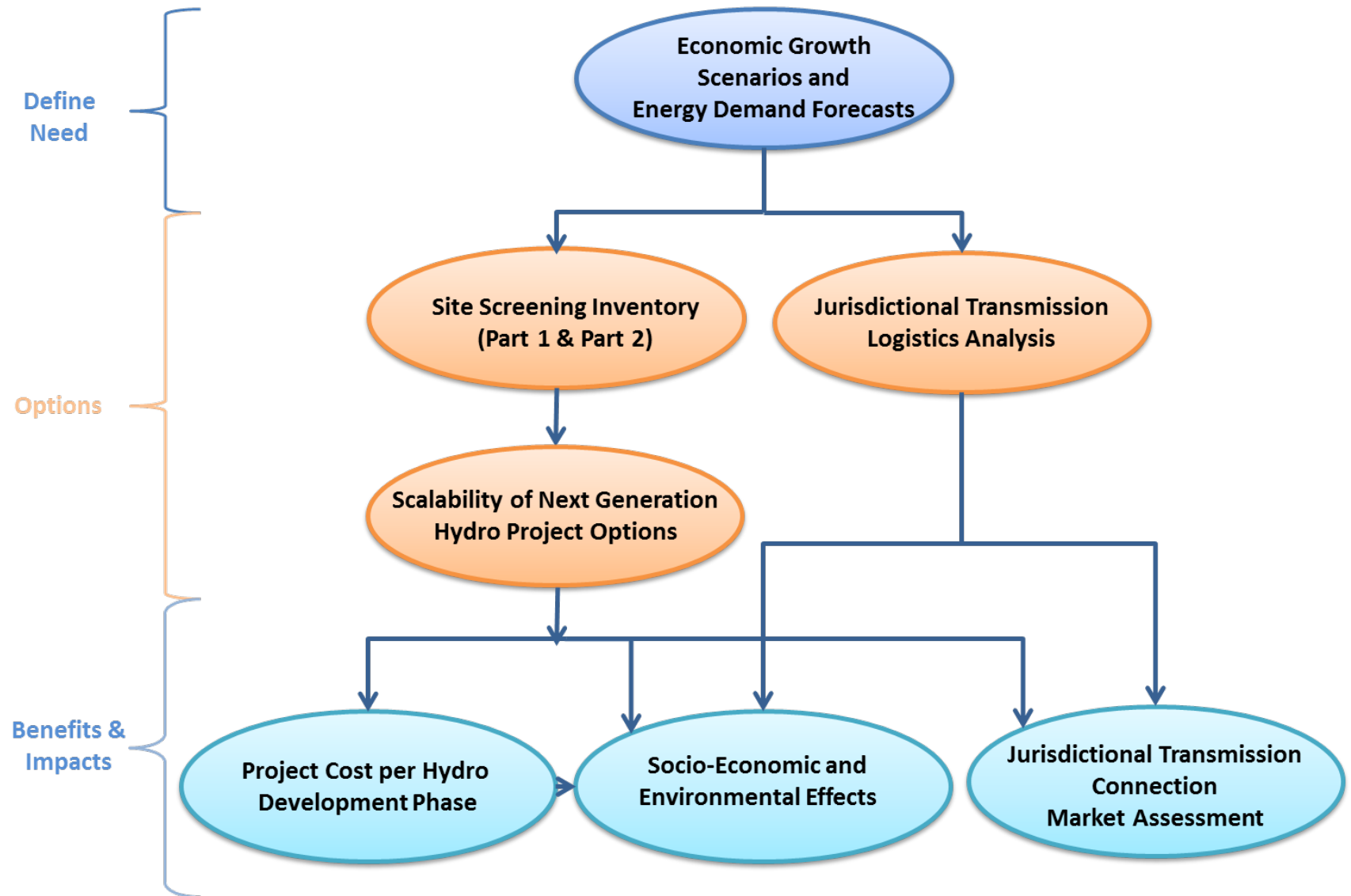
# Site Screening Inventory (Part 1): Results

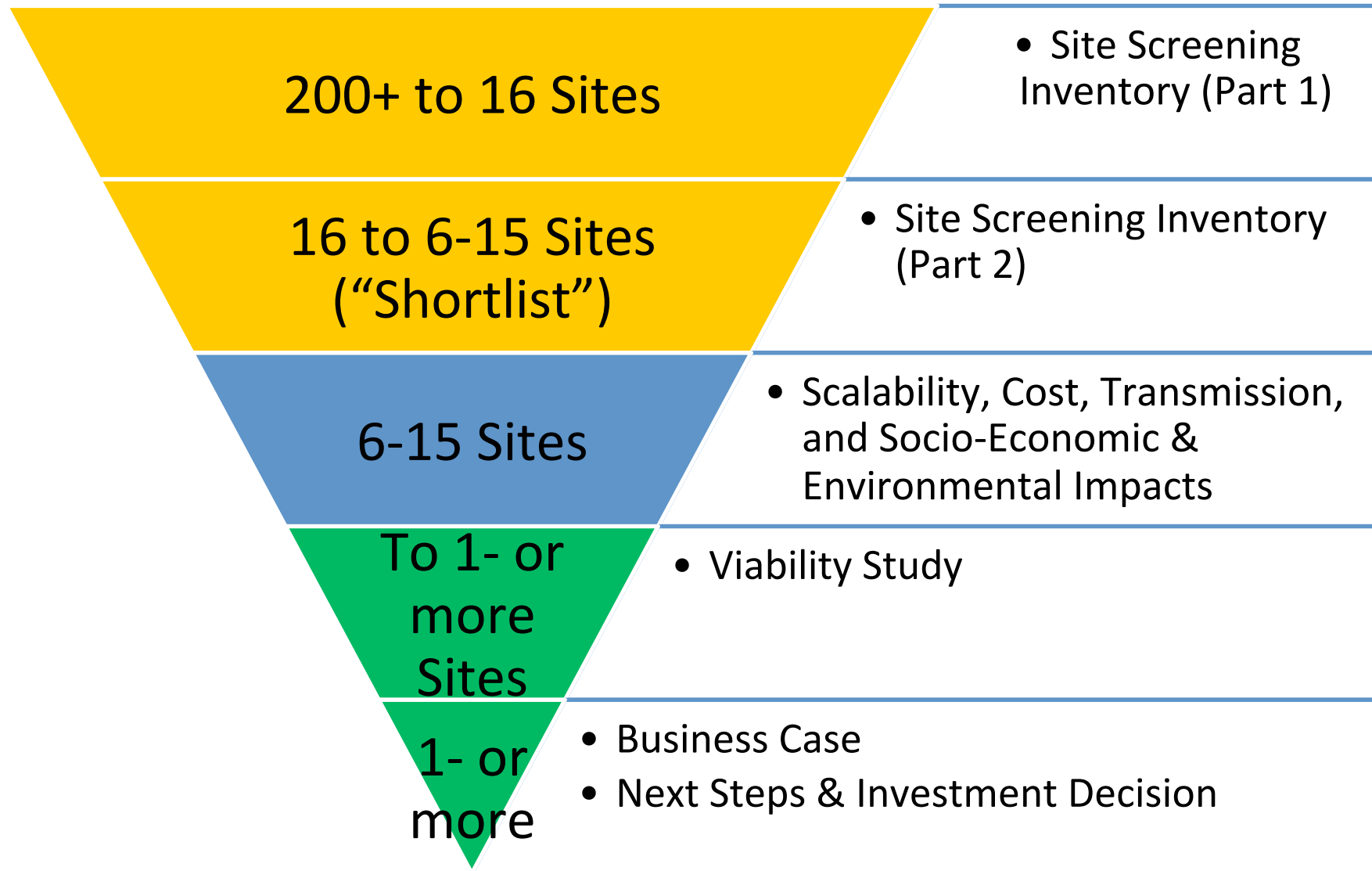


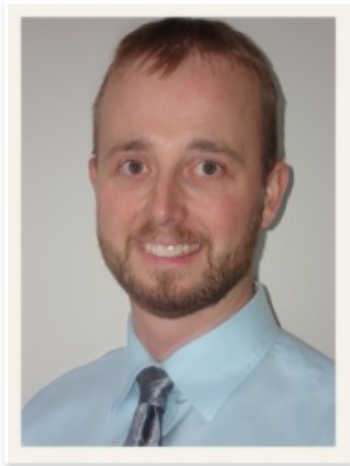
Site Name	Site ID	Size (MW)
Detour Canyon	PELLEY-PELLEY-0567-A	65
Detour Canyon + Fortin Lake Dam	PELLEY-PELLEY-0567-B	100
False Canyon	LIARD-FRANC-0696	58
Fraser Falls (High)	STEWA-STEWA-0519-B	300
Fraser Falls (Low)	STEWA-STEWA-0519-A	100
Granite Canyon (Large)	PELLEY-PELLEY-0480-B	254
Granite Canyon (Small)	PELLEY-PELLEY-0480-A	80
Hoole Canyon + Fortin Lake Dam	PELLEY-PELLEY-0760-A	40
Middle (or Lower) Canyon (Small)	LIARD-FRANC-0670-A	14
Middle (or Lower) Canyon (Large)	LIARD-FRANC-0670-B	75
NWPI (Low)	YUKON-TESLI-0670-A	55
Slate Rapids (Diversion Scheme)	PELLEY-PELLEY-0847-B	42
Two Mile Canyon	STEWA-HESS -0552	53
Upper Canyon (Large)	LIARD-FRANC-0730-C	75
Upper Canyon (Medium)	LIARD-FRANC-0730-B	58
Upper Canyon (Small)	LIARD-FRANC-0730-A	25



## **Next Steps**







## ***Peter Helland***

Midgard Consulting Incorporated

Email: [phelland@midgard-consulting.com](mailto:phelland@midgard-consulting.com)

Phone: 604.298.4997