
# The Alberta to British Columbia Trans Mountain Expansion Project

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# 1– Business Understanding – High Level

# Case Study

- The Alberta to British Columbia Trans Mountain Expansion Project

https://cases.open.ubc.ca/the-alberta-to-british-columbia-trans-mountain-expansion-project/

# Introduction

- The TMEP was proposed to reactivate sections of the existing pipeline, enlarge storage terminals, and build new pump stations at the marine terminal in Burnaby, BC. The project has attracted legal challenges and concerns from environmental activists and the Tsleil-Waututh First Nation due to its potential environmental, social and economic impacts.

# 5W 1H Analysis
# 1 – Who

| # | Question | Answer |
|---|---|---|
| Q1.1 | Who is involved? | Canadian Federal government, Alberta government, British Columbia government, NGOs, Tsleil-Waututh First Nation, National Energy Board, UN, Kinder Morgan |
| Q1.2 | Who is affected? | Tsleil-Waututh First Nation, Canadian Federal government, Alberta government, British Columbia government |
| Q1.3 | Who will benefit? | Federal government, Alberta government, British Columbia government |
| Q1.4 | Who will be harmed? | Tsleil-Waututh First Nation |

# 5W 1H Analysis
# 2 – What

| # | Question | Answer |
|---|---|---|
| Q2.1 | What is your topic narrowed down in a simple phrase/sentence? | The environmental, economic and social systems impact of the Trans Mountain Expansion Project in the Tsleil-Waututh Nation consultation area. |
| Q2.2 | What does your topic involve? (i.e. What are the different parts to it?) | • Environmental, economic and social systems impact of the Trans Mountain Expansion Project<br>• Expanding pre-existing pipeline's capacity from 300,000 oil barrels per day to 890,000 oil barrels per day<br>• Legal challenges to the TMEP<br>• Canada's adherence to the Kyoto Protocol |
| Q2.3 | What is it similar to / different from? | This project is similar to the Keystone Pipeline project. |
| Q2.4 | What might be affected/changed by your topic? | • Legal battles in court<br>• Oil spills from the pipelines<br>• Involvement of environmental activists<br>• An agreement between the Tseil-Waututh First Nations and the Federal and Provincial governments |

# 5W 1H Analysis
# 3 –When

| # | Question | Answer |
|---|---|---|
| Q3.1 | When does this take place? When did this take place? When will it take place? When should this take place? | • **1953:** Existing Trans Mountain Pipeline was built in 1953.<br>• **September 2007:** United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) was adopted by the UN General Assembly. Canada voted against the UNDRIP.<br>• **June 18, 2013:** Kinder Morgan filed an application with the Canadian National Energy Board to triple the capacity of the pre-existing Trans Mountain pipeline to 1,150 km that transports oil from Alberta to British Columbia and Washington State.<br>• **December 2013:** Trans Mountain submitted its application to the National Energy Board for the Trans Mountain Expansion Project<br>• **2016:** Canada reversed its position on UNDRIP and supported the declaration.<br>• **November 29, 2016:** The federal government approved the Trans Mountain Expansion Pipeline.<br>• **August 2018:** Federal Court of Appeal overturned Ottawa's approval of the Trans Mountain Expansion Project.<br>• **June 2019:** The Canadian government approved the Trans Mountain Expansion Pipeline for a second time. Trans Mountain Expansion Project announced the commencement of the construction of the pipeline.<br>• **September 2019:** The Tsleil-Waututh Nation announced their intentions to take their legal battle against the project to the Supreme Court of Canada<br>• **November 2019:** the British Columbia provincial government passed legislation to implement the UNDRIP. |
| Q3.2 | Does when this takes place affect the topic? | The project is taking place at a time where there is focus on green energy and climate change. The project's potential impacts on these are the reasons for opposing views from environmental activists and the Tseil-Waututh First Nations. |

# 5W 1H Analysis
# 4 – Where

| # | Question | Answer |
|---|---|---|
| Q4.1 | Where does this take place? (Where did it …. Where will it … Where should it ….?) | • Canada<br>  • Alberta<br>  • British Columbia<br>• Washington State, USA |
| Q4.2 | Does it matter where it takes place? Is it affected by location? | The project's development in territories belonging to the Tseil Waututh First Nations has raised contentions from the Tseil Waututh First Nations. |

# 5W 1H Analysis
# 5 – Why

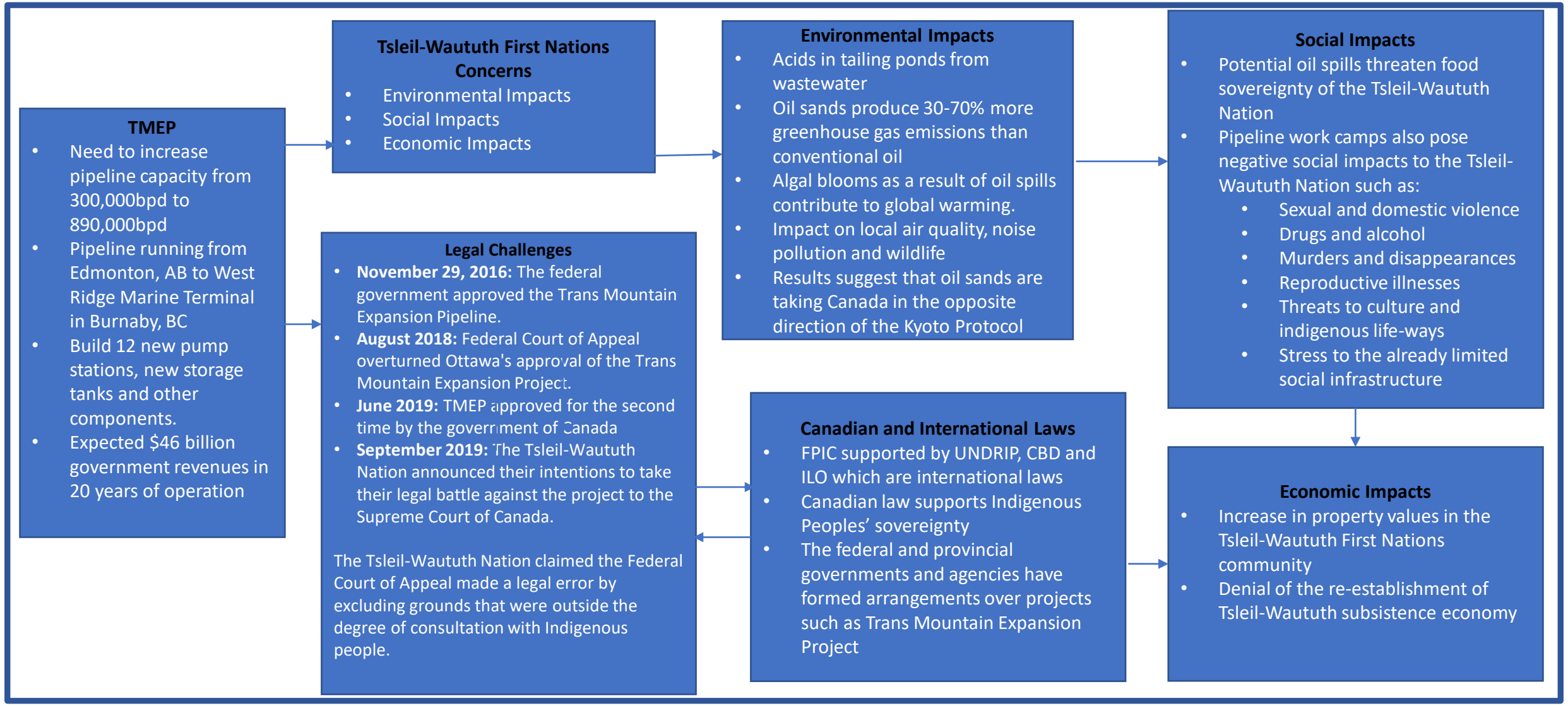
| # | Question | Answer | |
|---|---|---|---|
| Q5.1 | Why is this topic important? Why does it matter? | • It is necessary to ensure that all factors are considered to protect the environment, social systems and economy of the Tseil Waututh First Nations during and after the execution of the project.<br>• Execution of the project ensures increase in production of Canadian oil by increasing the pipeline's capacity from 300,000 oil barrels per day to 890,000 oil barrels per day and an increase in returns to oil producers through accessing new, higher priced markets in the Pacific Rim. | |
| Q5.2 | Why do certain things happen? (What are some causes and effects within the topic?) | **Causes** | **Effects** |
| | | Need to increase pipeline capacity to accommodate the transportation demand from increased production of Canadian oil and by increasing the returns to oil producers through accessing new and higher priced markets in the Pacific Rim. | Concerns raised by the Tseil-Waututh Frist Nations on the potential adverse effects of the TMEP on their environment, economy and social systems. |
| | | Alleged claims that Canada did not consult the Tseil-Waututh Frist Nations on the TMEP. | Legal battles in the Canadian Federal Court of Appeal and the Supreme Court of Canada. |

# 5W 1H Analysis
# 6 – How

| # | Question | Answer |
|---|---|---|
| Q6.1 | How does this topic work? How does it function? How does it do what it does? | • There is the need to increase pipeline capacity to boost revenues and to get access to other oil markets in the Pacific rim.<br>• There is also the need to ensure the environment is protected from greenhouse gas emissions and to ensure the territories of the Tsleil Waututh First Nations are protected from the potential adverse effects of the TMEP to their environment, economy and social systems. |
| Q6.2 | How did it come to be? | • The need to get access to other markets<br>• Insufficient consultations with the Tseil Waututh First Nations |
| Q6.3 | How are those involved affected? | • Loss of revenue for the energy industry if the TMEP is shut down<br>• Potential adverse effects of the project could lead to scarcity of key marine resources of the Tsleil-Waututh First Nations community.<br>• Some of the social impact concerns of the Tsleil-Waututh First Nations include sexual and domestic violence from oil and gas workers, drugs and alcohol, murders and disappearances, reproductive illnesses, threats to culture and Indigenous life-ways, and other social stressors.<br>• Man camps of oil and gas workers stress already limited social infrastructure in Indigenous communities such as policing, health, and mental health services.<br>• The Tsleil-Waututh First Nations do not consent to Trans Mountain Pipeline Expansion Project as they believe it denies the re-establishment of Tsleil-Waututh subsistence economy and development proposals negatively impact property values. |


# 2–
# Data Understanding – High Level

# Data Modeling – Conceptual Model



# Data Dictionary

| No | Topic | Definition |
|---|---|---|
| 1 | TMEP | Trans Mountain Expansion Project |
| 2 | Key Point | Distribution Point |
| 3 | Throughput | Volume of products passing through distribution points. |
| 4 | m3/d | Cubic meters per day |
| 5 | Kyoto Protocol | It operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries and economies in transition to limit and reduce greenhouse gases (GHG) emissions in accordance with agreed individual targets. |
| 6 | bpd | Barrels of oil per day |
| 7 | AB | Alberta |
| 8 | BC | British Columbia |
| 9 | Tsleil-Waututh First Nation | Formerly known as the Burrard Indian Band or Burrard Inlet Indian Band, is a First Nations band government in the Canadian province of British Columbia. |
| 10 | FPIC | Free, Prior and Informed Consent is a specific right that pertains to indigenous peoples and is recognized in the United Nations Declaration on the Rights of Indigenous Peoples. It allows them to give or withhold consent to a project that may affect them or their territories |
| 11 | CBD | Convention on Biological Diversity |
| 12 | UNDRIP | United Nations Declaration on the Rights of Indigenous Peoples |
| 13 | ILO | The International Labour Organization is a United Nations agency whose mandate is to advance social and economic justice through setting international labour standards. |
| 14 | Oil Sands | They are either loose sands or partially consolidated sandstone containing a naturally occurring mixture of sand, clay, and water, soaked with a dense and extremely viscous form of petroleum technically referred to as bitumen. |
| 15 | Conventional Oil | It refers to petroleum, or crude oil, and raw natural gas extracted from the ground by conventional means and methods. |


# 1 (Revisited) – Business Understanding – Low Level

# Business Questions

- Question 1) What product has the highest throughput (1000m3/day)?
- Question 2) Which key point has the highest throughput (1000m3/day) for Domestic Light product?


# 2 (Revisited) – Data Understanding – Low Level

# Data Set(s)

Link to dataset:
[Trans Mountain Pipeline Throughput and Capacity Dataset]

| | B | C | D | E | F | G | H | I | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Year | Corporate_Entity | Pipeline Name | Key_Point | Latitude | Longitude | Direction_ | Trade_Type | Product | Throughput_(1000m3/d) | Ava | Reason _For_Variance |
| 2 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | domestic heavy | 0 | 35 | |
| 3 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | domestic light | 8 | 35 | |
| 4 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | refined petroleum products | 13 | 35 | |
| 5 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Sumas | 49.0766 | -122.203 | south | export | domestic heavy | 1 | 35 | |
| 6 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Sumas | 49.0766 | -122.203 | south | export | domestic light | 15 | 35 | |
| 7 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Westridge | 49.2908 | -122.95 | west | export | domestic heavy | 4 | 35 | |
| 8 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Westridge | 49.2908 | -122.95 | west | export | domestic light | 0 | 35 | |
| 9 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | domestic heavy | 0 | 36 | |
| 10 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | domestic light | 8 | 36 | |
| 11 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | refined petroleum products | 14 | 36 | |
| 12 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Sumas | 49.0766 | -122.203 | south | export | domestic heavy | 2 | 36 | |
| 13 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Sumas | 49.0766 | -122.203 | south | export | domestic light | 12 | 36 | |
| 14 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Westridge | 49.2908 | -122.95 | west | export | domestic heavy | 3 | 36 | |
| 15 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Westridge | 49.2908 | -122.95 | west | export | domestic light | 0 | 36 | |
| 16 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | domestic heavy | 0 | 37 | |
| 17 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | domestic light | 8 | 37 | |
| 18 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | refined petroleum products | 13 | 37 | |
| 19 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Sumas | 49.0766 | -122.203 | south | export | domestic heavy | 3 | 37 | |
| 20 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Sumas | 49.0766 | -122.203 | south | export | domestic light | 13 | 37 | |
| 21 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Westridge | 49.2908 | -122.95 | west | export | domestic heavy | 3 | 37 | |
| 22 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Westridge | 49.2908 | -122.95 | west | export | domestic light | 0 | 37 | |
| 23 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | domestic heavy | 0 | 35 | Maintenance |
| 24 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | domestic light | 6 | 35 | Maintenance |
| 25 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | refined petroleum products | 10 | 35 | Maintenance |
| 26 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Sumas | 49.0766 | -122.203 | south | export | domestic heavy | 2 | 35 | Maintenance |
| 27 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Sumas | 49.0766 | -122.203 | south | export | domestic light | 15 | 35 | Maintenance |
| 28 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Westridge | 49.2908 | -122.95 | west | export | domestic heavy | 1 | 35 | Maintenance |
| 29 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Westridge | 49.2908 | -122.95 | west | export | domestic light | 0 | 35 | Maintenance |
| 30 | 2006 | Trans Mountain Pipeline ULC | Trans Mountain Pipeline | Burnaby | 49.2685 | -122.931 | west | intracanada | domestic heavy | 0 | 29 | |

# Database Diagram – Tables and Columns

**TMEP Canada**

| Column Name | Data Type | Allow Nulls |
|---|---|---|
| Month | bigint | ☑ |
| Year | bigint | ☑ |
| Key_Point | varchar(100) | ☑ |
| Latitude | varchar(50) | ☑ |
| Longitude | varchar(50) | ☑ |
| Product | varchar(100) | ☑ |
| [Throughput_(1000m3 d)] | bigint | ☑ |
| [Available_Capacity_(1000m3 d)] | bigint | ☑ |
| | | ☐ |


# 3 –
# Data Preparation

# Data Preparation – Data cleansing

- Data types for the following columns were changed:
  - *Month*
  - *Year*
  - *Throughput_(1000m3/d)*
  - *Available_Capacity_(1000m3/d)*
- Columns that were irrelevant to this analysis were removed.

# Data Preparation – SQL Query for Question 1

```
Select [Product], sum([Throughput_(1000m3 d)]) as Total_Throughput_1000m3_d
From [AdventureWorks2019].[dbo].[TMEP_Canada]
Group by [Product]
Order by sum([Throughput_(1000m3 d)]) desc
```

# Data Preparation – Data set returned for Query 1

Results | Messages

| | Product | Total_Throughput_1000m3_d |
|---|---|---|
| 1 | domestic light | 5253 |
| 2 | domestic heavy | 1324 |
| 3 | refined petroleum products | 1306 |

# Data Preparation – SQL Query for Question 2

```
Select [Key_Point], [Product], sum([Throughput_(1000m3 d)]) as Total_Throughput_1000m3_d
From [AdventureWorks2019].[dbo].[TMEP_Canada]
Where [Product]='domestic light'
Group by [Product], [Key_Point]
Order by sum([Throughput_(1000m3 d)]) desc
```

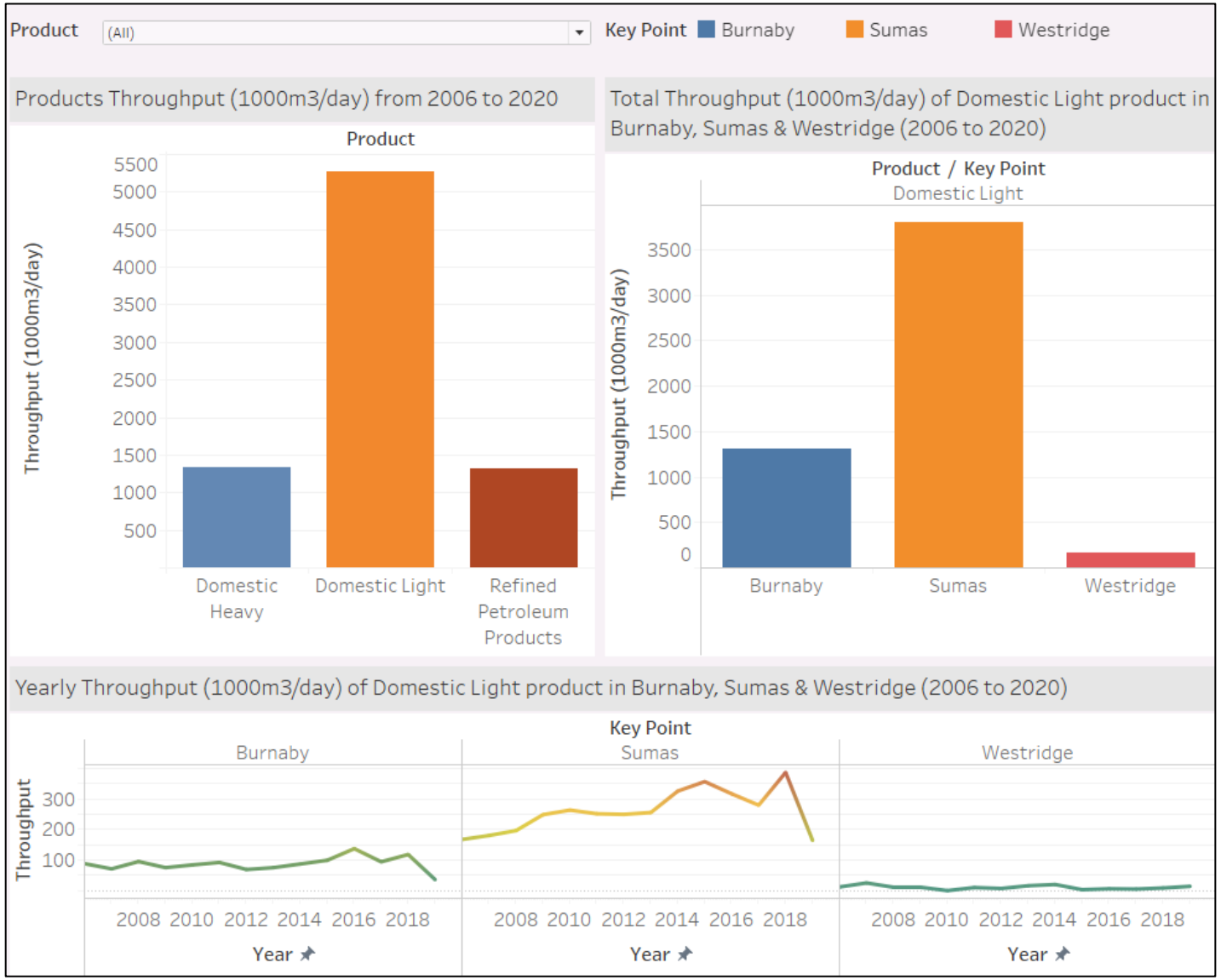
# Data Preparation – Data set returned for Query 2

Results | Messages

| | Key_Point | Product | Total_Throughput_1000m3_d |
|---|---|---|---|
| 1 | Sumas | domestic light | 3792 |
| 2 | Burnaby | domestic light | 1304 |
| 3 | Westridge | domestic light | 157 |


# 4 – Modeling

# Visualization - Dashboard

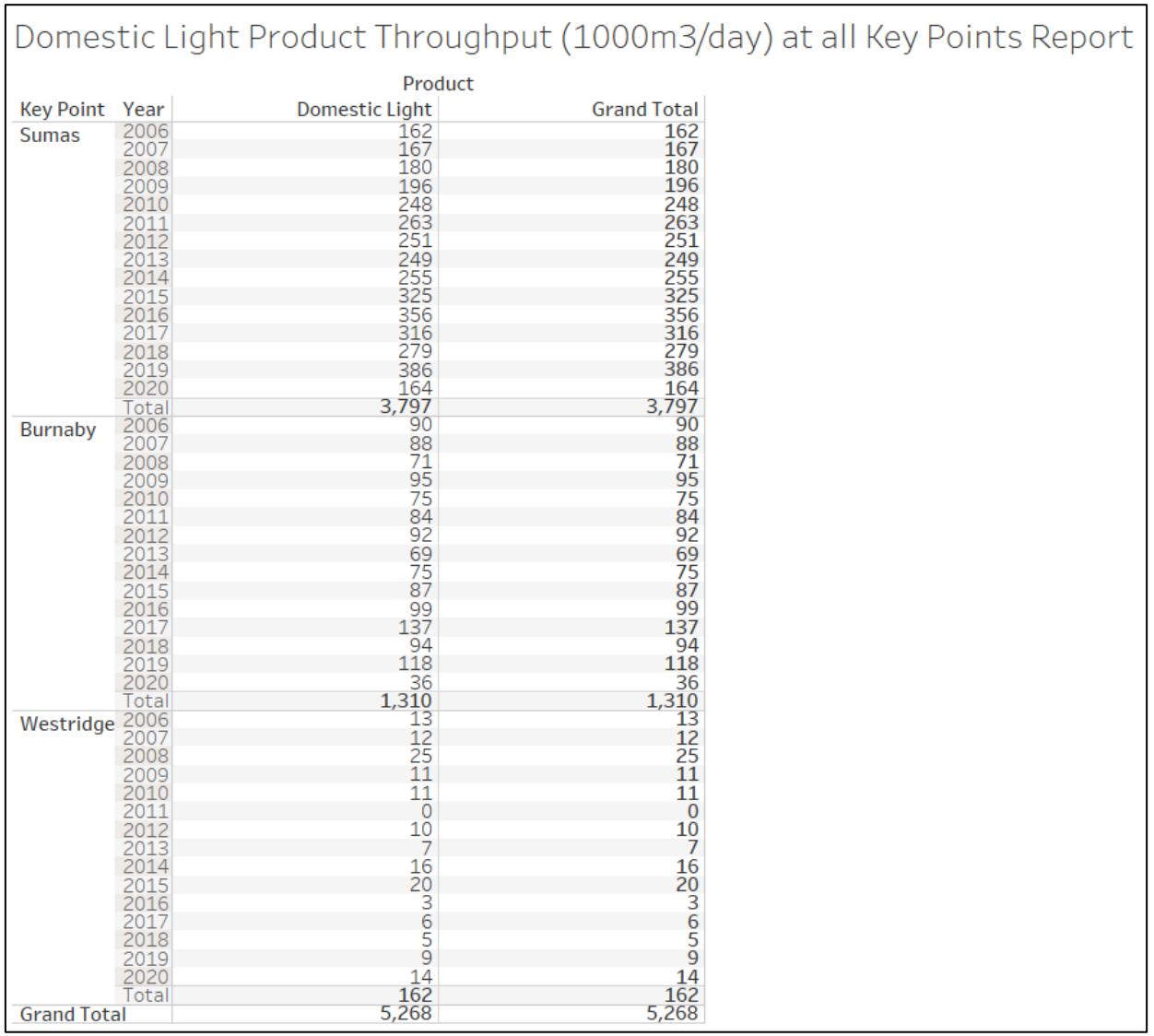


# Visualization – Report 1

Throughput (1000m3/day) Report for all products at all Key Points

| Key Point | Product | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Burnaby | Domestic Heavy | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Domestic Light | 90 | 88 | 71 | 95 | 75 | 84 | 92 | 69 | 75 | 87 | 99 | 137 | 94 | 118 | 36 | 1,310 |
| | Refined Petroleum Products | 125 | 125 | 81 | 101 | 89 | 89 | 90 | 94 | 102 | 107 | 97 | 80 | 53 | 55 | 24 | 1,312 |
| | Total | 215 | 213 | 152 | 196 | 164 | 173 | 182 | 163 | 177 | 194 | 196 | 217 | 147 | 173 | 60 | 2,622 |
| Sumas | Domestic Heavy | 19 | 41 | 45 | 2 | 5 | 3 | 10 | 9 | 19 | 13 | 8 | 2 | 11 | 2 | 0 | 189 |
| | Domestic Light | 162 | 167 | 180 | 196 | 248 | 263 | 251 | 249 | 255 | 325 | 356 | 316 | 279 | 386 | 164 | 3,797 |
| | Total | 181 | 208 | 225 | 198 | 253 | 266 | 261 | 258 | 274 | 338 | 364 | 318 | 290 | 387 | 164 | 3,985 |
| Westridge | Domestic Heavy | 34 | 64 | 56 | 132 | 142 | 84 | 105 | 103 | 89 | 54 | 43 | 49 | 112 | 31 | 43 | 1,141 |
| | Domestic Light | 13 | 12 | 25 | 11 | 11 | 0 | 10 | 7 | 16 | 20 | 3 | 6 | 5 | 9 | 14 | 162 |
| | Total | 47 | 76 | 81 | 143 | 153 | 84 | 115 | 110 | 105 | 74 | 46 | 55 | 117 | 39 | 57 | 1,302 |
| Grand Total | | 443 | 497 | 458 | 537 | 570 | 523 | 558 | 531 | 556 | 606 | 606 | 590 | 554 | 599 | 281 | 7,909 |

# Visualization – Report 2



Domestic Light Product Throughput (1000m3/day) at all Key Points Report

| | | Product | |
|---|---|---|---|
| Key Point | Year | Domestic Light | Grand Total |
| Sumas | 2006 | 162 | 162 |
| | 2007 | 167 | 167 |
| | 2008 | 180 | 180 |
| | 2009 | 196 | 196 |
| | 2010 | 248 | 248 |
| | 2011 | 263 | 263 |
| | 2012 | 251 | 251 |
| | 2013 | 249 | 249 |
| | 2014 | 255 | 255 |
| | 2015 | 325 | 325 |
| | 2016 | 356 | 356 |
| | 2017 | 316 | 316 |
| | 2018 | 279 | 279 |
| | 2019 | 386 | 386 |
| | 2020 | 164 | 164 |
| | Total | 3,797 | 3,797 |
| Burnaby | 2006 | 90 | 90 |
| | 2007 | 88 | 88 |
| | 2008 | 71 | 71 |
| | 2009 | 95 | 95 |
| | 2010 | 75 | 75 |
| | 2011 | 84 | 84 |
| | 2012 | 92 | 92 |
| | 2013 | 69 | 69 |
| | 2014 | 75 | 75 |
| | 2015 | 87 | 87 |
| | 2016 | 99 | 99 |
| | 2017 | 137 | 137 |
| | 2018 | 94 | 94 |
| | 2019 | 118 | 118 |
| | 2020 | 36 | 36 |
| | Total | 1,310 | 1,310 |
| Westridge | 2006 | 13 | 13 |
| | 2007 | 12 | 12 |
| | 2008 | 25 | 25 |
| | 2009 | 11 | 11 |
| | 2010 | 11 | 11 |
| | 2011 | 0 | 0 |
| | 2012 | 10 | 10 |
| | 2013 | 7 | 7 |
| | 2014 | 16 | 16 |
| | 2015 | 20 | 20 |
| | 2016 | 3 | 3 |
| | 2017 | 6 | 6 |
| | 2018 | 5 | 5 |
| | 2019 | 9 | 9 |
| | 2020 | 14 | 14 |
| | Total | 162 | 162 |
| Grand Total | | 5,268 | 5,268 |


# 5 – Evaluation

# Conclusion – Answer to Question 1

- Domestic Light product has the highest throughput from 2006 to June 2020. Total throughput was  5,253,000m3 (33,040,376 barrels).

# Conclusion – Answer to Question 2

- Sumas has the highest throughput from 2006 to June 2020 among the three (3) key points for Domestic Light product. Total throughput was 3,702,000m3 (23,284,879 barrels) between 2006 and June 2020.