Rachel Sundusky is a manager of the South-Atlantic office of the Stateline Shipping and Transport Company. She is in the process of negotiating a new shipping contract with Polychem, a company that manufactures chemicals for industrial use. Polychem wants Stateline to pick up and transport waste products from its six plants to three waste disposal sites. Rachel is very concerned about this proposed arrangement. The chemical wastes that will be hauled can be hazardous to humans and the environment if the leak. In addition, a number of towns and communities in the region where the plants are located prohibit hazardous materials from being shipped through the municipal limits. Thus, not only will the shipments have to be handled carefully and transported at reduced speeds, they will also have to traverse circuitous routes in many cases. Rachel has estimated the cost of shipping a barrel of waste from each of the six plants to each of the three waste disposal sites as shown in the following table.

**WASTE DISPOSAL SITE**

|  |  |  |  |
| --- | --- | --- | --- |
| Plant | Whitewater | Los Canos | Duras |
| Kingsport | $ 12 | $ 15 | $ 17 |
| Danville |  14 |  9 |  10 |
| Macon |  13 |  20 |  11 |
| Selma |  17 |  16 |  19 |
| Columbus |  7 |  14 |  12 |
| Allentown |  22 |  16 |  18 |

The plants generate the following amounts of waste products each week.

|  |  |
| --- | --- |
| Plant | Waste per week(bbl) |
| Kingsport | 35 |
| Danville | 26 |
| Macon | 42 |
| Selma | 53 |
| Columbus | 29 |
| Allentown | 38 |

The three waste disposal sites at Whitewater, Los Canos and Duras can accommodate a maximum of 65, 80 and 105 barrels per week, respectively.

In addition to shipping directly from each of the six plants to one of the three waste disposal sites, Rachel is also considering using each of the plant and waste disposal sites as intermediate shipping points. Trucks would be able to drop a load at a plant or disposal sites to be picked up and carried on the final destination by another truck, and vice versa. Stateline would not incur any handling costs because Polychem has agreed to take care of all local handling of the wastes materials at the plants and the waste disposal sites. In others words, the only cost Stateline incurs is the actual transportation cost. So Rachel wants to be able to consider the possibility that it may be cheaper to drop and pick up loads at intermediate points rather than ship them directly. Rachel estimates the shipping costs per barrel between each of the six plants to be as follows:

**Plant**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Plant | Kingsport | Danville | Macon | Selma | Columbus | Allentown |
| Kingsport | $ --- | $ 6 | $ 4 | $ 9 | $ 7 | $ 8 |
| Danville |  6 |  --- |  11 |  10 |  12 |  7 |
| Macon |  5 |  11 |  ---- |  3 |  7 |  15 |
| Selma |  9 |  10  |  3 |  ---- |  3 |  16 |
| Columbus |  7 |  12 |  7 |  3 |  ---- |  14 |
| Allentown |  8 |  7 |  15 |  16 |  14 |  ----- |

The estimated shipping cost per barrel between each of the three waste disposal sites is as follows:

**Waste Disposal Site**

|  |  |  |  |
| --- | --- | --- | --- |
| Waste Disposal Site | Whitewater | Los Canos | Duras |
| Whitewater | $ ---- | $ 12 | $ 10 |
| Los Canos |  12 |  ----- |  15 |
| Duras |  10 |  15 |  ----- |

Rachel wants to determine the shipping routes that will minimize Stateline’s total cost in order to develop a contract proposal to submit to Polychem for waste disposal. She particularly wants to know if it would be cheaper to ship directly from the plants to the waste sites or if she should drop and pick up some loads at the various plants and waste sites. Develop a model to assist Rachel and solve the model to determine the optimal routes.

**Requirement**

1.      In Excel, or other suitable program, develop a model for shipping the waste directly from the 6 plants to the 3 waste disposal sites.

2.      Solve the model you developed in #1 (above) and clearly describe the results.

3.      In Excel, or other suitable program, Develop a transshipment model in which each of the plants and disposal sites can be used as intermediate points.

4.       Solve the model you developed in #3 (above) and clearly describe the results.

5.      Interpret the results and draw conclusions that address the question posed in the case problem.  What are the limits of the study?  Write at least one paragraph.

***There are two deliverables for this Case Problem, 1)the Excel spreadsheet, with the different solutions given in separate worksheets, and 2) an accompanying written description/explanation (submitted as a Word document).  Please submit both of them electronically via the dropbox.***