6 Mobile Source Inventory (Vehicle)

6.1 Developing and Updating Method for Emission inventory

Mobile source inventory from vehicle exhaust gas is created with Microsoft Access (EmissionFromTransport Inv01 2015.mdb) based on the following formula. This detail is referred to Sector report for mobile source inventory. Regarding temporal change, hourly operating pattern by season is calculated by using the result of traffic count survey in major road.

$$E_i = \sum_{t=1}^{N_t} \sum_{L=1}^{N_L} \sum_{VT=1}^{N_{VT}} EF_{VTi}(V_{Lt}) \cdot tv_{VT,L,t}$$

E_i Annual emission of pollutant i (ton)

t time

N_t Annual number of time (366 x 24=8,784 hours (in leap year), 365 x 24 = 8,760 hours (in normal year))

L Link

N_L Number of link

VT Vehicle type

N_{VT} Number of vehicle type

EF_{VTi} Emission factor by vehicle type of each pollutant

V_{Lt} Travelling speed by time by link

$tv_{VT, L,t}$ Traffic volume by time by link by vehicle type

6.1.1 Collecting and Organizing Information on Activity Data

Traffic volume is activity data in emission inventory for vehicle. Traffic volume means the value multiplying traffic count by distance in a road section and this unit is “vehicle x km”. In other words, traffic volume is the total mileage in a road section.

Therefore, it is necessary to obtain the information on the traffic count and road distance every link.

Link means the section that traffic count does not change extremely, such as the road between major intersections etc.

1 Traffic Count

The traffic count required to calculate emissions of pollutants by vehicle exhaust gas is not the traffic count at the intersection but the traffic count at the location that the traffic count between links assumes not to change.

In JICA technical cooperation project "Capacity Development Project for Air Pollution Control in Ulaanbaatar City in Mongolia", traffic count survey was conducted in 2010. However, after that time, traffic count survey has not been conducted. Therefore, it is desirable that conducting the traffic volume survey be proposed and the traffic count reflecting the latest traffic situation be measured.

Meanwhile, hourly traffic count has been measured with 52 VDSs by Traffic Control Center of UB city and this data is available. The accuracy of the VDS is validated by comparing the actual observation result with the traffic count using VDS and if there is no problem, it is possible to consider using the traffic count measured by VDS.

2 Road Distance

Obtain the GIS data of the road network in UB city. Urban Planning Department of the Capital City and Public Transportation Department of the Capital City (PTDCC) are considered as the main candidates for data acquisition. Since large-scale construction for relieving traffic congestion has also been implemented in recent years, it is necessary to obtain and update the latest road network data. If possible, it is preferable to obtain with line data (Polyline data).

In order to calculate the emissions from the main road, the major road from the acquired road network is necessary to be extracted. As the conditions of the major road, the presence or absence of the number of lanes and a median strip, and etc. be assumed, but setting according to the current traffic conditions is necessary. On the other hand, if having past road network data, you should check which road has been updated using the GIS tool, and if update of the main road is found, you should also update the previous road network data

6.1.2 Collecting and Organizing Information for Developing Emission Factor

6.1.2.1 Collecting and Organizing Information for Developing Emission Factor by Vehicle Type

Since vehicles are not manufactured in Mongolia, all the vehicles traveling in Mongolia are imported vehicles and most of them are manufactured in Japan and Korea. For that reason, apply Regulation of Exhaust Gas of Motor Vehicles in Japan to vehicles traveling in Mongolia. However, since there are the following situations in Mongolia, the ability to match the value of Regulation of Exhaust Gas of Motor Vehicles may is not demonstrated.

- The standard value of sulfur content of fuel used in Mongolia is higher than Japan.
- The fuel that was used in the past included lead.
- Regular inspection and maintenance is not conducted compared with Japan

Therefore, the actual condition in Mongolia was decided to approximate by multiplying the emission factor of Regulation of Exhaust Gas of Motor Vehicles in Japan by the factor taking Mongolian situation into account.

On the other hand, exhaust gas measurement at the time of actual traveling was started using the on-board emission measurement system. The actual condition of emissions in Mongolia can be further approximated by using the measurement results.

The vehicle type composition ratio by Regulation year of Exhaust Gas of Motor Vehicles in Japan is necessary as the necessary information to create the emission factor by vehicle type. Vehicle inspection registration database that is managed at the vehicle inspection registration center is necessary as the original data to calculate the vehicle type composition ratio. Information such as vehicle type, engine type, manufacturing year, and import year etc. are registered one by one in this vehicle inspection registration database.

6.1.2.2 Collecting and Organizing Information for Developing the Emission Factor of Fugitive Road Dust

Emission factors for fugitive road dust are calculated using the emission factor model of AP-42. In AP-42, emission factor model differs between paved and unpaved roads. The outline of the coefficients of each formula is shown inTable 6-1 and Table 6-2.

The geometric mean of the analysis result of the sample that is actually collected on the road in UB city is applied as the amount of silt on the paved road.

1 Paved Road

$$EF = k \times sL^{0.91} \times W^{1.02} \times (1 - \frac{P}{4N})$$

Table 6-1 Coefficient Using the Calculation of the Emission Factor of Fugitive Road Dust in Paved Road

Coefficient	Contents	Value	Source
k	Particle size multiplier (g/VKT)	0.62	AP-42, Table 13.2.1-1, PM-10,
sL	Silt Loading (g/m2)	1.01	Results of Monitoring Activity on 30th May by considering the monitoring points.
	Winter Baseline Multiplier(April – October)	1	Coefficient in non-Winter season
	November - March	0.25	Coefficient in Winter season
W	Average weight (tons) of vehicles traveling	1.48	Weighted average of vehicle inspection data of UB, 2009
P	Number of Wet Day (April – October)	37	http://geodata.us/weather/place.php?usaf=442920&uban=99999&c=Mongolia&y=2010
	November - March	120	Since the road surface is frozen in winter season, the winter season, four months, is treated as wet.
N	Number of days in the averaging period (April – October)	214	
	November - March	151	

2 Unpaved Road

$$EF = \left(\frac{k \times (s/12)^a \times (S/30)^d}{(M/0.5)^c} - C \right) \times 281.9 \times \frac{365 - RD}{365}$$

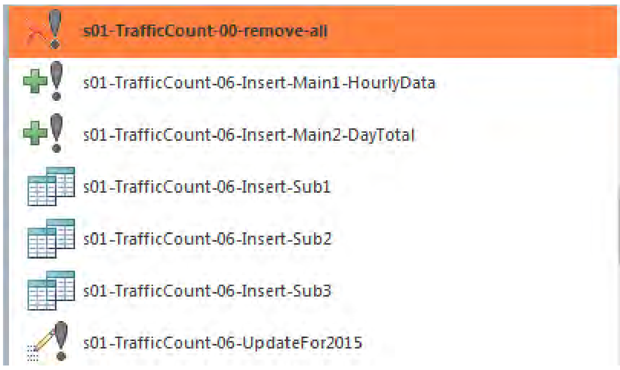
Table 6-2 Coefficient Using the Calculation of the Emission Factor of Fugitive Road Dust in Unpaved Road

Coefficient	Contents	Value	Source
k	Empirical constant (lb/VMT)	1.8	AP-42, Table 13.2.2-2, Public Roads, PM-10
a	Empirical constant	1	AP-42, Table 13.2.2-2, Public Roads, PM-10
c	Empirical constant	0.2	AP-42, Table 13.2.2-2, Public Roads, PM-10
d	Empirical constant	0.5	AP-42, Table 13.2.2-2, Public Roads, PM-10
s	Surface material silt content (%)	1.8	AP-42, Table 13.2.2-3, Surface Silt Content % minimum value
M	Surface material moisture content (%)	13	AP-42, Table 13.2.2-3, Median value of "Public Roads" maximum value
S	Mean vehicle speed (m/h)	4.349598	7km/h (Simple average of "Roads in ger areas, 4 > count of lanes >= 2" of Travel Speed Survey)
C	Emission factor for 1980's vehicle	0.00047	AP-42, Table 13.2.2-4, PM-10
RD	Annual number of rain and snow average days	157	http://geodata.us/weather/place.php?usaf=442920&uban=99999&c=Mongolia&y=2010 Since the road surface is frozen in winter season, the winter season, four months, is treated as wet.

6.1.3 Developing and Updating Emission Inventory

6.1.3.1 Updating Traffic Count

To estimate the traffic count by link for the target year, after deleting the existing data with “s01-TrafficCount-00-remove-all” query, run the two add queries (“s01-TrafficCount-06-Insert-Main1-HourlyData” and “s01-TrafficCount-06-Insert-Main2-DayTotal”) to calculate the traffic count by link by vehicle type using the traffic count data in 2010.

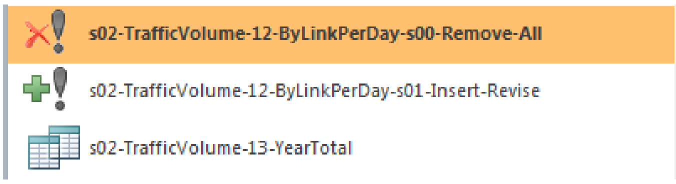


Since the number plate regulation on weekdays was not implemented at the time of the traffic count survey in 2010, in order to estimate the traffic count after 2012, calculate a value by multiplying the traffic count by vehicle type by 4/5.

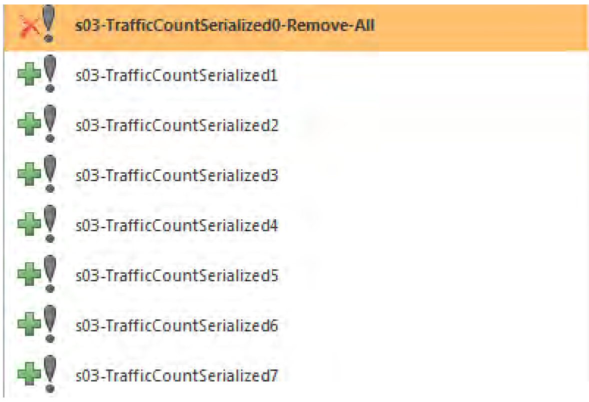
```
SELECT [s01-TrafficCount-06-Insert-Sub1].LocationID, [s01-TrafficCount-06-Insert-Sub1].Season, [s01-TrafficCount-06-Insert-Sub1].DayType, [s01-TrafficCount-06-Insert-Sub1].Direction, [s01-TrafficCount-06-Insert-Sub1].TimeFrom, [s01-TrafficCount-06-Insert-Sub1].TimeTo, [s01-TrafficCount-06-Insert-Sub1].TimeToInt, [s01-TrafficCount-06-Insert-Sub1].TimeText, IIf([s01-TrafficCount-06-Insert-Sub1]!Count1>0,IIf([s01-TrafficCount-06-Insert-Sub1].DayType='weekday',[s01-TrafficCount-06-Insert-Sub1]!Count1*4/5,[s01-TrafficCount-06-Insert-Sub1]!Count1),0) AS Count1, IIf([s01-TrafficCount-06-Insert-Sub1]!Count2>0,IIf([s01-TrafficCount-06-Insert-Sub1].DayType='weekday',[s01-TrafficCount-06-Insert-Sub1]!Count2*4/5,[s01-TrafficCount-06-Insert-Sub1]!Count2),0) AS Count2, IIf([s01-TrafficCount-06-Insert-Sub1]!Count3>0,IIf([s01-TrafficCount-06-Insert-Sub1].DayType='weekday',[s01-TrafficCount-06-Insert-Sub1]!Count3*4/5,[s01-TrafficCount-06-Insert-Sub1]!Count3),0) AS Count3, IIf([s01-TrafficCount-06-Insert-Sub1]!Count4>0,IIf([s01-TrafficCount-06-Insert-Sub1].DayType='weekday',[s01-TrafficCount-06-Insert-Sub1]!Count4*4/5,[s01-TrafficCount-06-Insert-Sub1]!Count4),0) AS Count4, IIf([s01-TrafficCount-06-Insert-Sub1]!Count5>0,IIf([s01-TrafficCount-06-Insert-Sub1].DayType='weekday',[s01-TrafficCount-06-Insert-Sub1]!Count5*4/5,[s01-TrafficCount-06-Insert-Sub1]!Count5),0) AS Count5, IIf([s01-TrafficCount-06-Insert-Sub1]!Count6>0,IIf([s01-TrafficCount-06-Insert-Sub1].DayType='weekday',[s01-TrafficCount-06-Insert-Sub1]!Count6*4/5,[s01-TrafficCount-06-Insert-Sub1]!Count6),0) AS Count6, IIf([s01-TrafficCount-06-Insert-Sub1]!Count7>0,IIf([s01-TrafficCount-06-Insert-Sub1].DayType='weekday',[s01-TrafficCount-06-Insert-Sub1]!Count7*4/5,[s01-TrafficCount-06-Insert-Sub1]!Count7),0) AS Count7, [s01-TrafficCount-06-Insert-Sub1].CountTotal, [s01-TrafficCount-06-Insert-Sub1].RowStatus
FROM [s01-TrafficCount-06-Insert-Sub1];
```

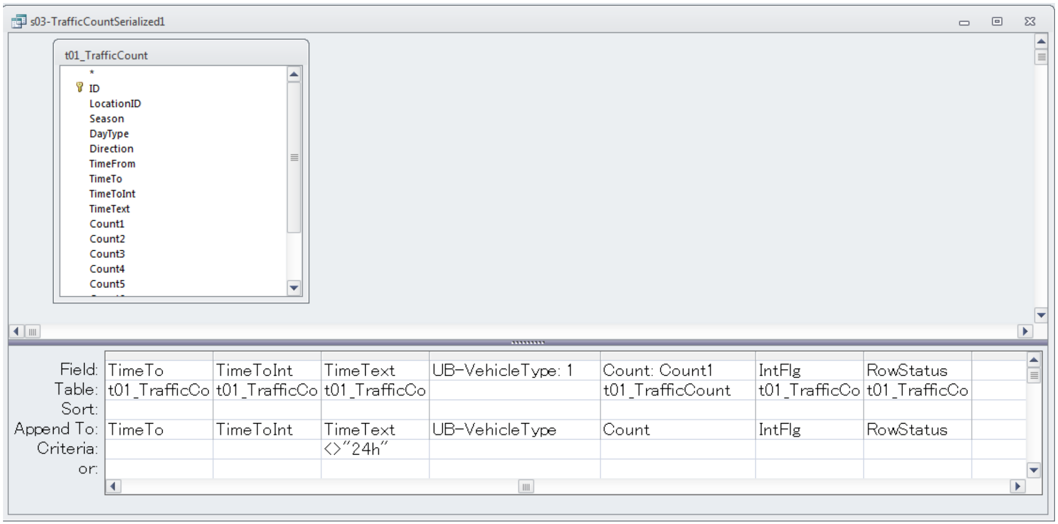
In order to estimate the traffic count of target year, the coefficient of the expression of [Update To:] in each field of “s01-TrafficCount-06-UpdateFor2015” query is changed. The coefficient applies to the ratio of the number of vehicle inspection registration in target year to 2010.

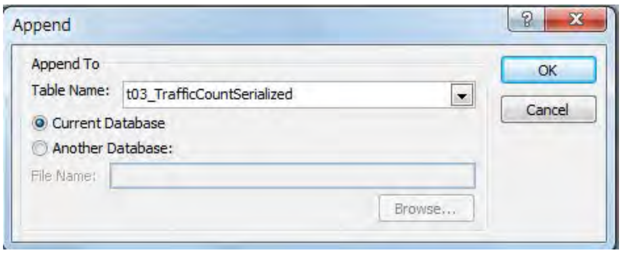
Calculate the daily traffic volume using the “t01-TrafficCount” table updated according to the above, and calculate the annual traffic volume by multiplying it by the annual number of days by season by weekday or holiday.



Sort the “t01-TrafficCount” table into a table of traffic count by vehicle type by time by weekday or holiday by season by link. After deleting the existing data with “s03-TrafficCountSerialized0-Remove-All” query, run “s03-TrafficCountSerialized1” query and add the result to “t03-TrafficCountSerialized” table. Do this work for queries 2 to 7 in the same way.

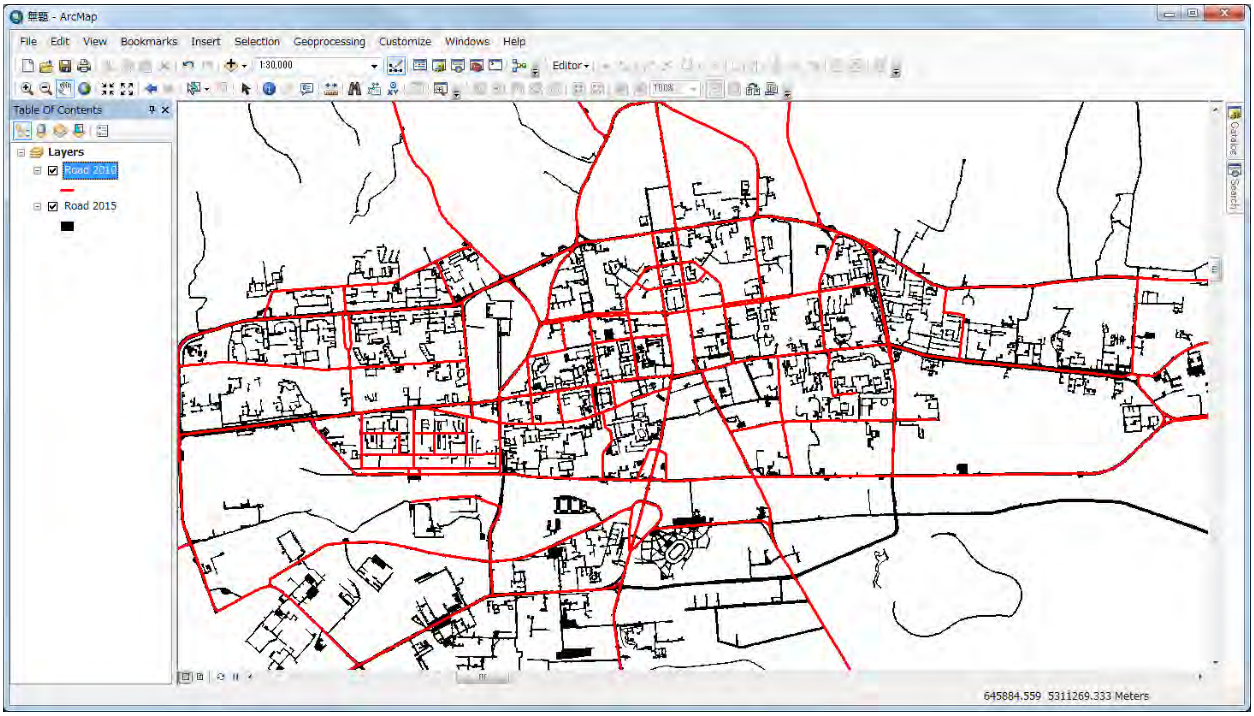




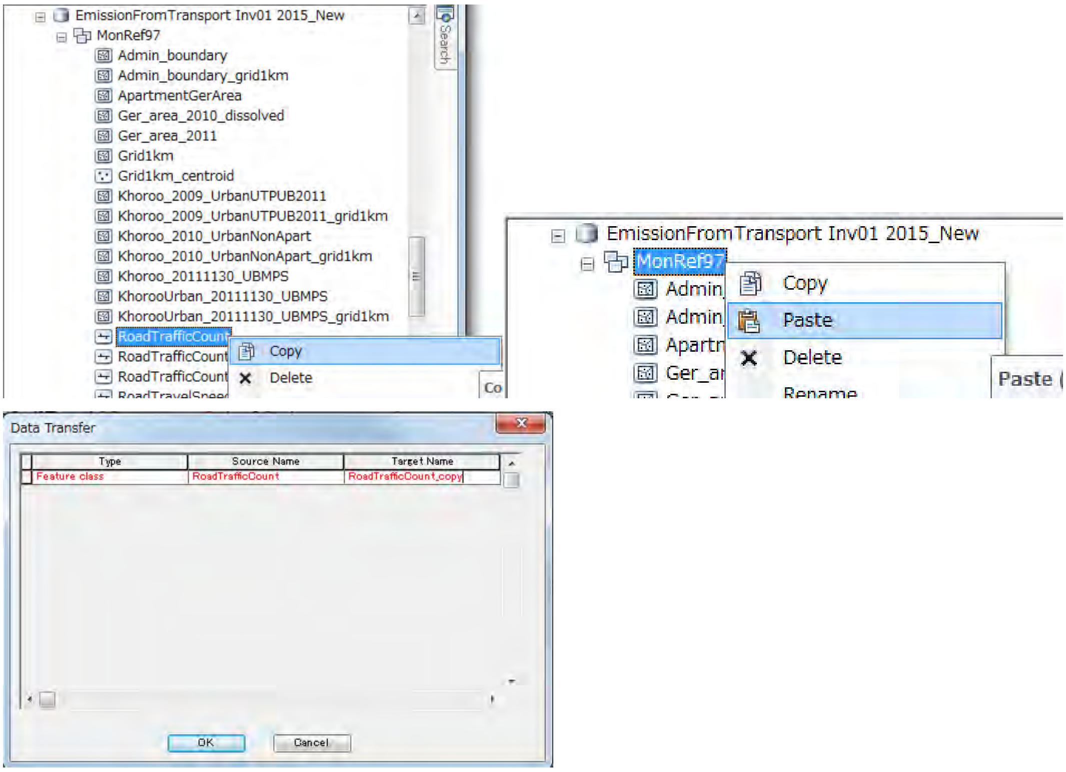


6.1.3.2 Updating Road Network

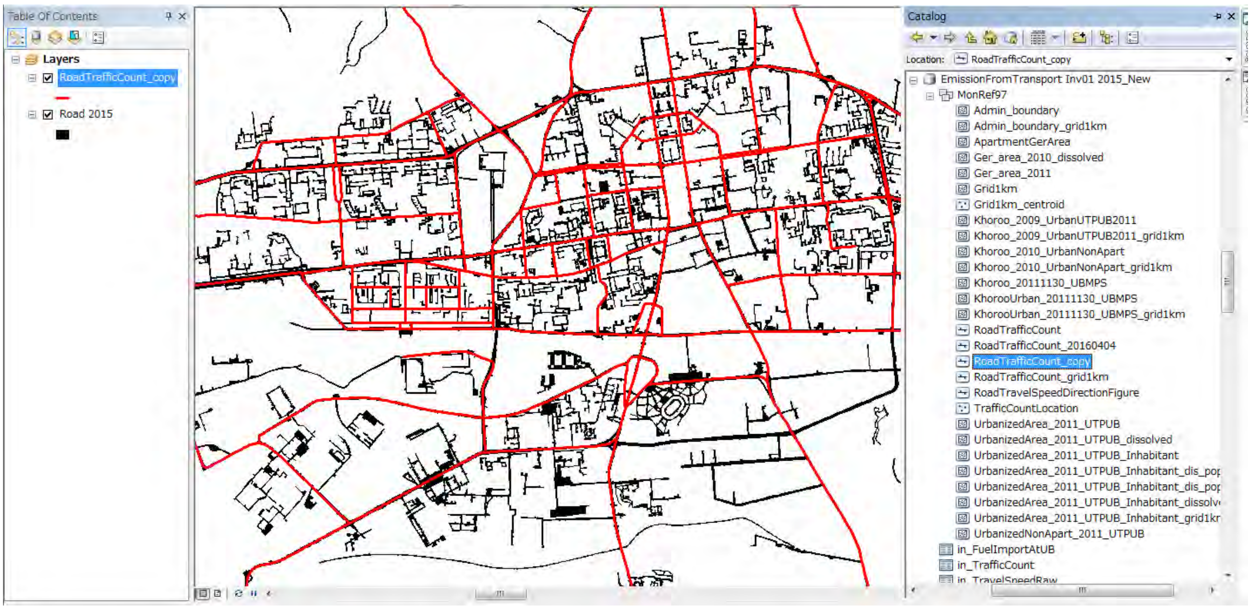
The existing road network and the newly acquired road network are overlapped on GIS software. If there is a road that is not included in the existing road network but is included in the newly acquired road network, a new road network is added to the layer of the existing road network.

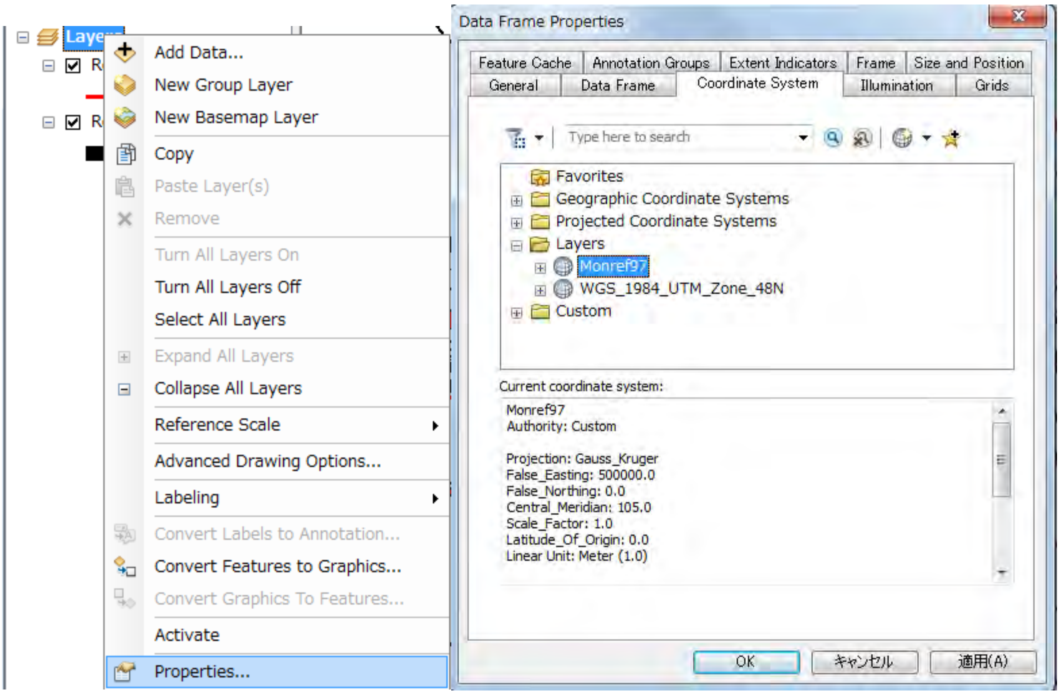


Make the copy of road network to modify and save the different name.

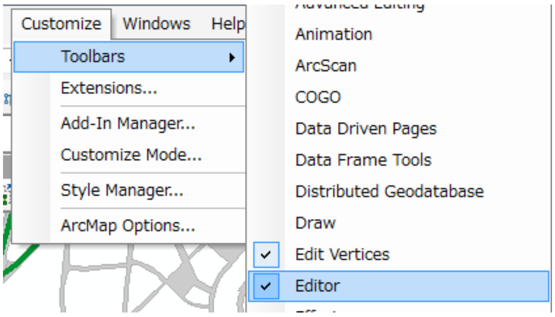


Layers of the new road and layers of the old road copied above are overwrapped and displayed. At this time, the coordinate system in the map is set to the coordinate system of the layer of the copied old road.

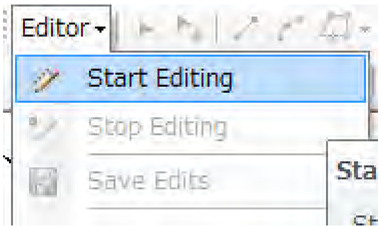




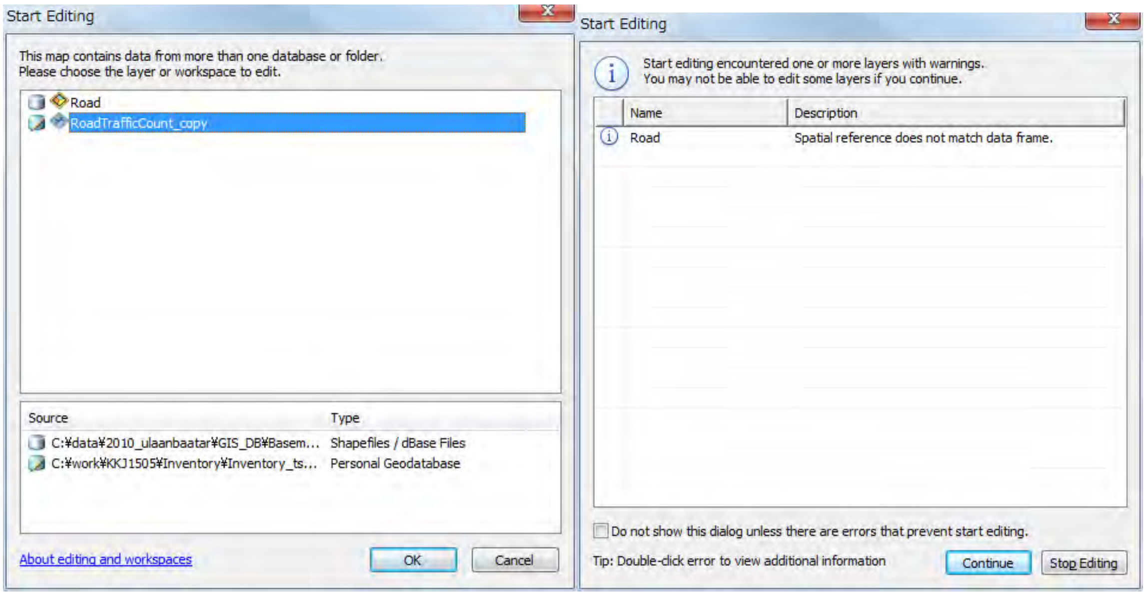
To edit the road network data, click [Customize]-[Toolbars]-[Editor] and show “Editor” toolbar.



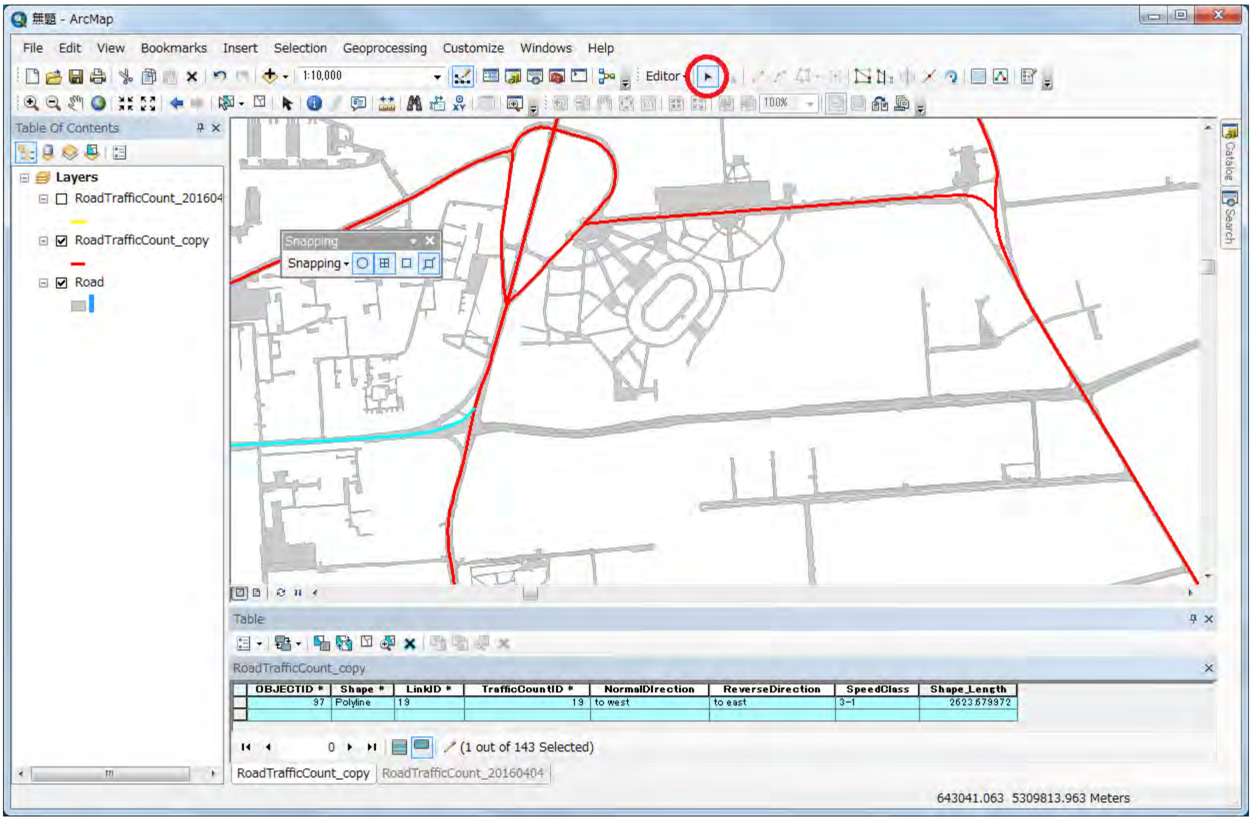
Click [Editor]-[Start Editing] in “Editor” toolbar.



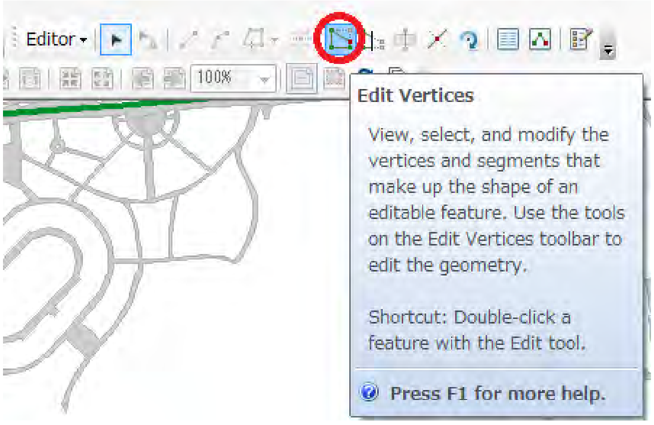
Select the layer of road network to edit and click [OK]. Also, when showing the right dialog, click [Continue].



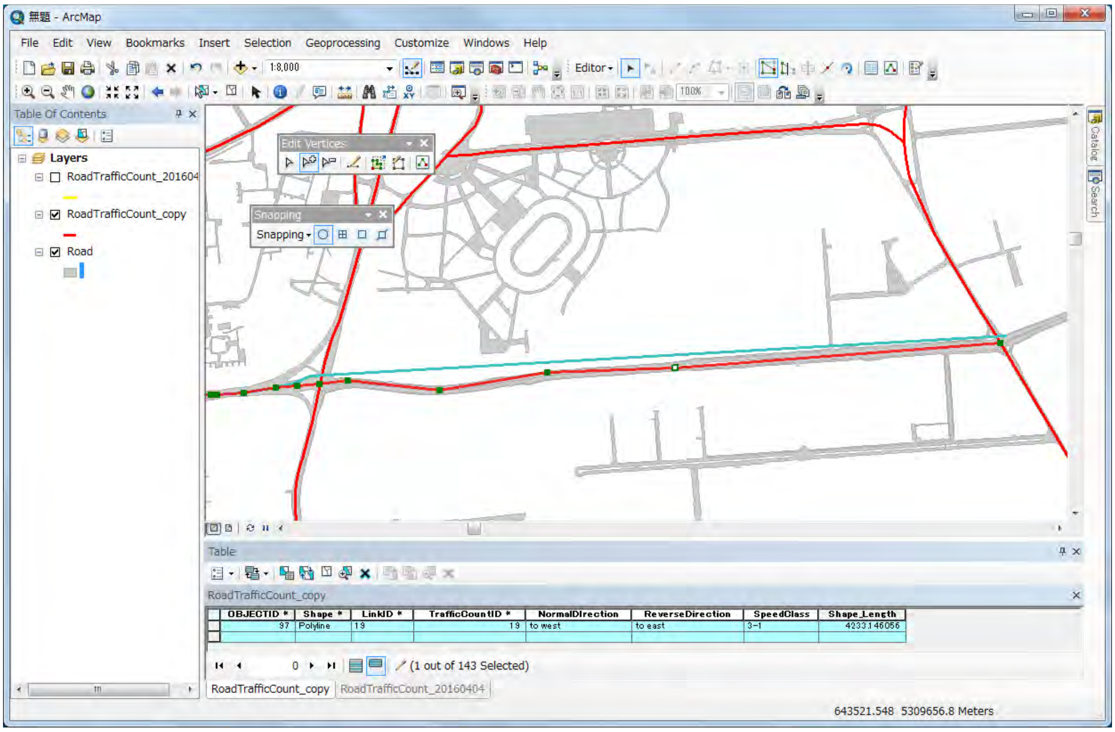
After selecting the icon in red circle, select the road to update. Color of selected road is changed to light blue.



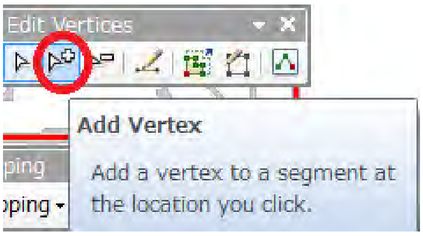
To modify the selected road, click the icon in red circle. This icon has the function to modify the location and number of vertex of road.



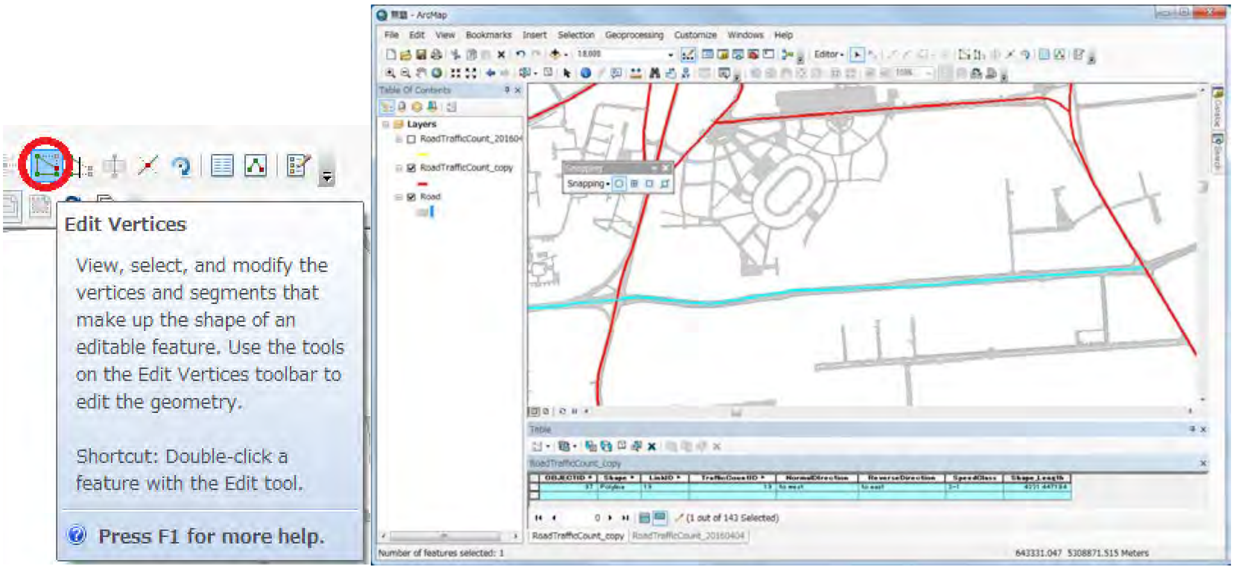
Green rectangle on line is vertex. When pointing vertex with a cursor, and clicking and moving the mouse, vertex moves.



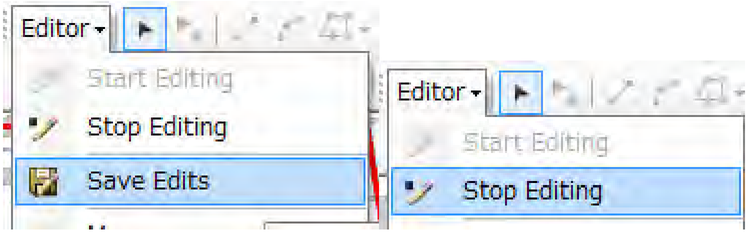
To add new vertex between the existing vertices, after clicking the icon in red circle, point the line between the existing vertices with a cursor and click.



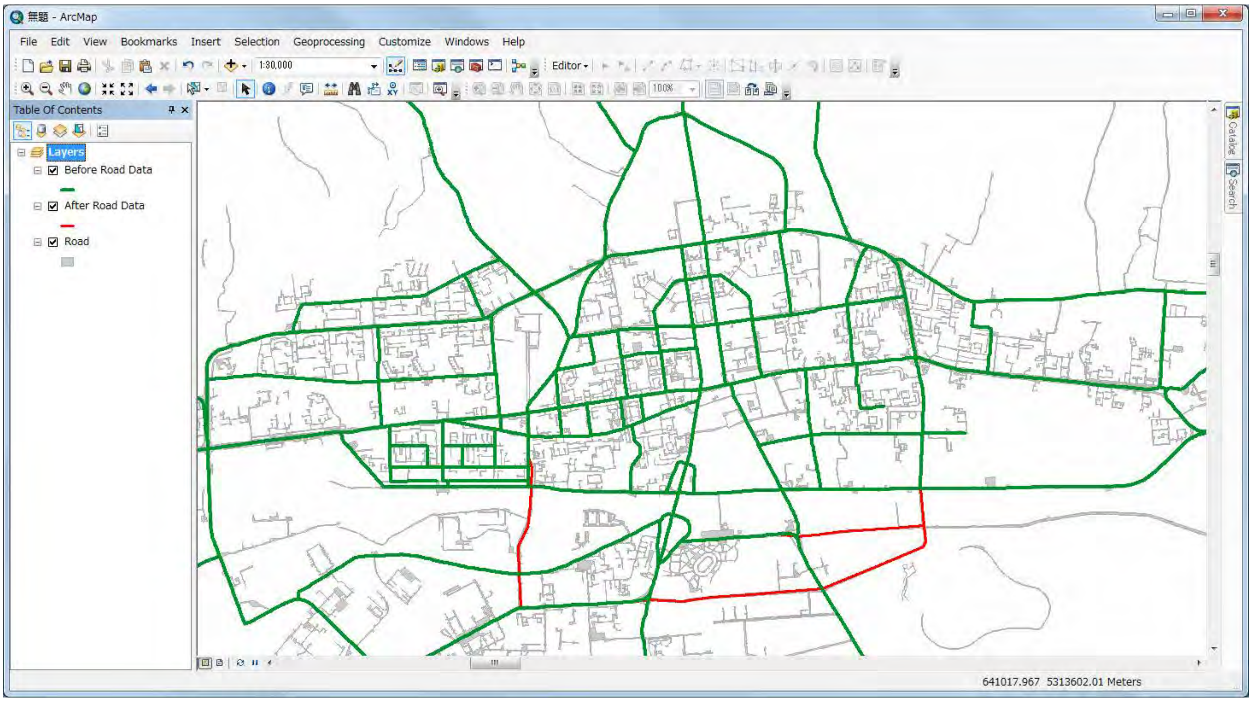
Click the icon in the following figure and complete the edit of vertex.



After completing to add the target road, save the layer by clicking [Save Edits] of [Editor] and complete the edit mode by clicking [Stop Editing].



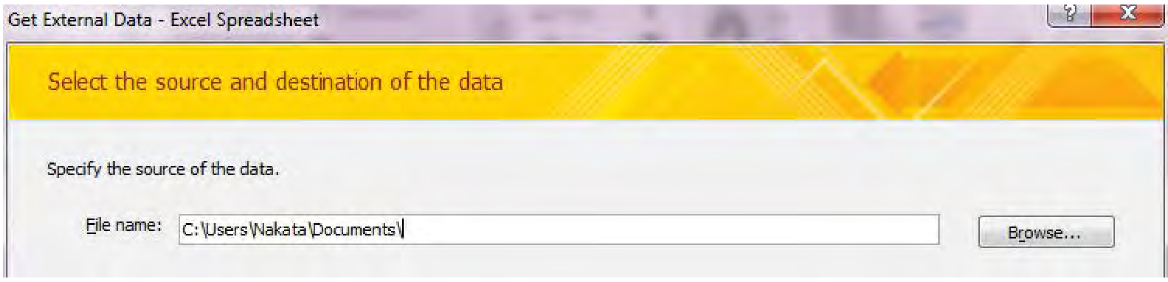
Updating road network shows red line as follows.



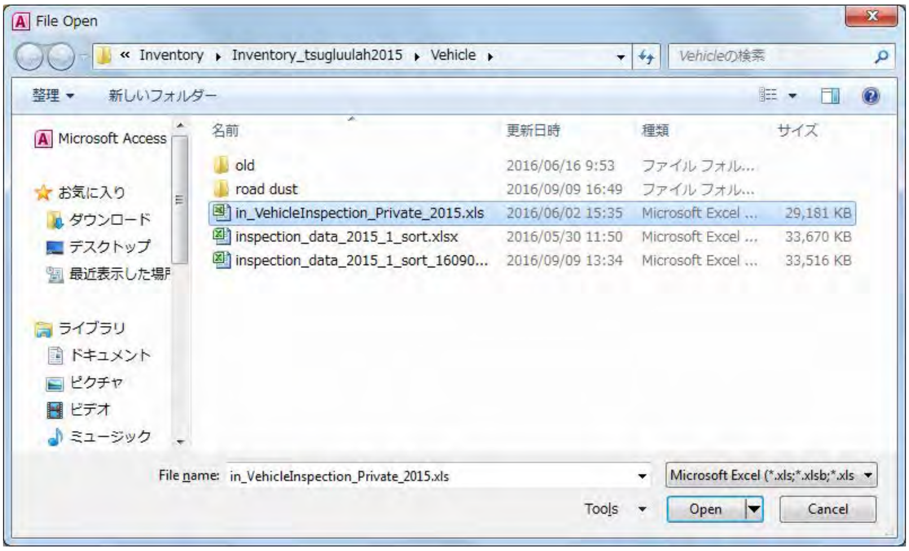
6.1.3.3 Updating Vehicle Inspection Registration Data

Select [External Data] tab and select [Excel] in [Import & Link].

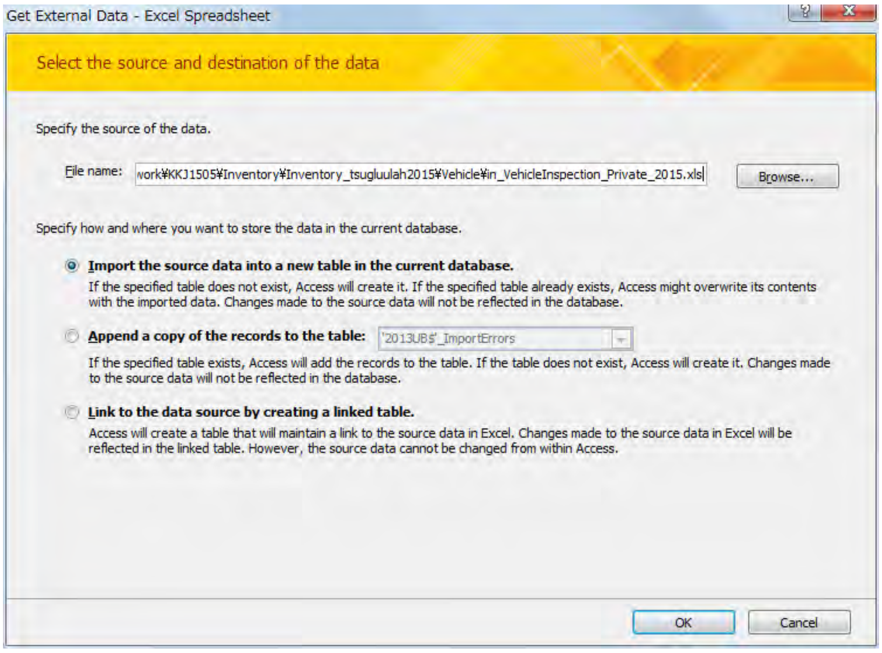
Click [Browse].



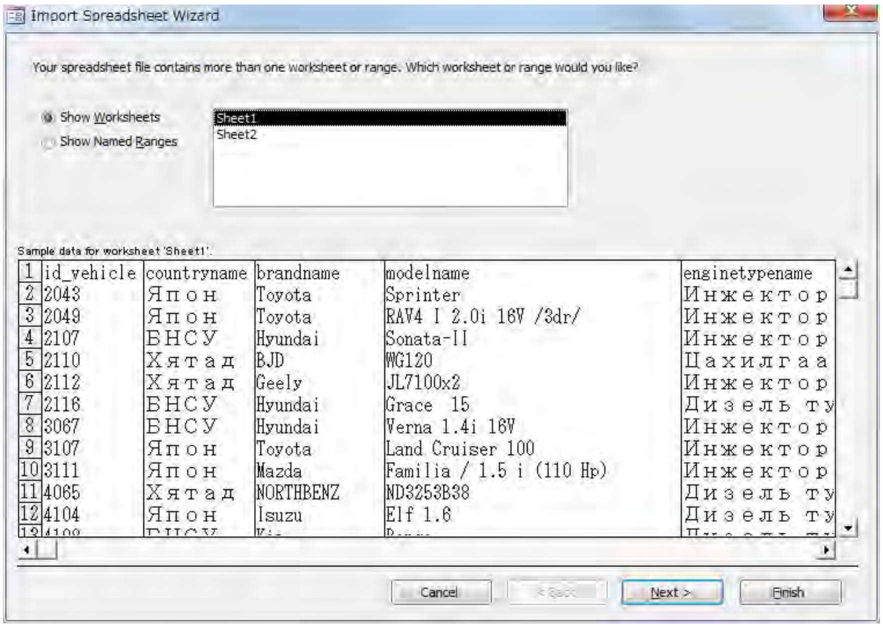
Select the file you want to import (Here it is “in_VehicleInspection_Private_2015.xls”).



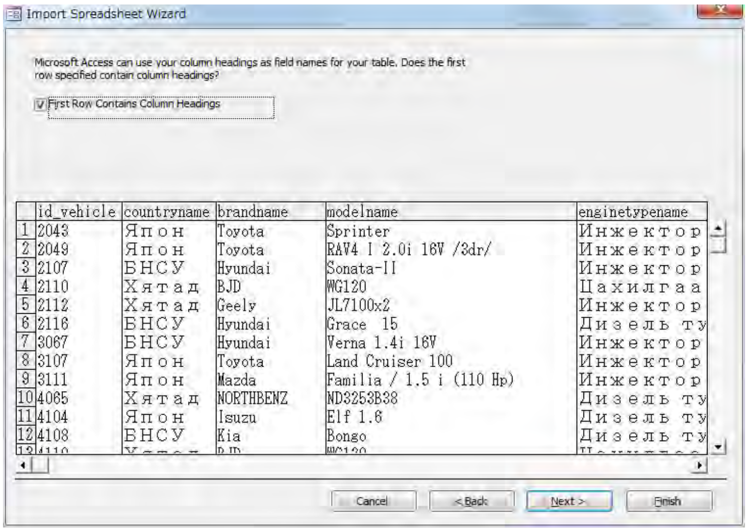
Select [Import the source data into a new table in the current database.] and click [OK].



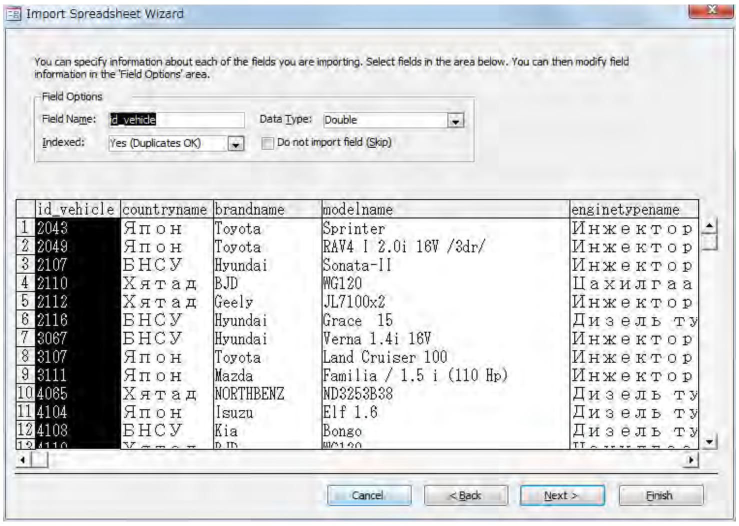
Check [Show Worksheets] is selected, select [Sheet1] sheet, and click [Next].



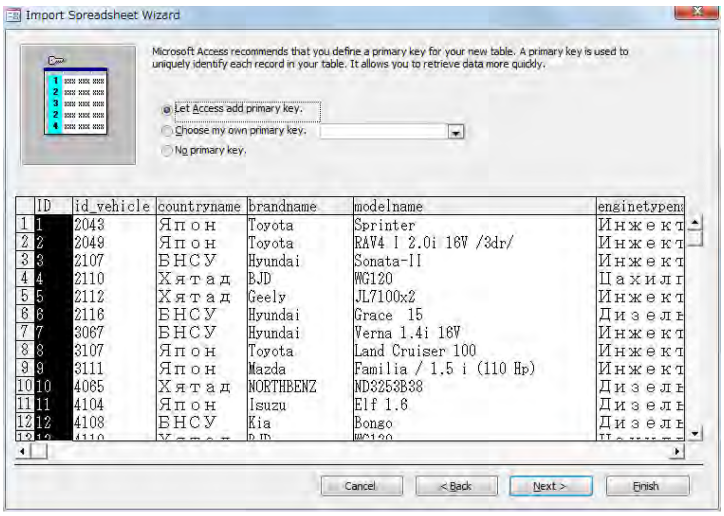
Check [First Row Contains Column Headings] is checked and click [Next].



Click [Next]

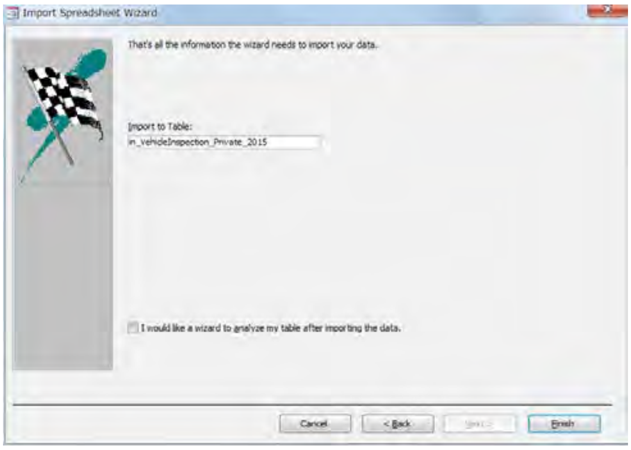


Select [Let Access add primary key.] and Click [Next].

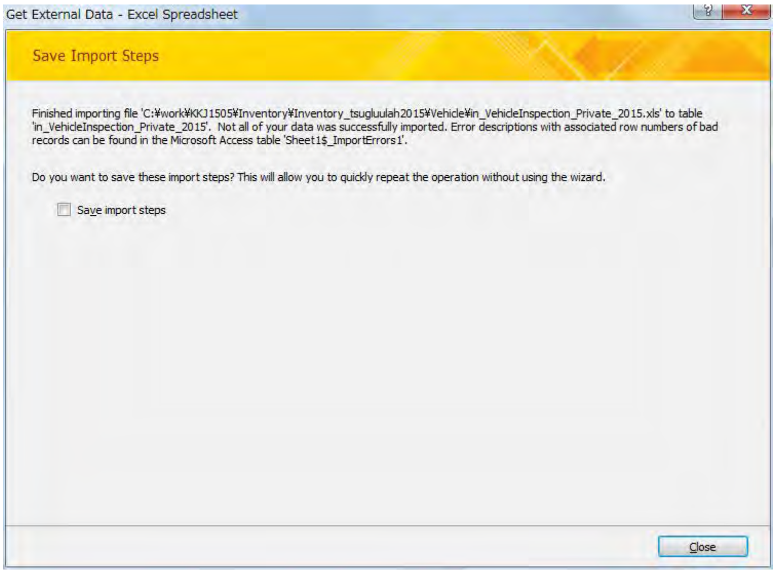


Input the table name in the [Import to Table:] textbox and click [Finish].

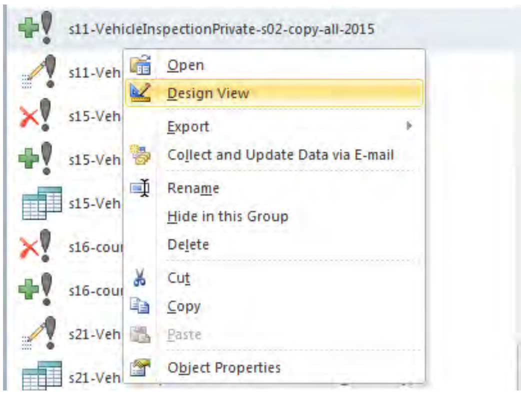
(Here it is “in_VehicleInspection_Private_2015”.)

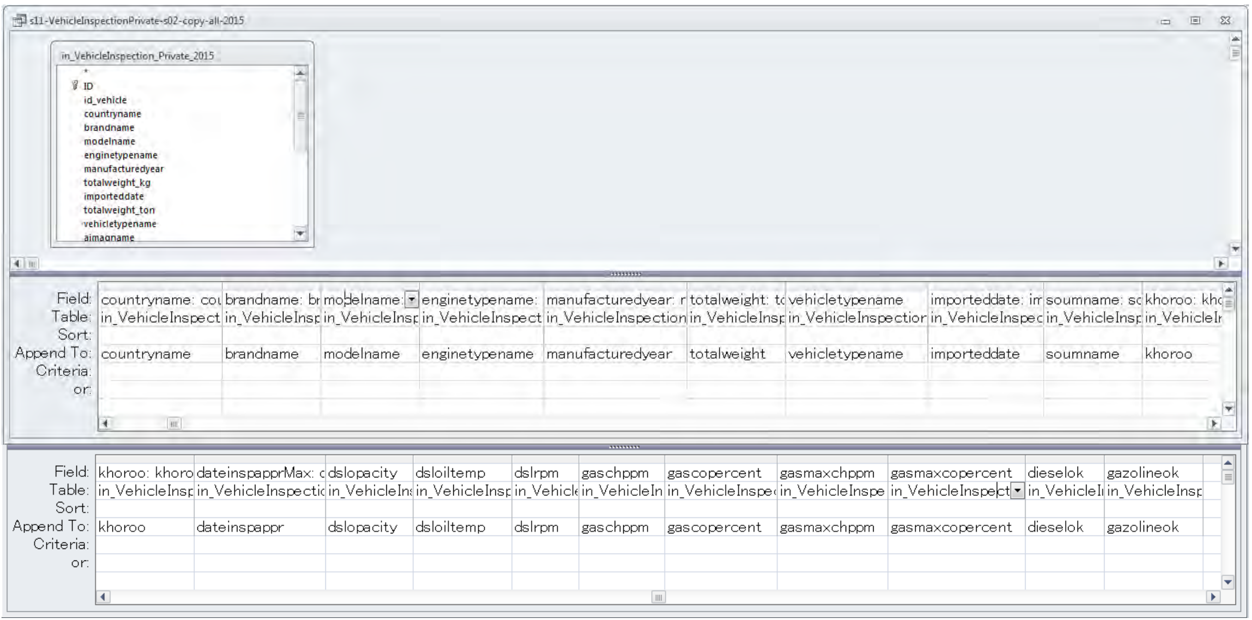


Click [Close].

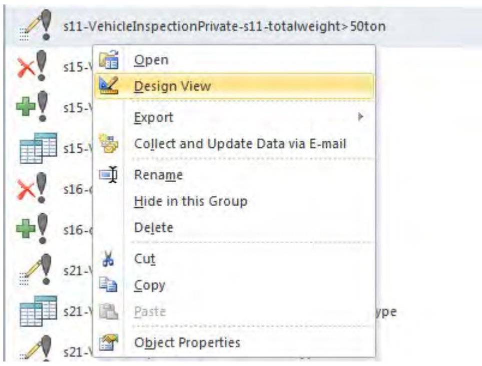


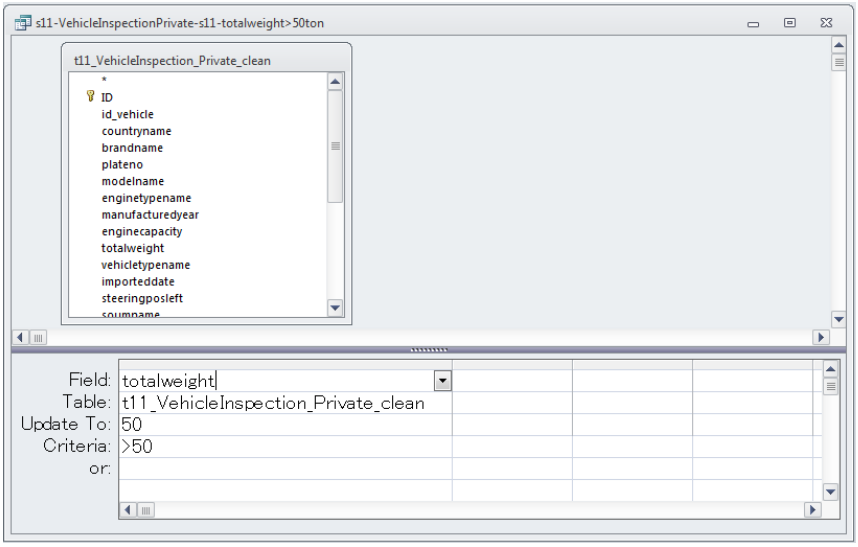
Right-click “s11-VehicleInspectionPrivate-s02-copy-all-2015” query and click [Design View].



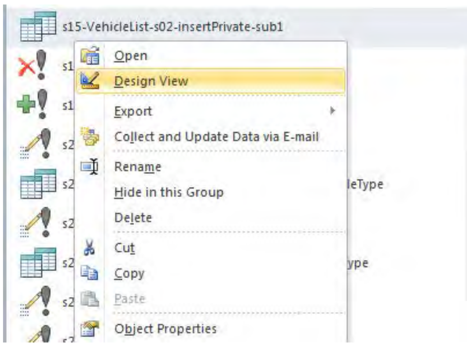


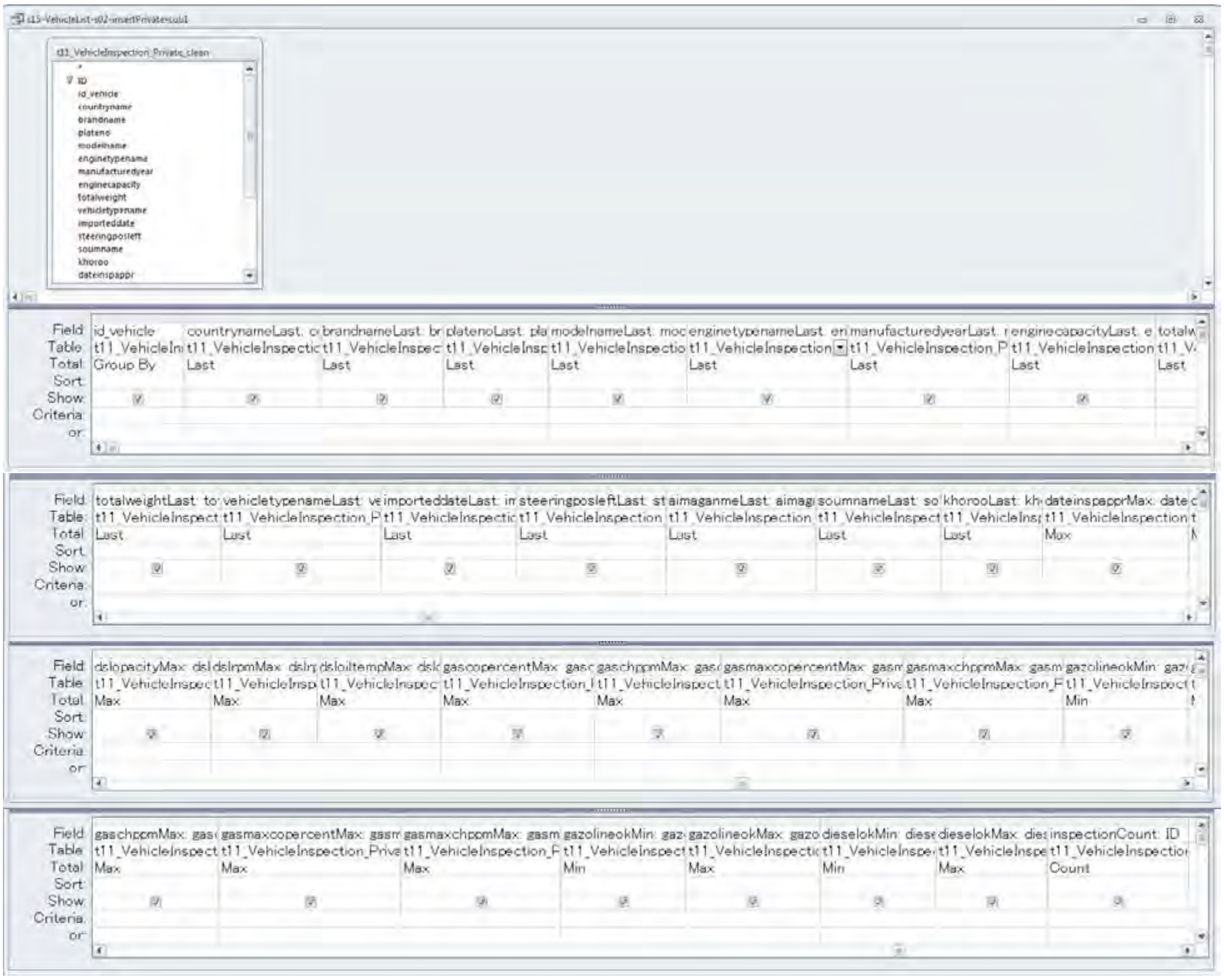
The value in the [totalweight] column may exceed 50. Since the unit of this column is “ton” and the value exceeding 50 is not a realistic value as the weight of vehicle, all values exceeding 50 tons is regarded as 50 tons. So right-click “s11-VehicleInspectionPrivate-s11-totalweight>50ton” query and click [Design View].





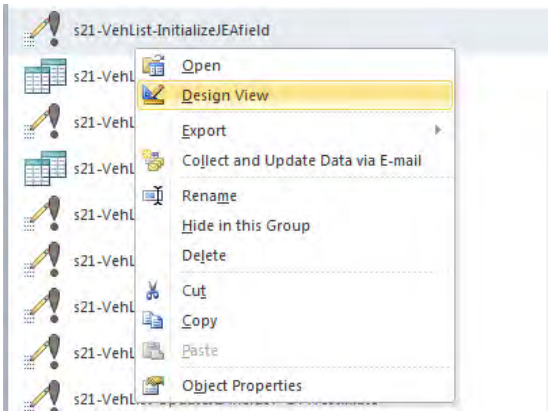
Create a table for allocating coefficients considering the year of Regulation of Exhaust Gas of Motor Vehicles in Japan and the condition in Mongolia to data cleaned vehicle inspection registration data. So right-click “s15-VehicleList-s02-insertPrivate-sub1” query and click [Design View].

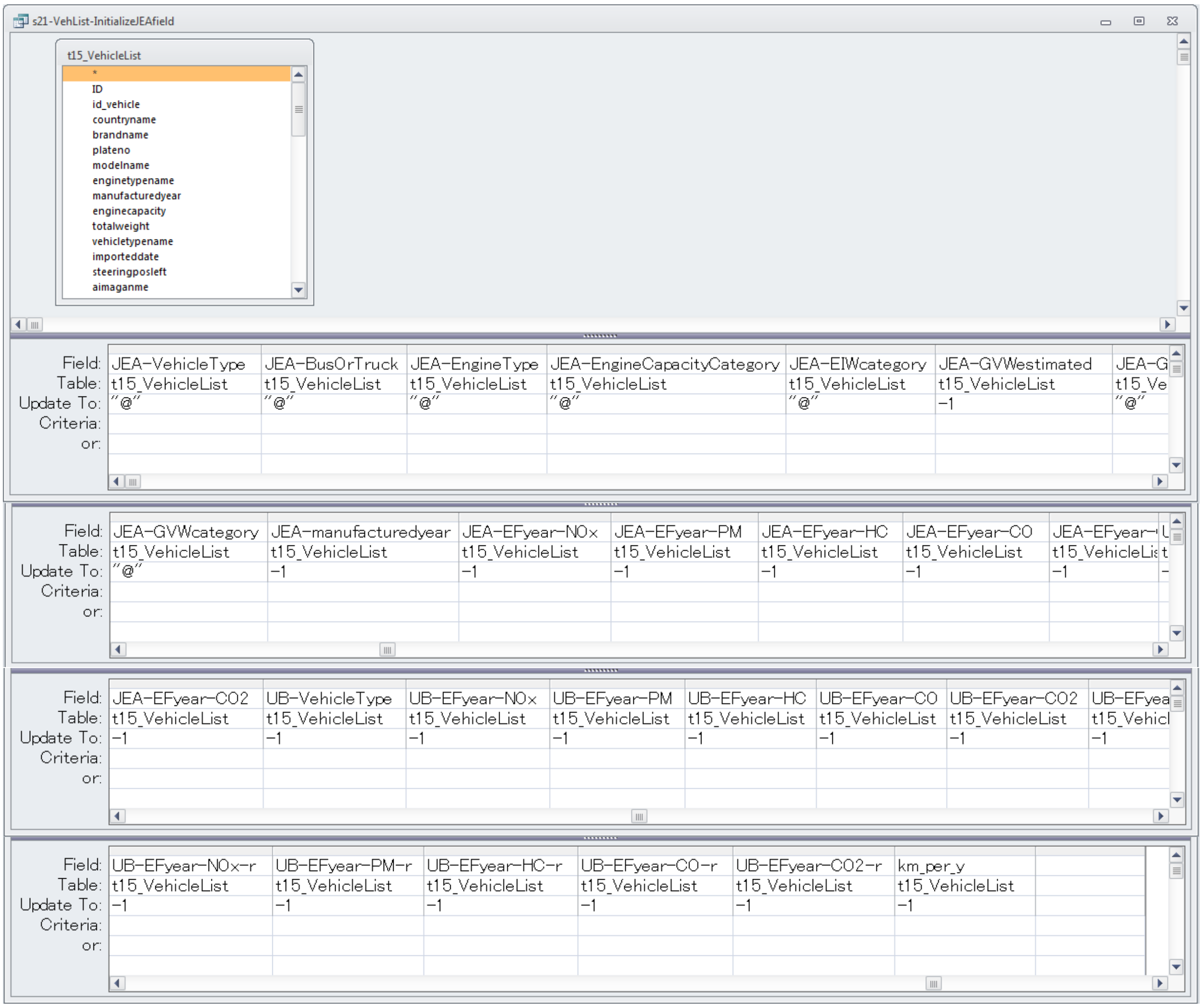




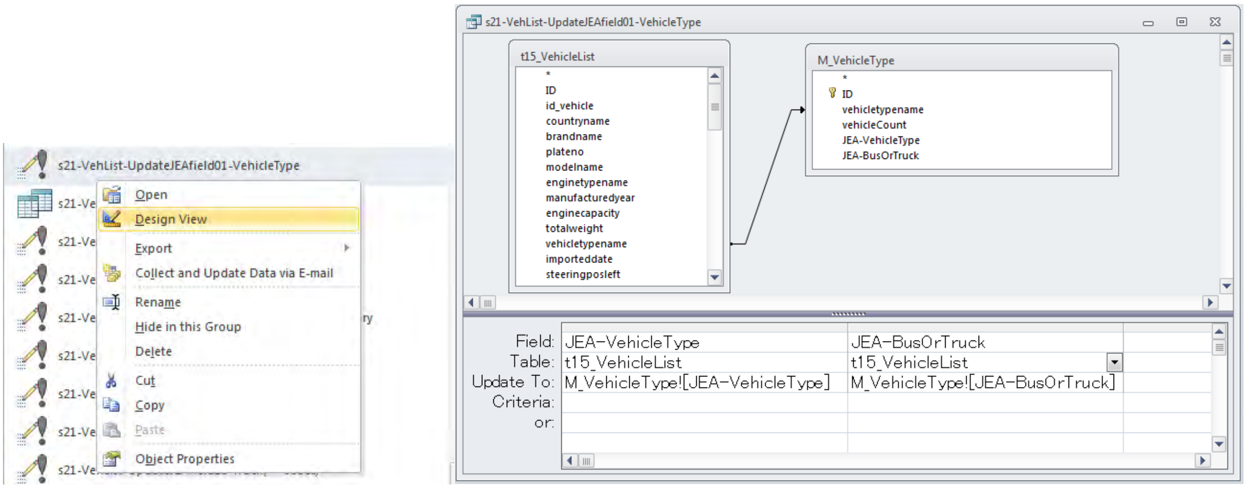
6.1.3.4 Setting the Classification of Regulation of Exhaust Gas of Motor Vehicles in Japan

Set the classification of Regulation of Exhaust Gas of Motor Vehicles to each car in the table created above. First, initialize the value of the column of classification year Regulation of Exhaust Gas of Motor Vehicles in Japan and the coefficient taking into consideration the condition in Mongolia. Right-click ”s21-VehList-InitializeJEAfield” query and click [Design View].

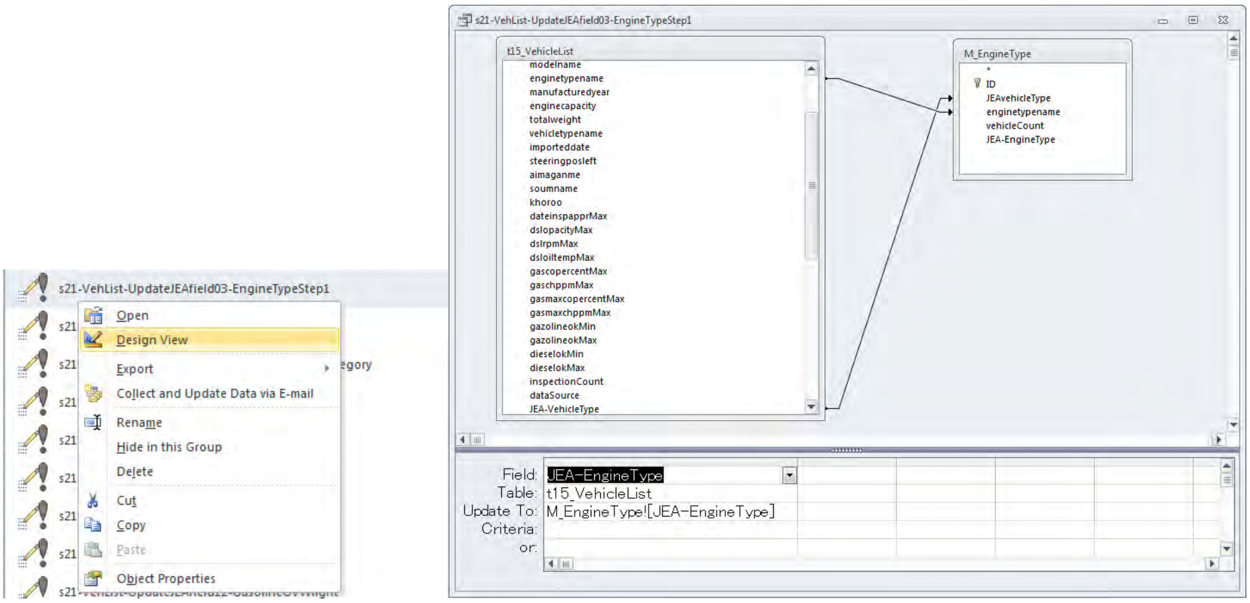




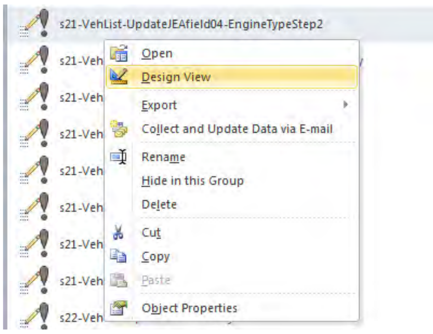
Right-click “s21-VehList-UpdateJEAfield01-VehicleType” query and click [Design View]. In this query, set the vehicle type classification for each registered vehicle.

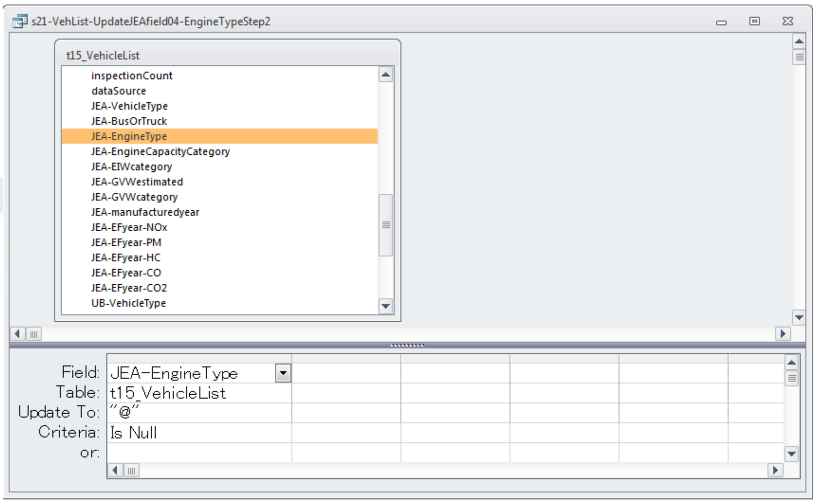


Right-click “s21-VehList-UpdateJEAfield03-EngineTypeStep1” query and click [Design View]. In this query, set the engine type in regulation of exhaust gas of motor vehicles in Japan to each registered vehicle.

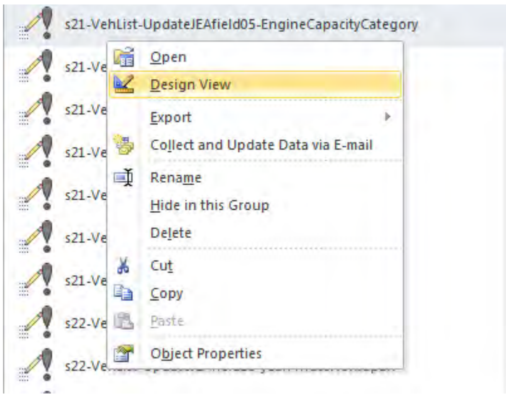


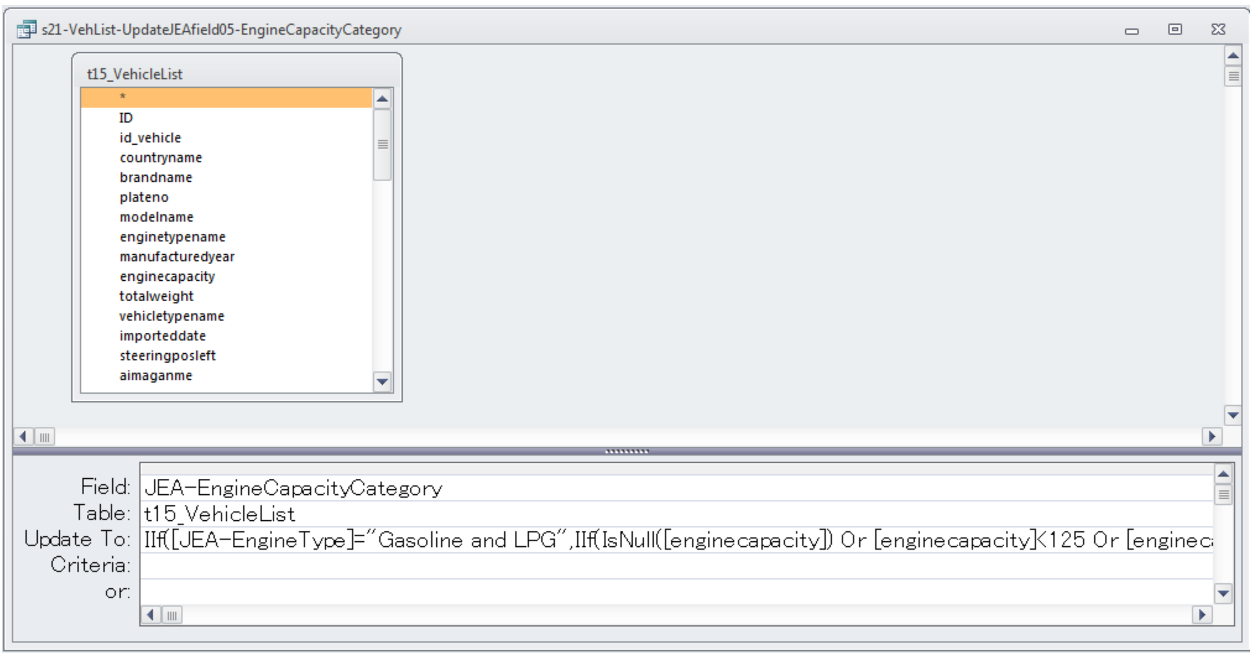
Right-click “s21-VehList-UpdateJEAfield04-EngineTypeStep2” query and click [Design View]. In this query, set the symbol indicating no classification “@” to the column of vehicle engine type that is null when running “Step1”.

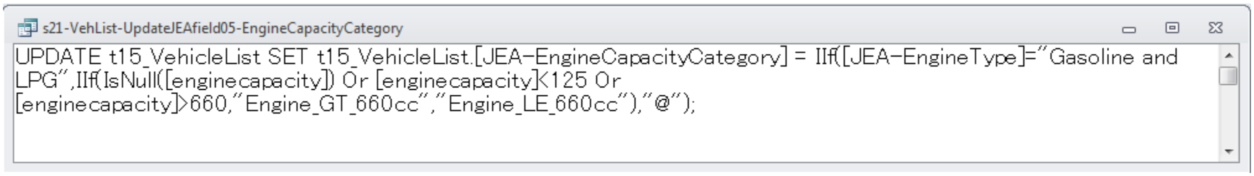




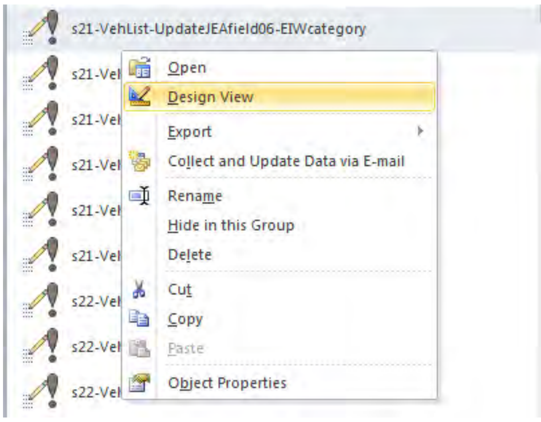
Right-click "s21-VehList-UpdateJEAfield05-EngineCapacityCategory" query and click [Design View]. In this query, classify the category according to the engine capacity of vehicle.



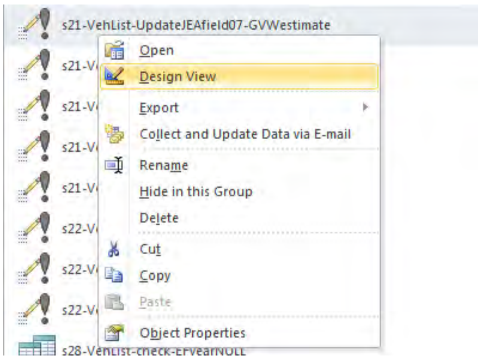


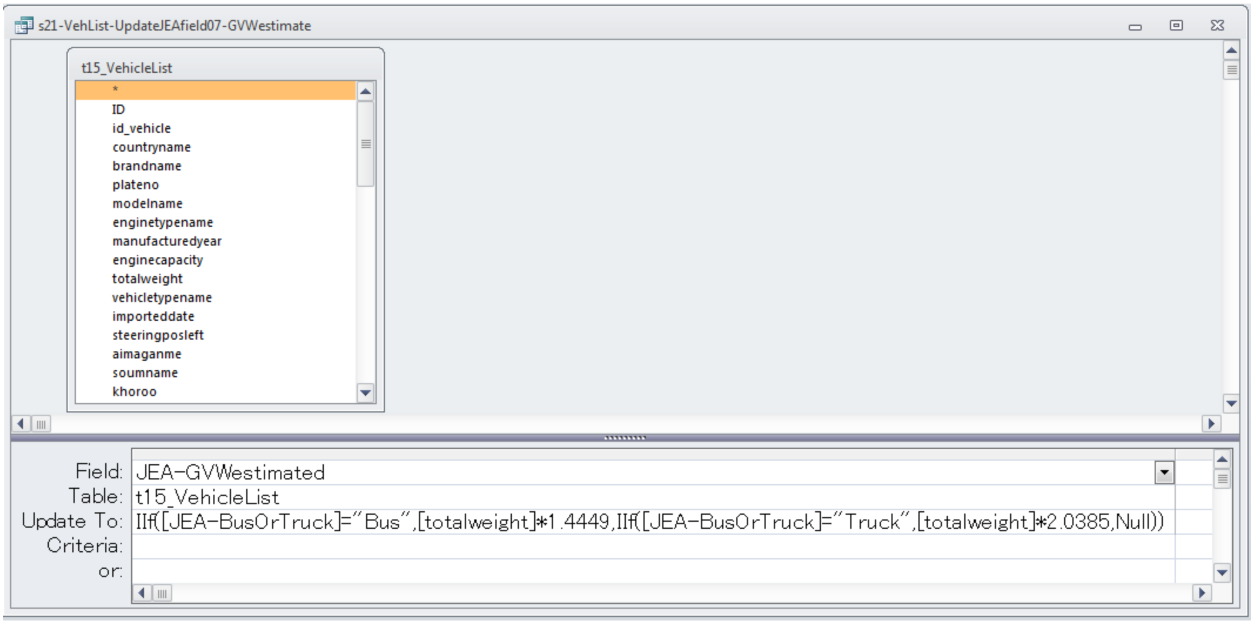


Right-click "s21-VehList-UpdateJEAfield06-EIWcategory" query and click [Design View]. In this query, classify the category of Equivalent Inertia Weight (EIW) in diesel passenger car.

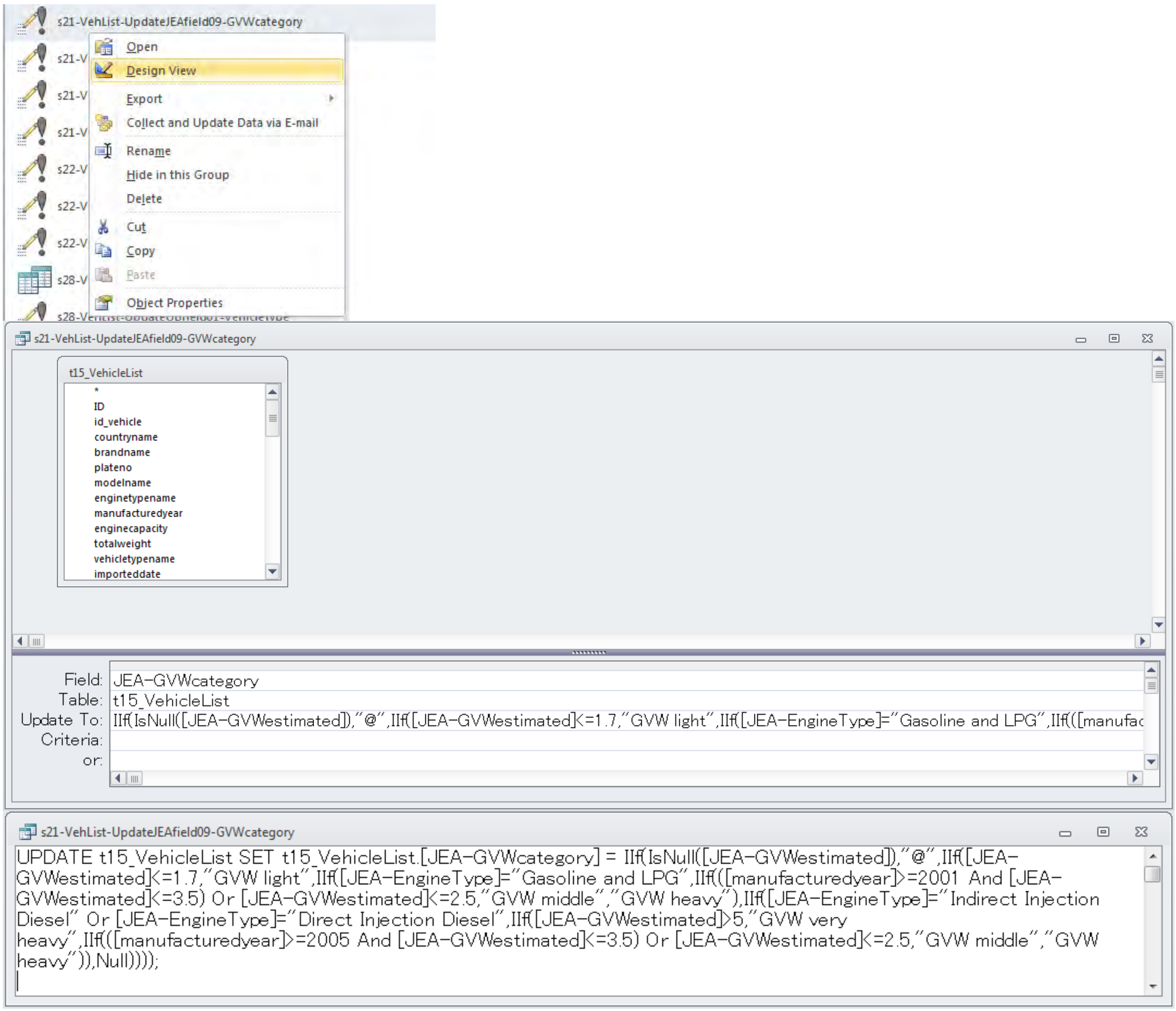


Right-click "s21-VehList-UpdateJEAfield07-GVWestimate" query and click [Design View]. In this query, estimate the Gross Vehicle Weight (GVW) of bus and truck.

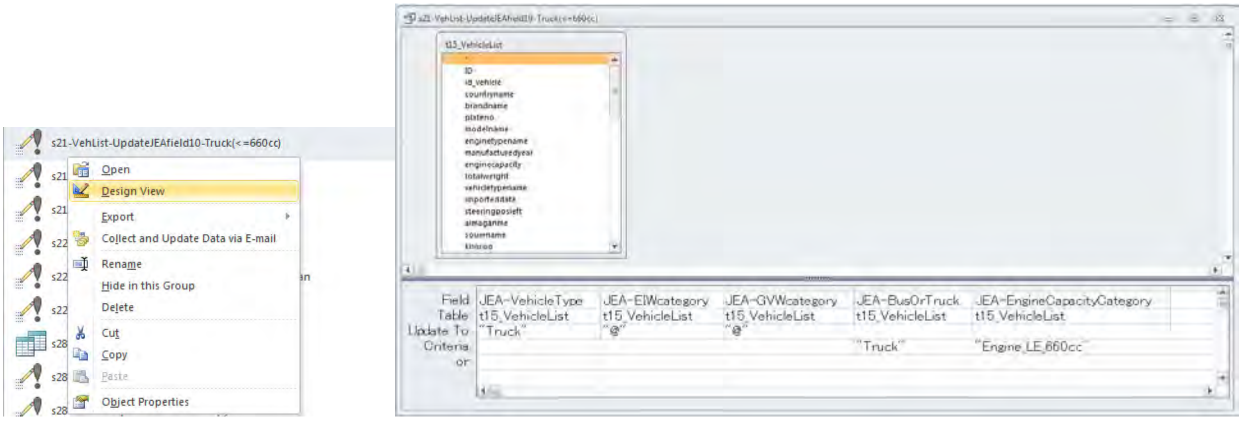




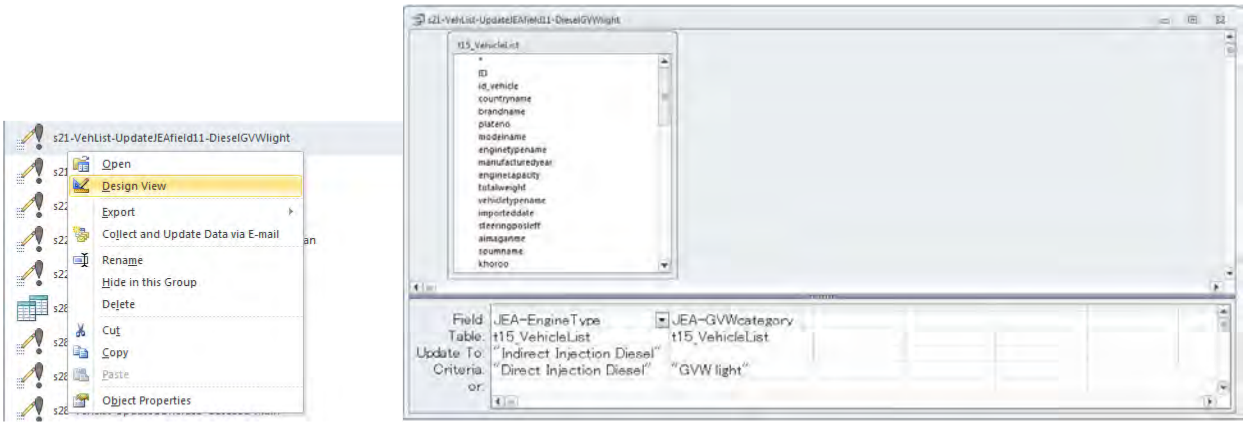
Right-click "s21-VehList-UpdateJEAfield09-GVWcategory" query and click [Design View]. In this query, classify the category of GVW by vehicle type.



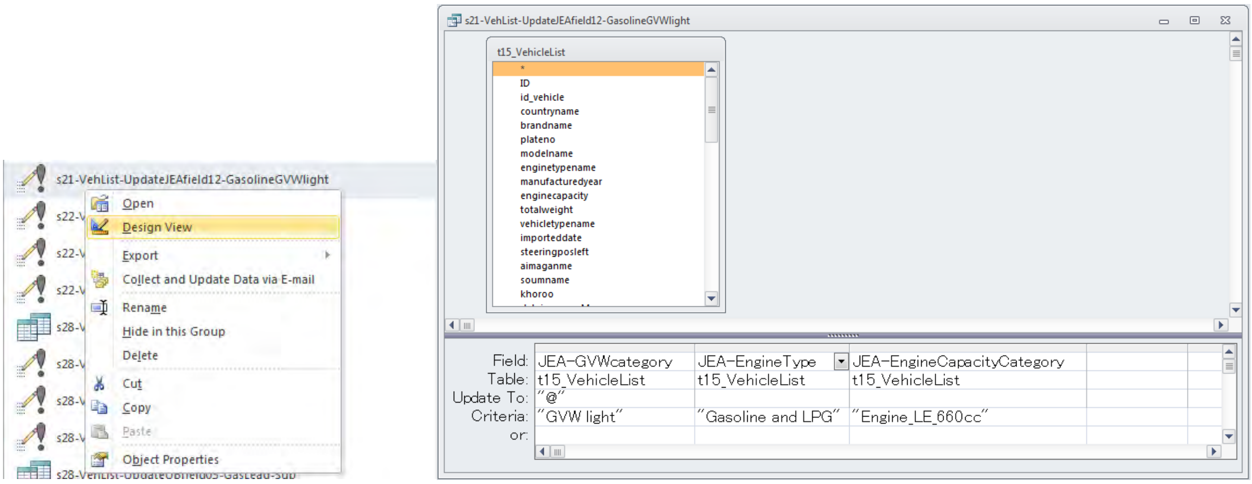
Right-click "s21-VehList-UpdateJEAfield10-Truck(<=660cc)" query and click [Design View]. In this query, modify the category of EIW and GVW of truck of engine capacity less than 660cc.



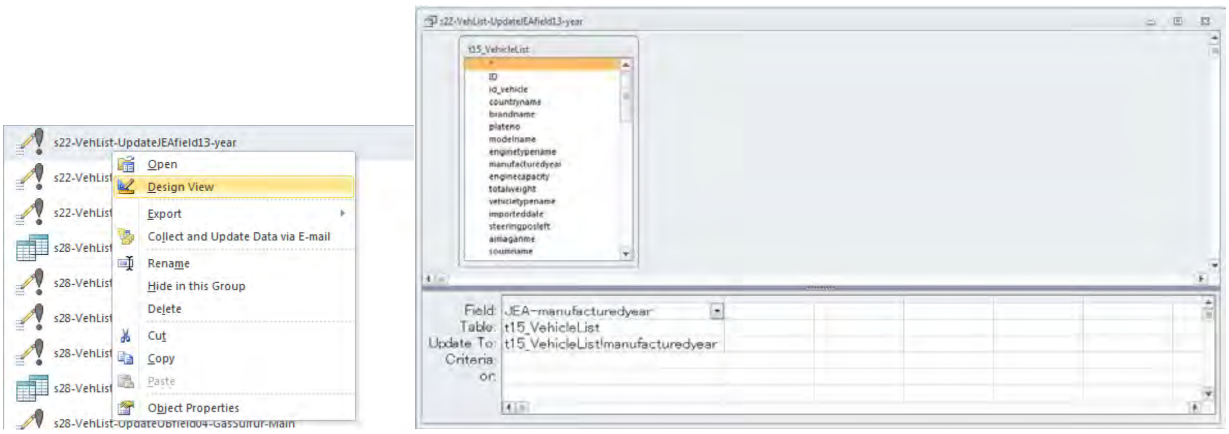
Right-click "s21-VehList-UpdateJEAfield10-Truck(<=660cc)" query and click [Design View]. In this query, change the vehicle engine type of direct injection diesel engines of light classification GVW "Direct Injection Diesel" to "Indirect Injection Diesel".



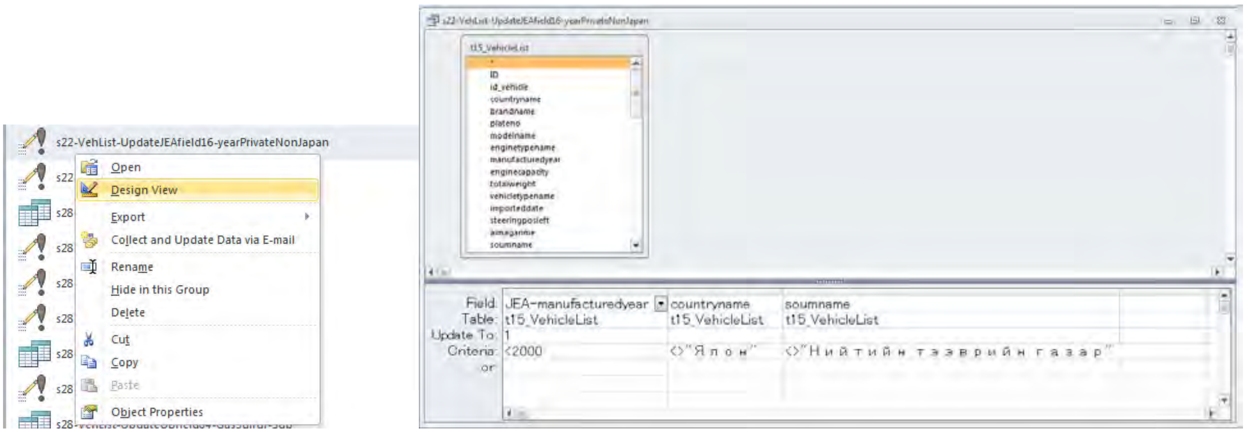
Right-click "s21-VehList-UpdateJEAfield12-GasolineGVWlight" query and click [Design View]. In this query, update the GVW classification of gasoline vehicle less than 660cc to the symbol indicating no classification "@".



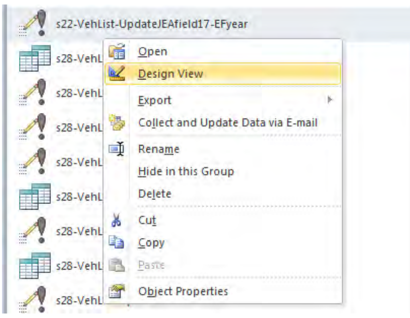
Right-click "s21-VehList-UpdateJEAfield13-year" query and click [Design View]. In this query, copy and paste information of manufactured year ("manufacturedyear" column) to the column to classify the regulation year of exhaust gas of vehicle in Japan ("JEA-manufacturedyear" column).

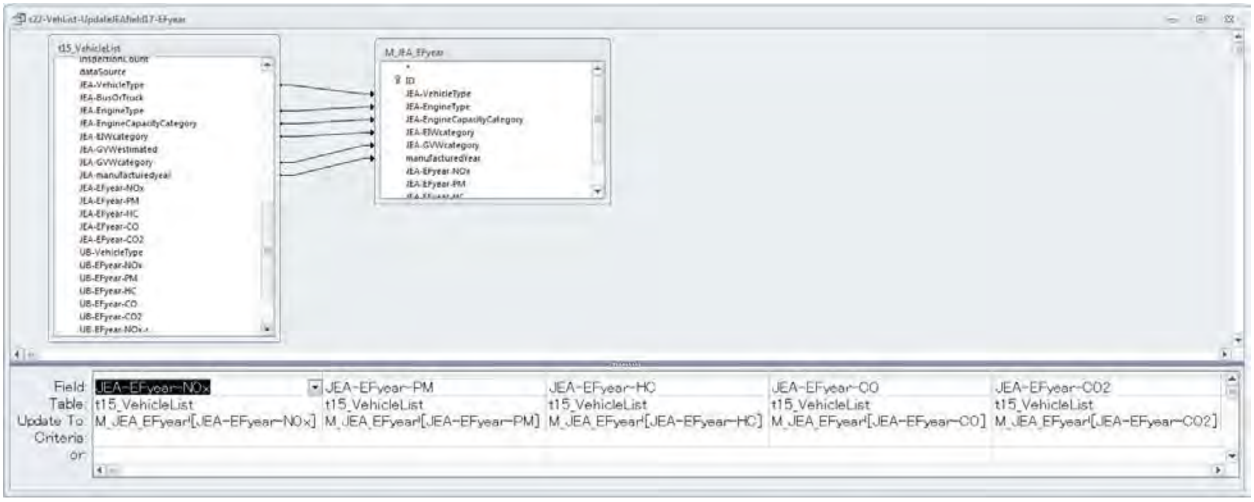


Right-click “s22-VehList-UpdateJEAfield16-yearPrivateNonJapan” query and click [Design View]. In this query, update the regulation year of exhaust gas of vehicle in Japan for the vehicle manufactured in except Japan to “1” (before regulation).



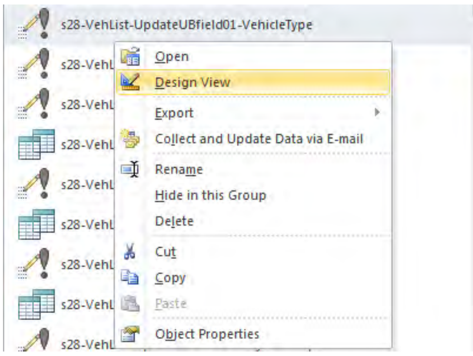
Right-click “s22-VehList-UpdateJEAfield17-EFyear” query and click [Design View]. In this query, set the regulation year of vehicle exhaust gas of vehicle by pollutant defined by vehicle type, engine type, engine capacity classification, EIW classification, GVW classification, and manufactured year.

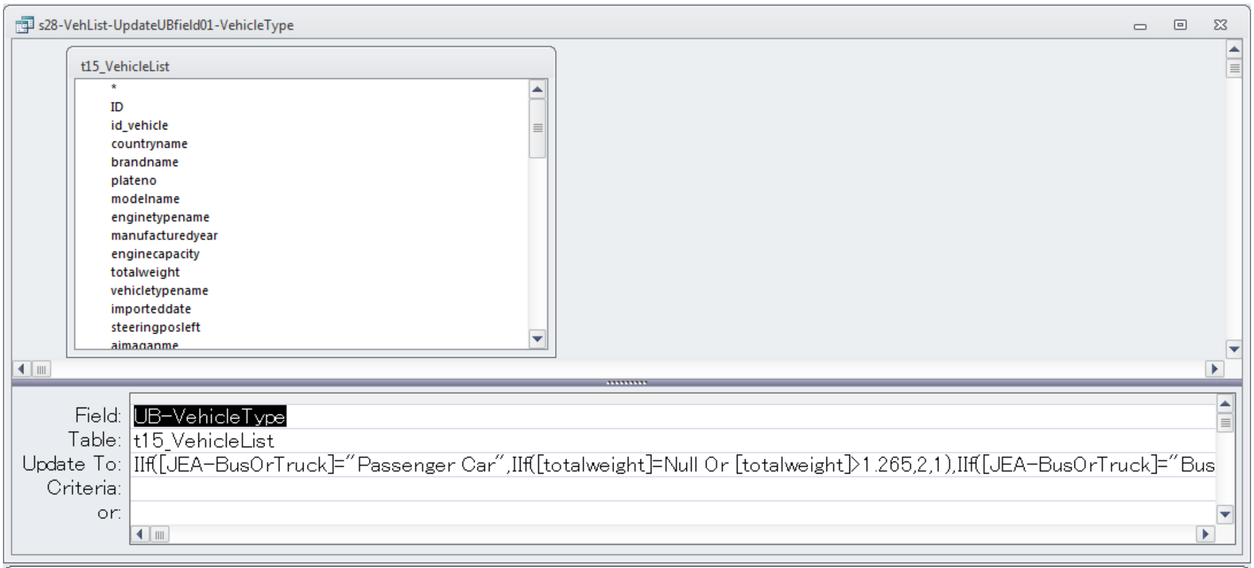


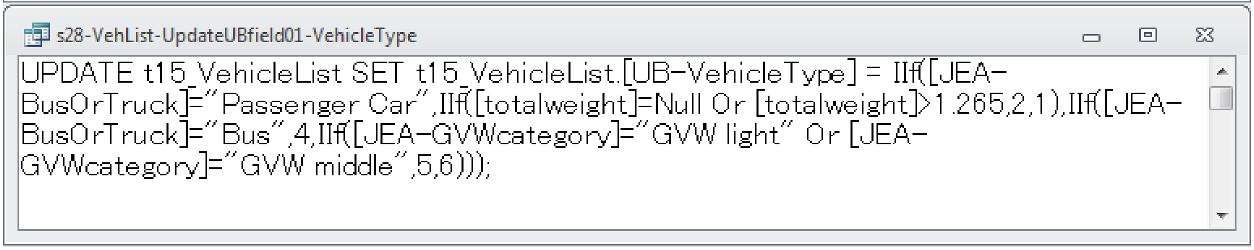


6.1.3.5 Setting the Coefficient Considering the Condition of Mongolia

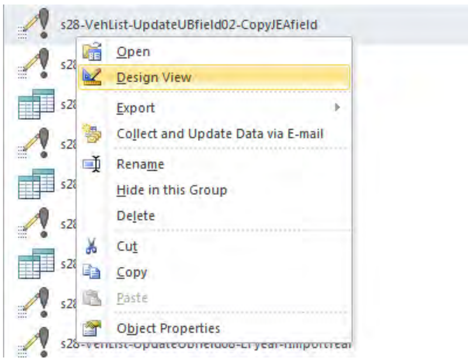
Right-click “s28-VehList-UpdateUBfield01-VehicleType” query and click [Design View]. In this query, set the vehicle type classification in UB city according to vehicle type classification in Japan and vehicle weight.

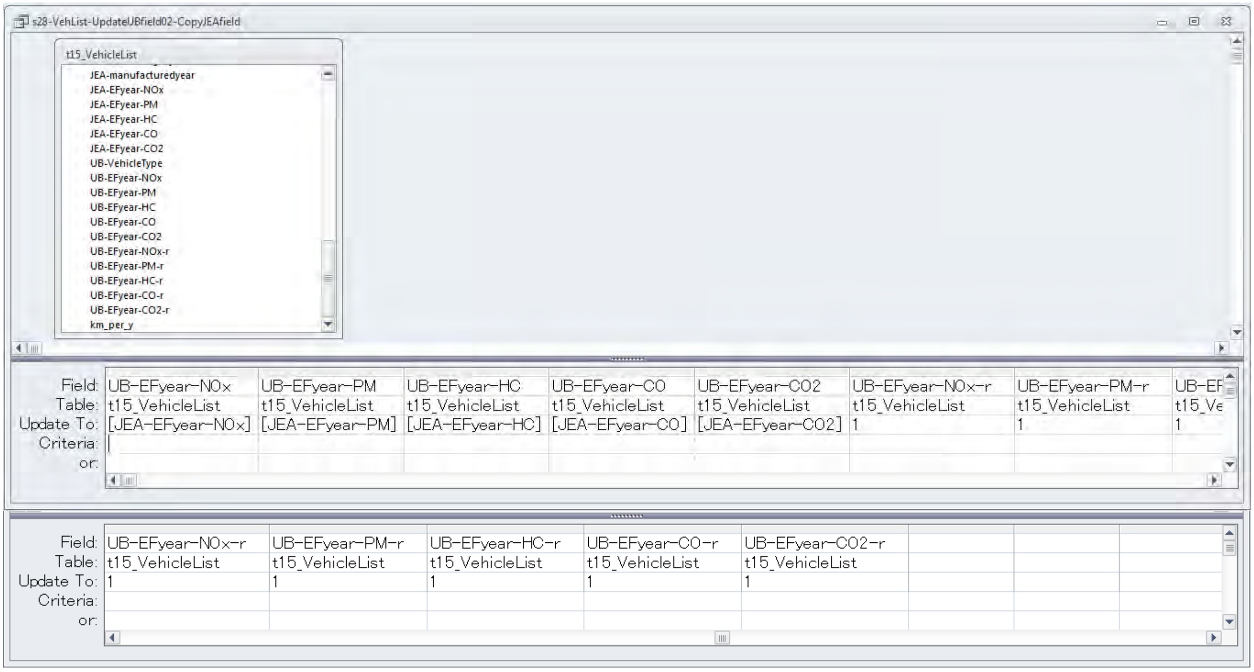






Right-click "s28-VehList-UpdateUBfield02-CopyJEAfield" query and click [Design View]. In this query, copy and paste the regulation year of exhaust gas of vehicle in Japan set by "s22-VehList-UpdateJEAfield17-EFyear" query to the column for applying the regulation year of exhaust gas of vehicle in Mongolia ("UB-EFyear-NOx" etc.) and set "1" as initial value to the column of coefficient considered the condition in Mongolia ("UB-EFyear-NOx-r" etc.).

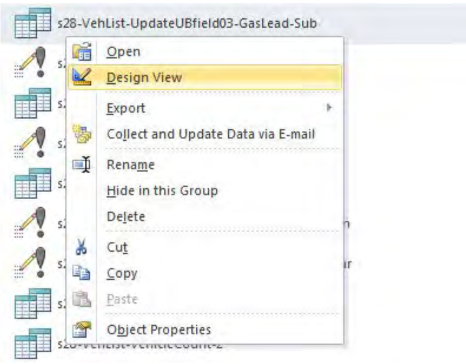


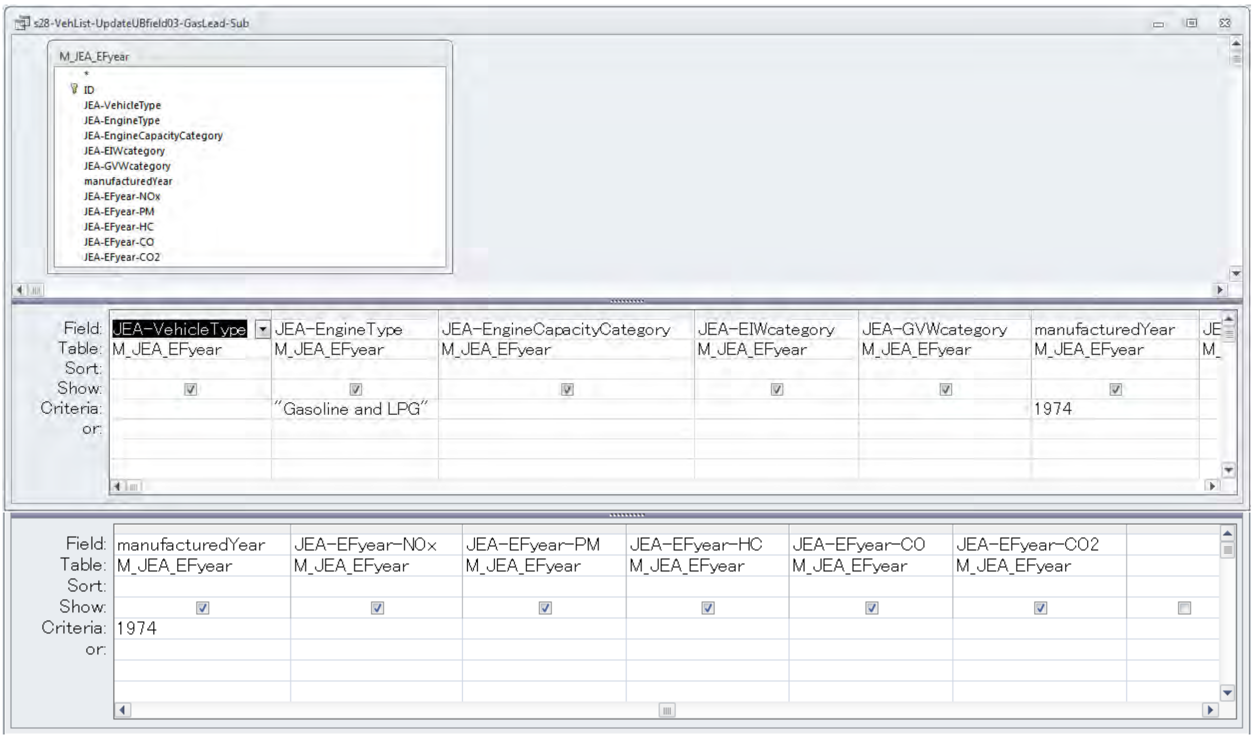


1 Effect of Using Leaded Gasoline

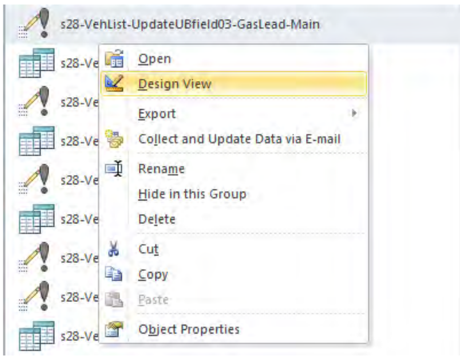
Exhaust gas treatment equipment for gasoline vehicles imported before 2007 is considered to be deteriorated by leaded gasoline based on MNS217:87. Therefore, the emission factor in 1974, when leaded gasoline was sold in Japan, will be applied for gasoline vehicles imported before 2007.

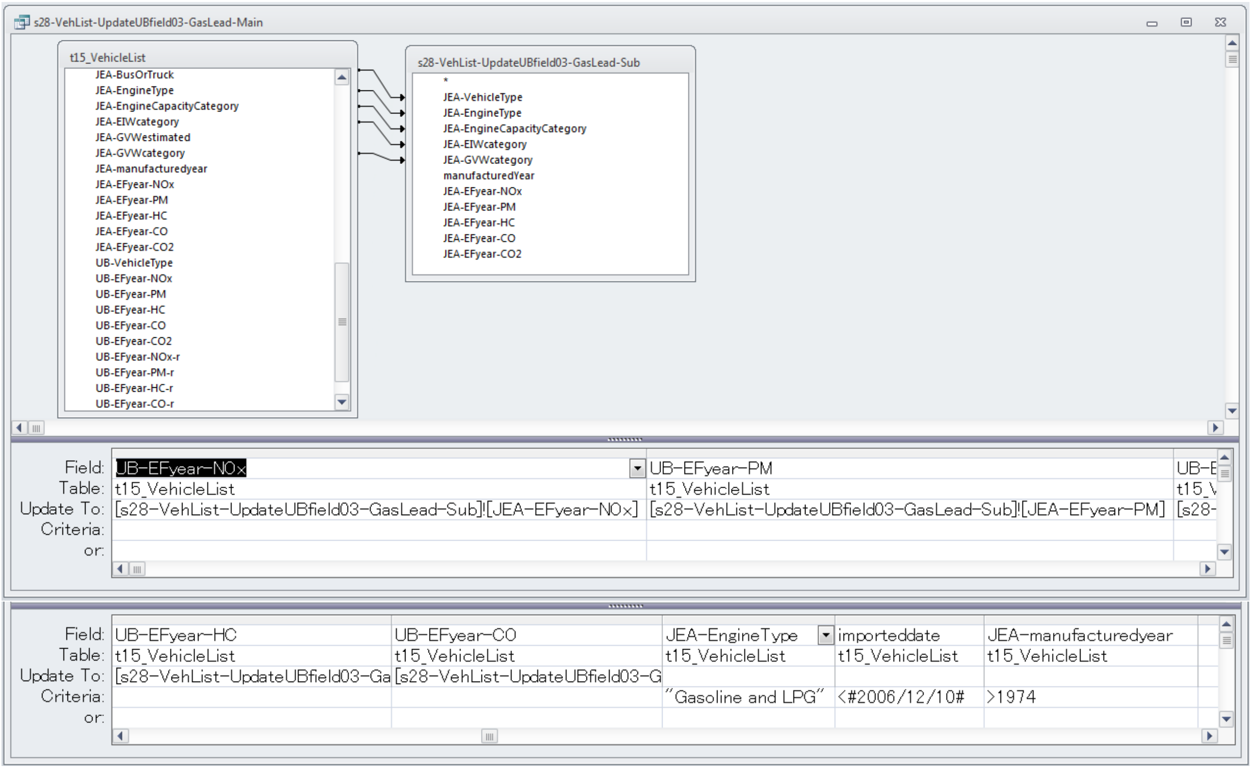
Right-click "s28-VehList-UpdateUBfield03-GasLead-Sub" query and click [Design View]. In this query, extract the regulation year of exhaust gas of vehicle by pollutant in 1974.





Right-click "s28-VehList-UpdateUBfield03-GasLead-Main" query and click [Design View]. In this query, change the regulation year of exhaust gas of vehicle applied in Mongolia for gasoline vehicle imported before 2007 to the regulation year of exhaust gas of vehicle in 1974 (the result of "s28-VehList-UpdateUBfield03-GasLead-Sub" query).

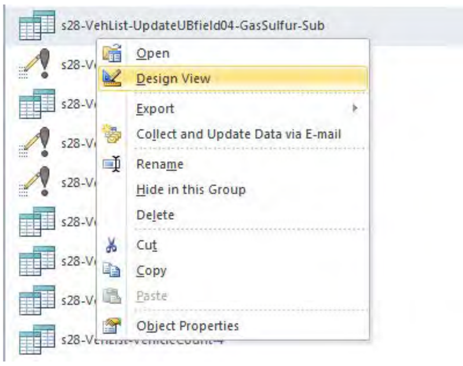


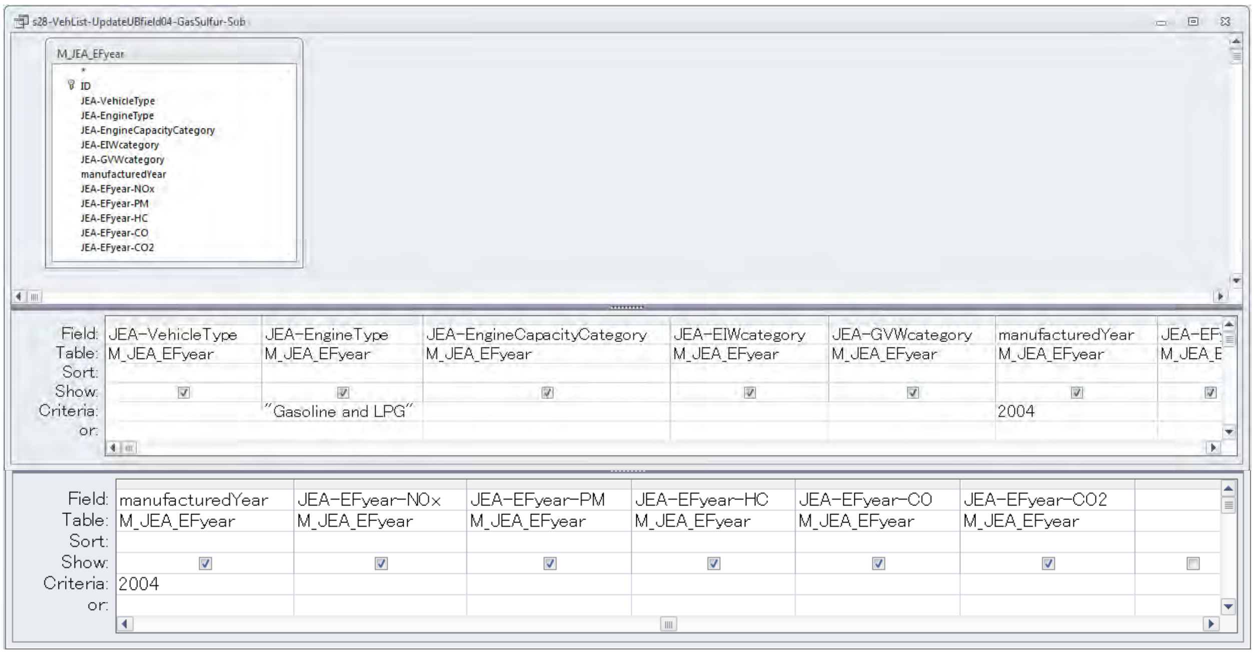


2 *Effect of Using the High Sulfur Gasoline*

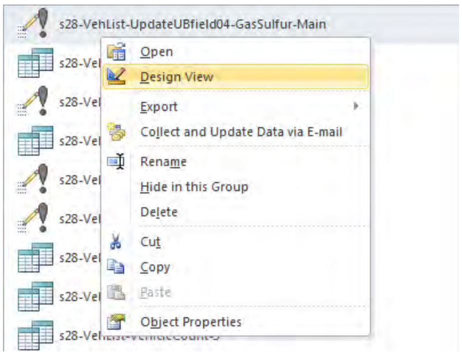
Since the gasoline currently sold in Mongolia exceeds the sulfur concentration standard required to Japanese vehicle after 2005, it is considered that the exhaust gas treatment device is deteriorating. For this reason, the emission factor of 2004 is applied to gasoline vehicles manufactured after 2005 and imported after 2007.

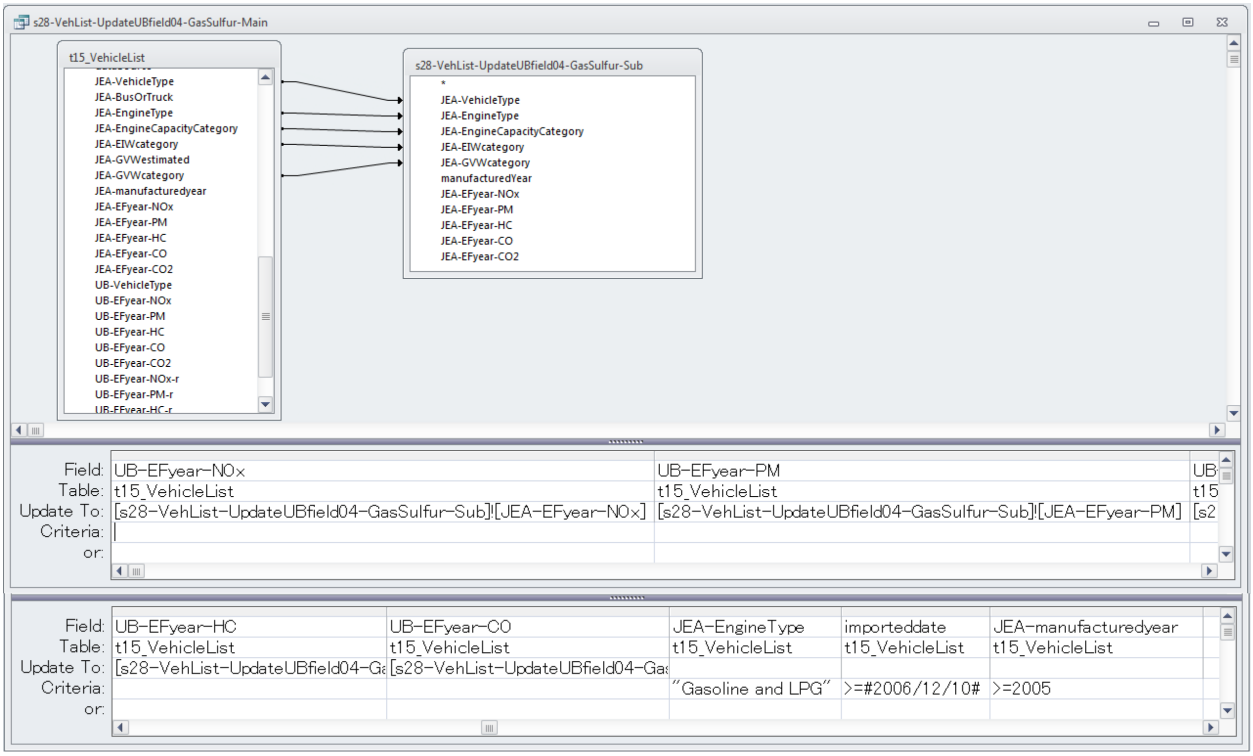
Right-click "s28-VehList-UpdateUBfield04-GasSulfur-Sub" query and click [Design View]. In this query, extract the regulation year of exhaust gas of vehicle by pollutant in 2004.





Right-click "s28-VehList-UpdateUBfield04-GasSulfur-Main" query and click [Design View]. In this query, change the regulation year of exhaust gas of vehicle applied in Mongolia for gasoline vehicle manufactured after 2005 and imported after 2007 to the regulation year of exhaust gas of vehicle extracted by "s28-VehList-UpdateUBfield03-GasLead-Sub" query.

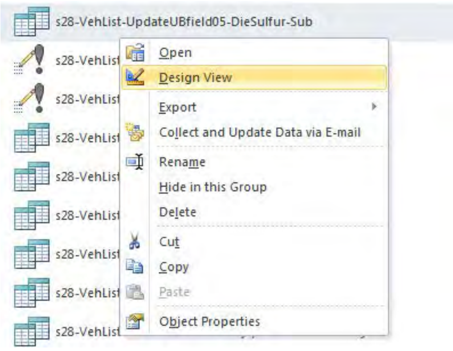


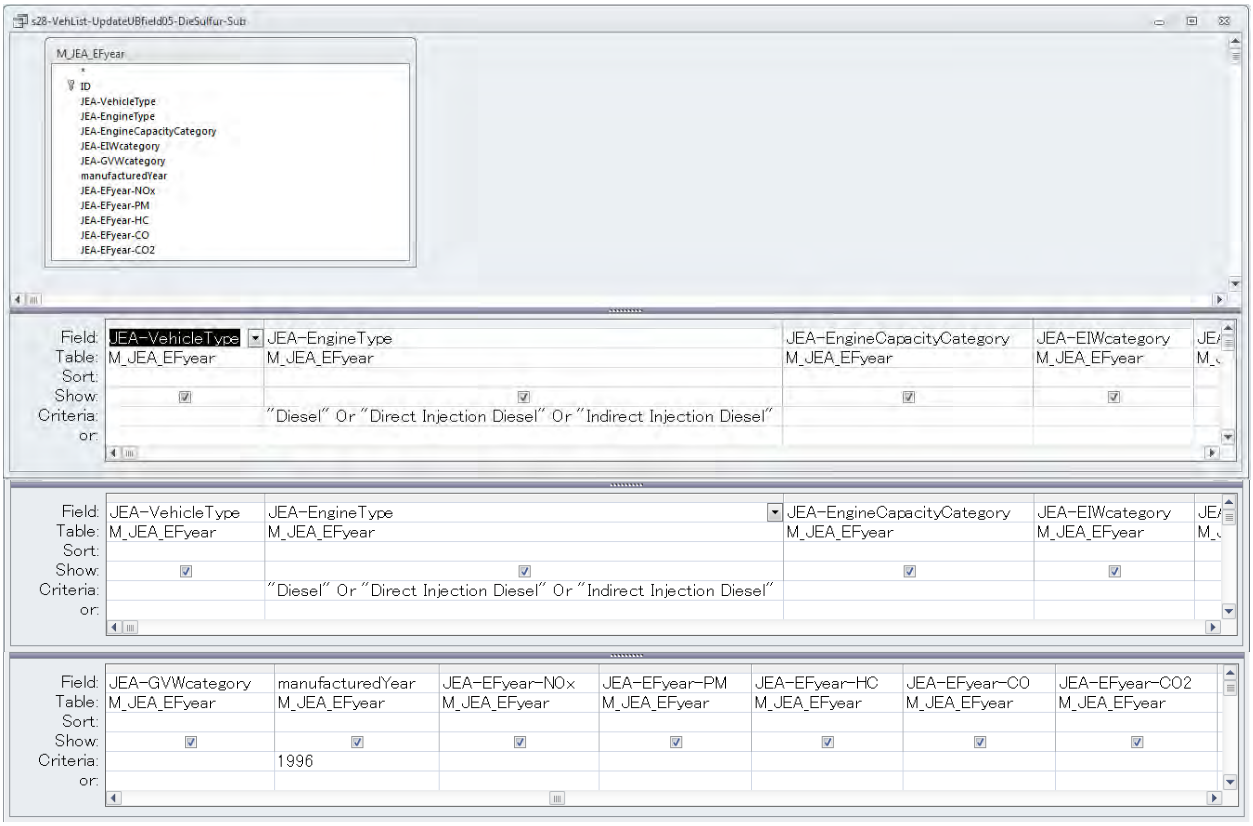


3 Effect of Using the High Sulfur Diesel

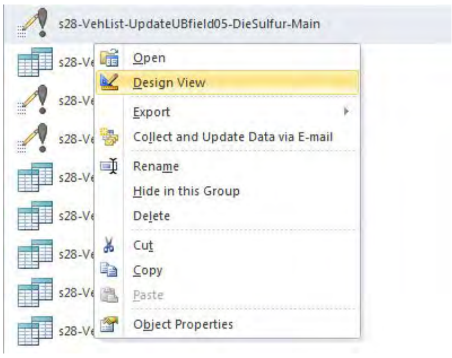
Since the diesel currently sold in Mongolia exceeds the sulfur concentration standard required to Japanese vehicle after 1997, it is considered that the exhaust gas treatment device is deteriorating. For this reason, the emission factor of 1996 is applied to gasoline vehicles manufactured after 1997.

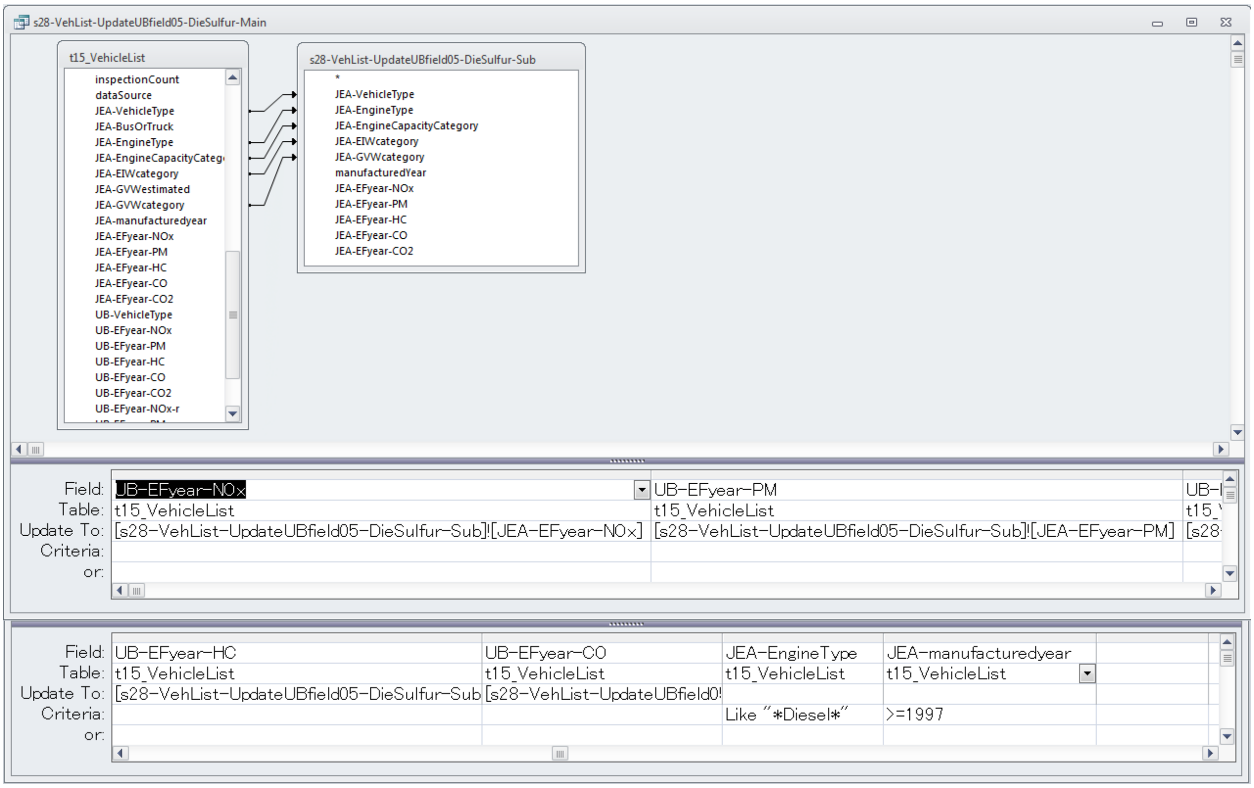
Right-click "s28-VehList-UpdateUBfield05-DieSulfur-Sub" query and click [Design View]. In this query, extract the regulation year of exhaust gas of vehicle by pollutant in 1996.





Right-click "s28-VehList-UpdateUBfield05-DieSulfur-Main" query and click [Design View]. In this query, change the regulation year of exhaust gas of vehicle applied in Mongolia for the vehicle manufactured after 1997 in Japan to the regulation year of exhaust gas of vehicle extracted by "s28-VehList-UpdateUBfield05-DieSulfur-Sub" query.

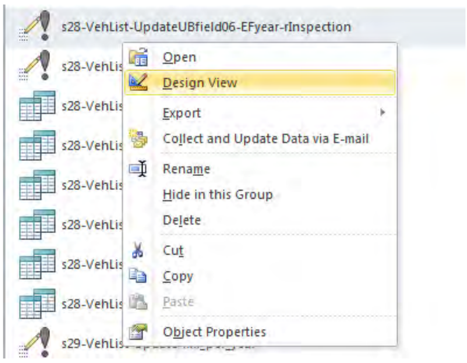




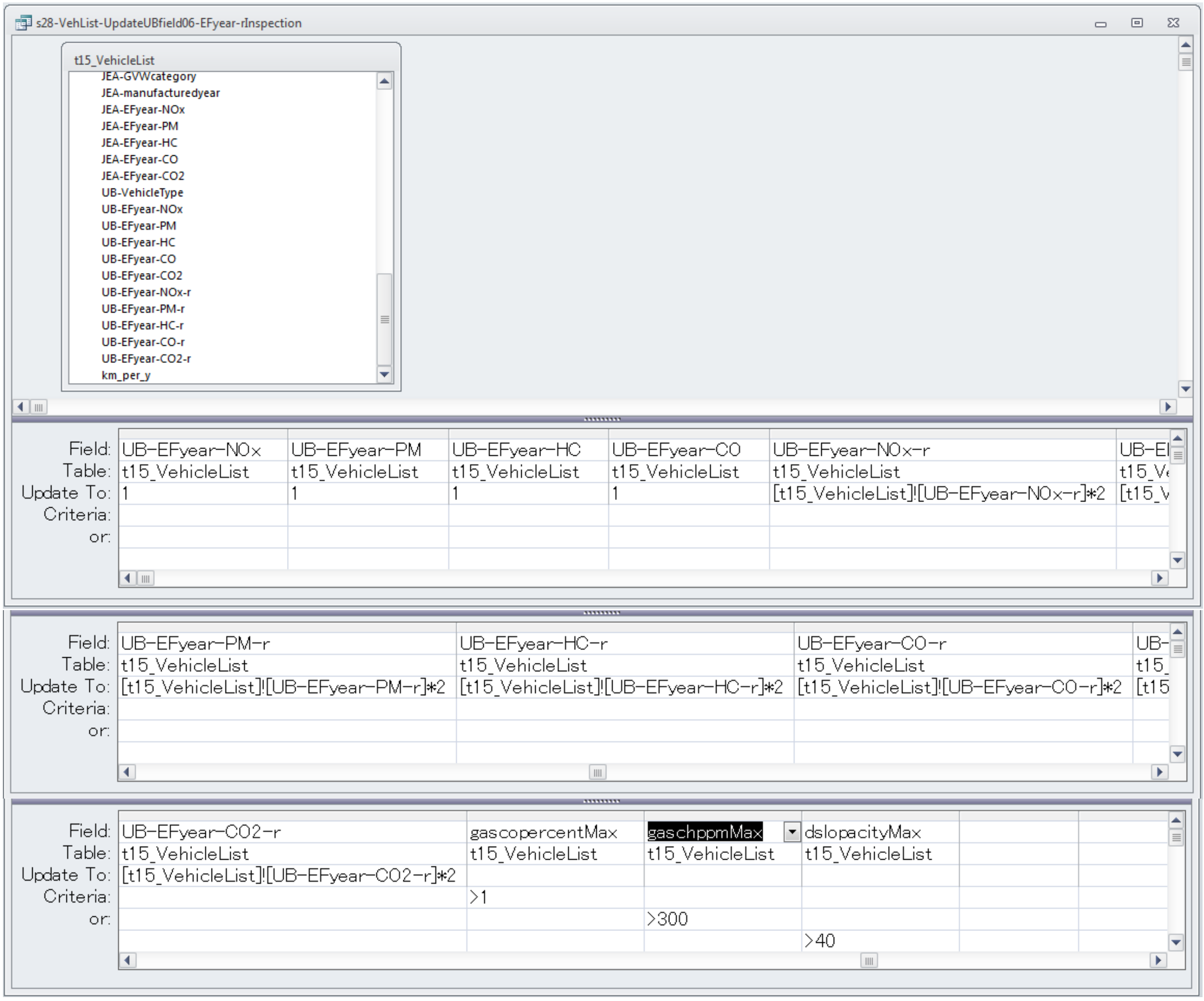
4 Effect of the travelling of the Vehicles that Have not Passed Vehicle Inspection

Many vehicles have high exhaust gas concentration. For that reason, for vehicle corresponding to Japan's inspection standard rejection[7], double the emission factor and the fuel consumption rate for unregulated vehicles.

Right-click "s28-VehList-UpdateUBfield06-EFyear-rInspection" query and click [Design View]. In accordance with the above conditions, set the regulation year of exhaust gas of vehicle as "1" (before regulation) and double the coefficient taking into consideration the influence in Mongolia.



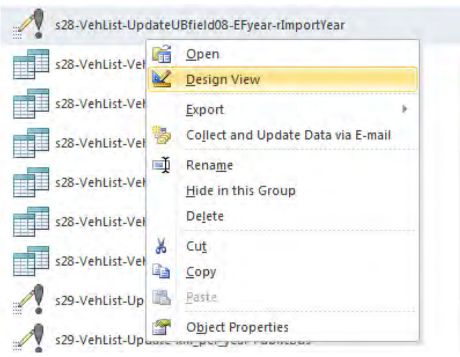
[7] For gasoline vehicles: CO concentration> 1% or HC concentration> 300 ppm, for diesel vehicles: permeability> 40%

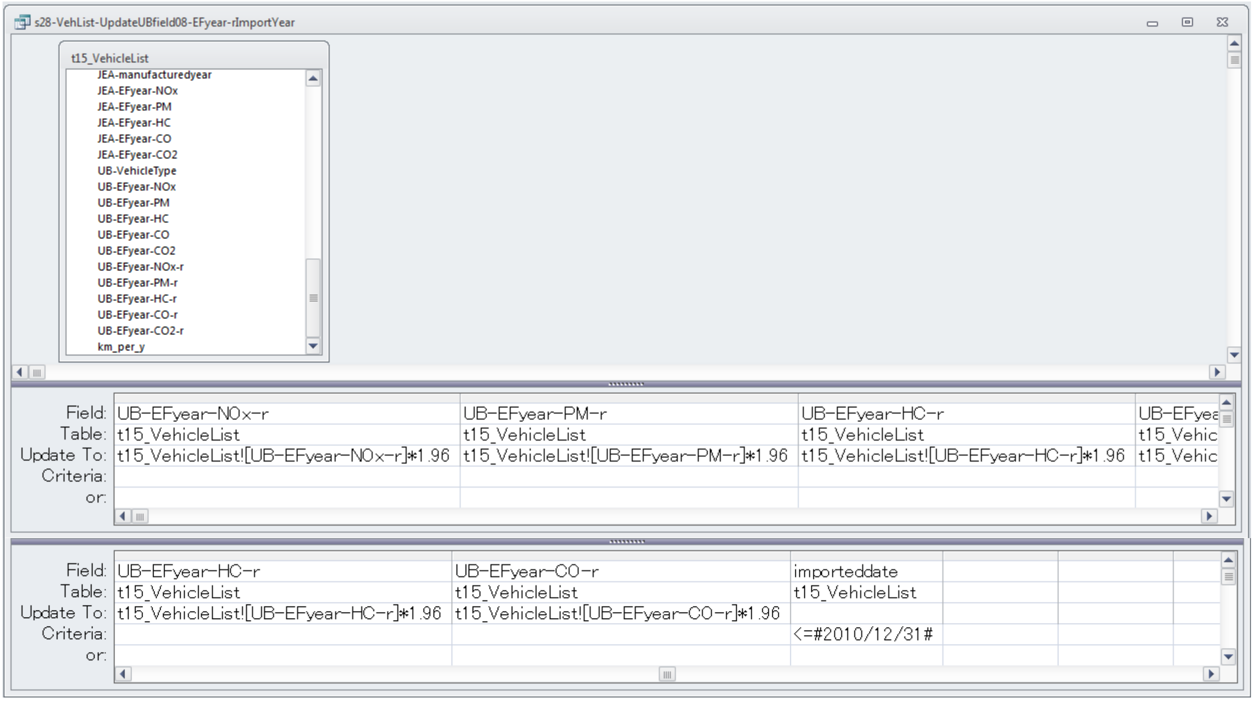


5 *Effect of Inadequate Maintenance of Vehicle*

Some vehicles running in the UB are the vehicles with insufficient maintenance. In Japan, there are investigations that vehicles with insufficient maintenance have 96% more air pollutants contained in exhaust gas than regularly maintained vehicles. Therefore, for vehicles imported before 2011, set the emission factor to add 96%.

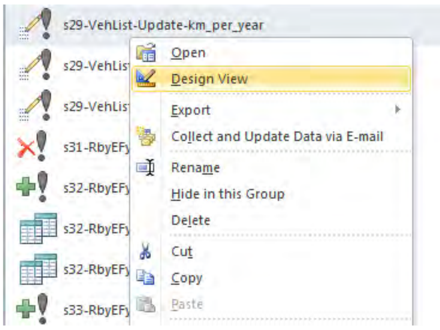
Right-click “s28-VehList-UpdateUBfield08-EFyear-rImportYear” query and click [Design View]. In this query, 1.96 times the coefficients with Mongolian condition added to vehicles imported before 2011.

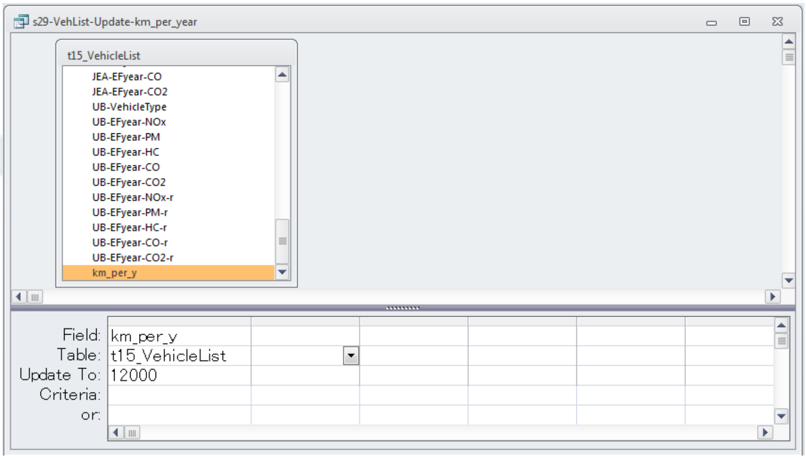




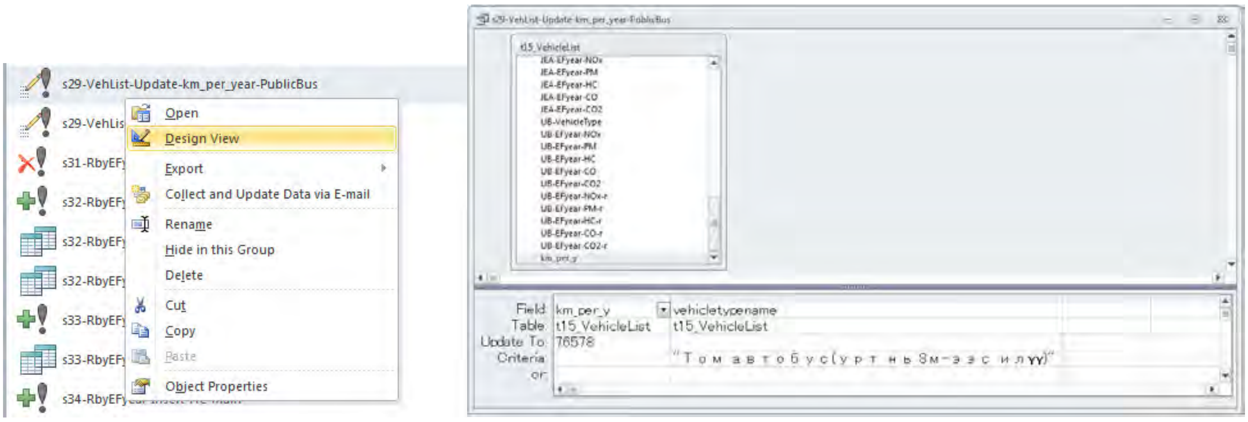
6.1.3.6 Setting the Annual Traffic Volume by Vehicle Type

Right-click “s29-VehList-Update-km_per_year” query and click [Design View]. In this query, set the travel distance of all registered vehicle as 12,000km (passenger car).

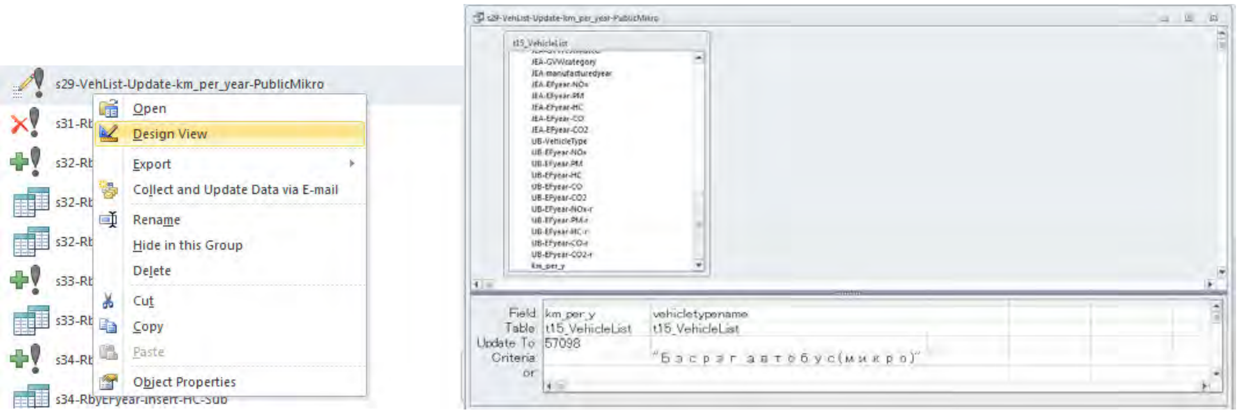




Right-click “s29-VehList-Update-km_per_year-PublicBus” query and click [Design View]. In this query, set the travel distance large-sized bus (assumed as public bus) as 76,578km.

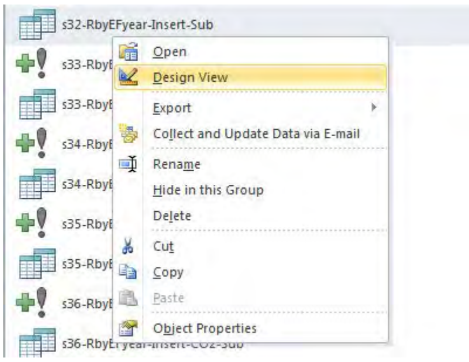


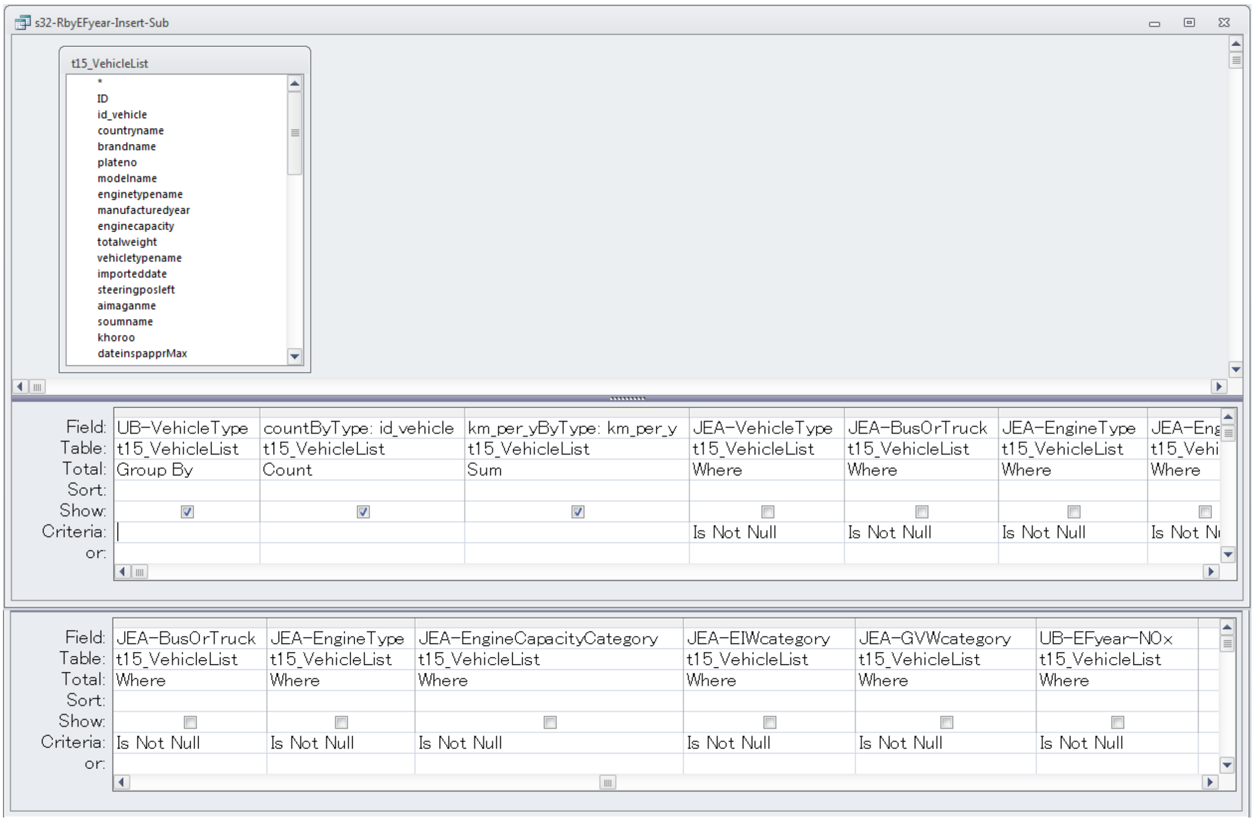
Right-click "s29-VehList-Update-km_per_year-PublicMikro" query and click [Design View]. In this query, set the travel distance of micro bus as 57,098km.



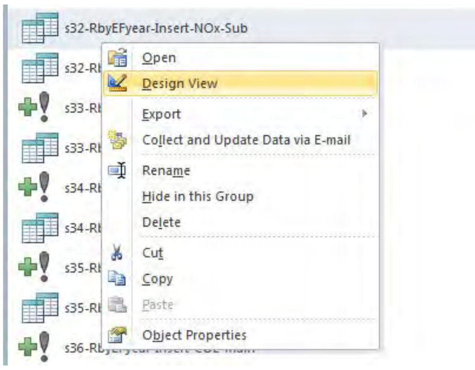
6.1.3.7 Composition Ratio of Vehicle Type

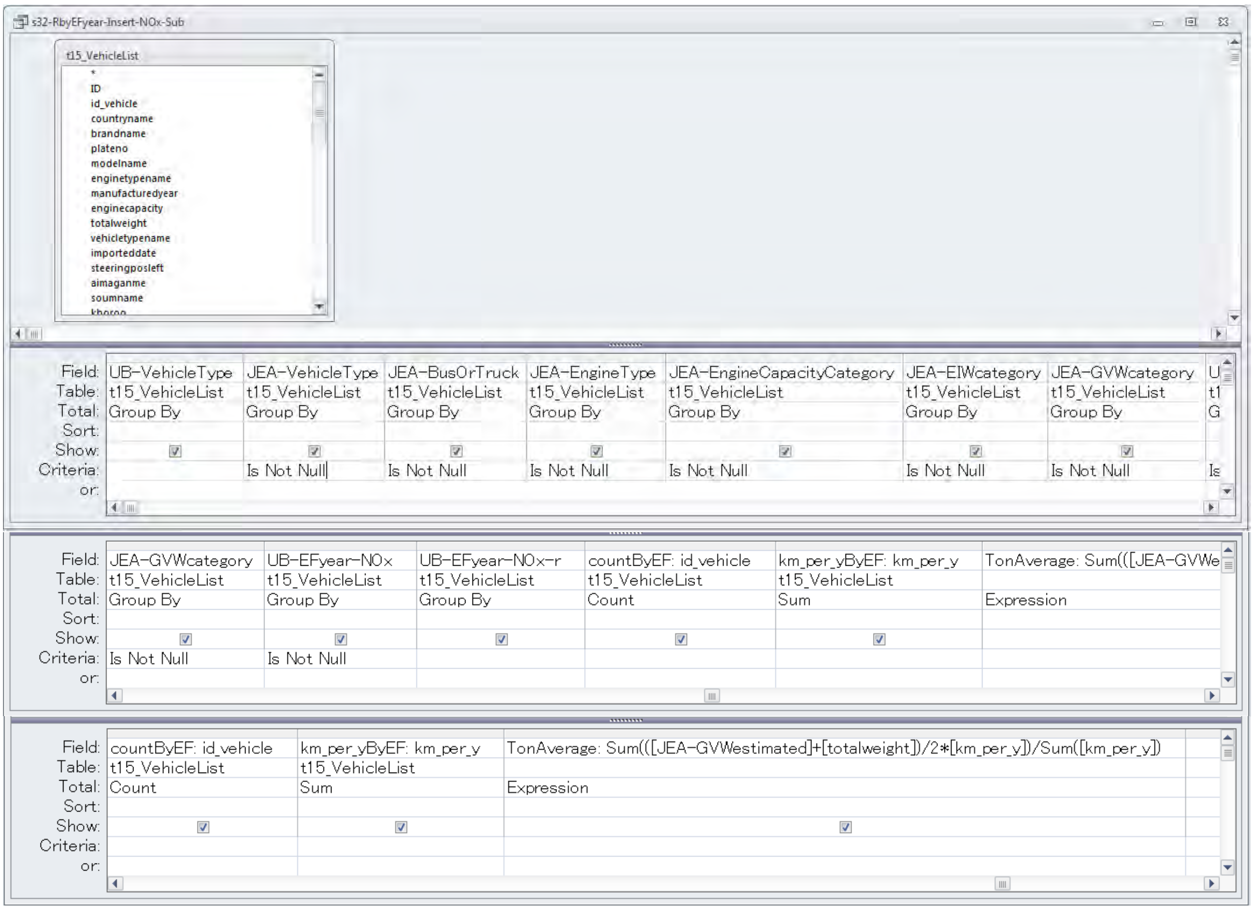
Right-click "s32-RbyEFyear-Insert-Sub" query and click [Design View]. In this query, calculate the vehicle count and traffic volume by vehicle type.



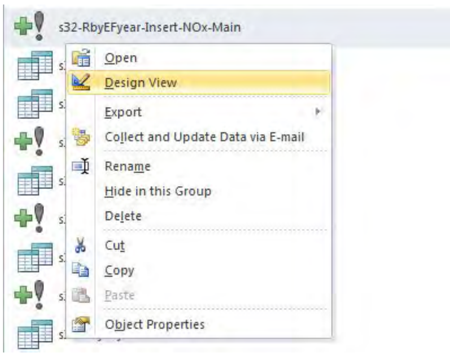


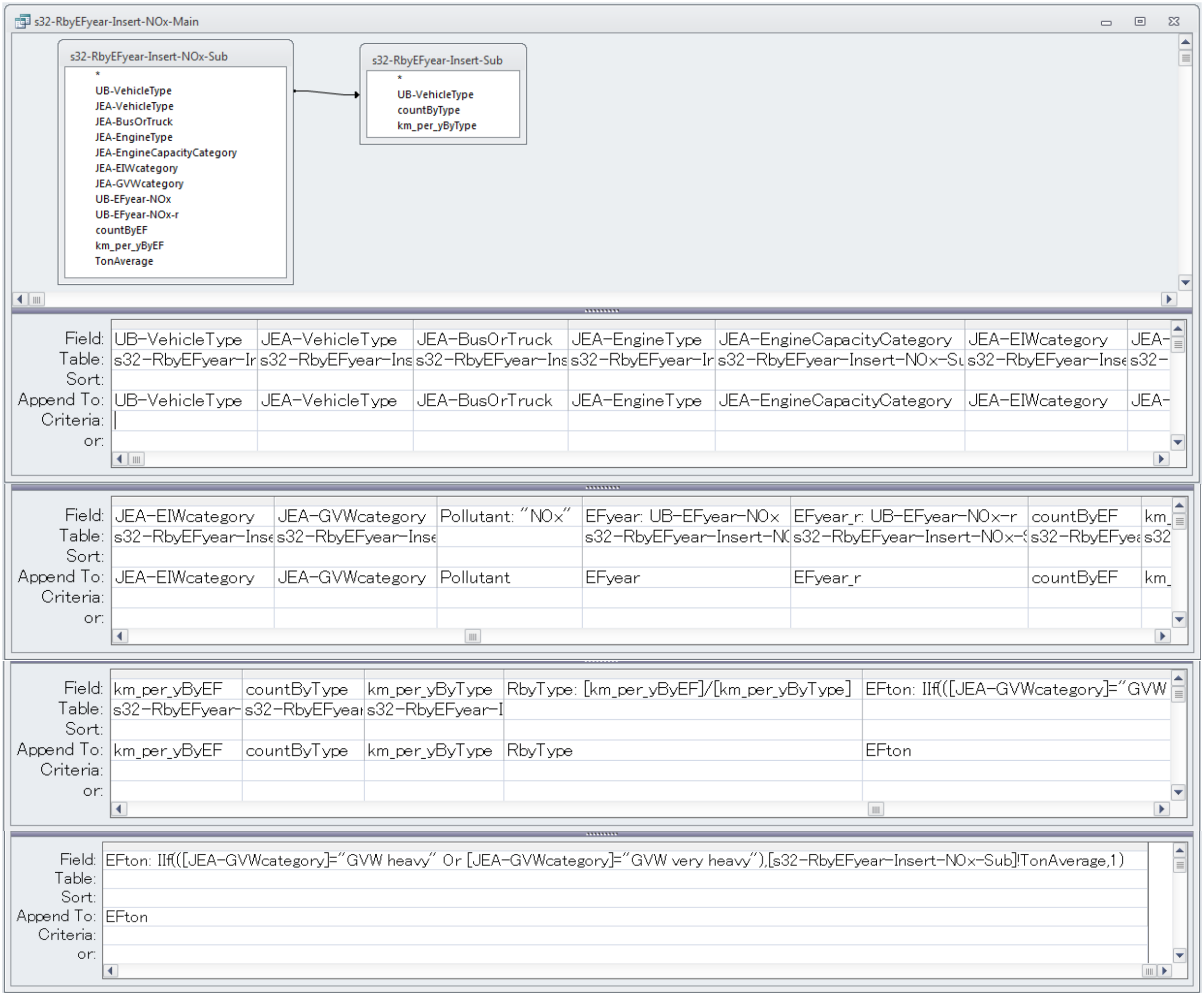
Right-click “s32-RbyEFyear-Insert-NOx-Sub” query and click [Design View]. In this query, calculate the vehicle count, traffic volume, and averaged vehicle weight by vehicle type by the regulation year of exhaust gas of vehicle of NOx.



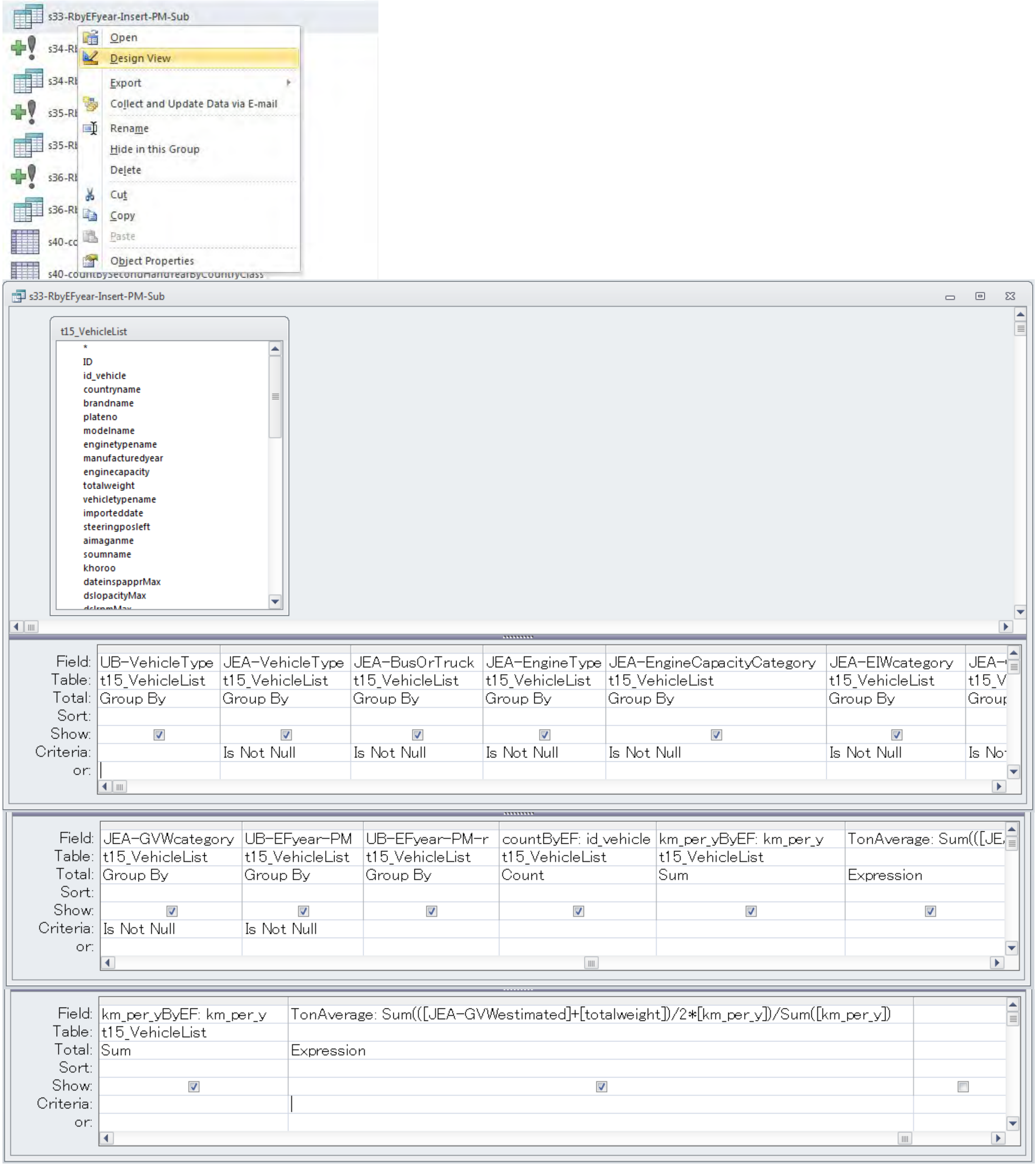


Right-click “s32-RbyEFyear-Insert-NOx-Main” query and click [Design View]. In this query, calculate the vehicle type composition ratio of NOx by the regulation year of exhaust gas of vehicle and averaged vehicle weight. After clicking [Run] and executing, add this query result to “t31_RbyEFyear” table.

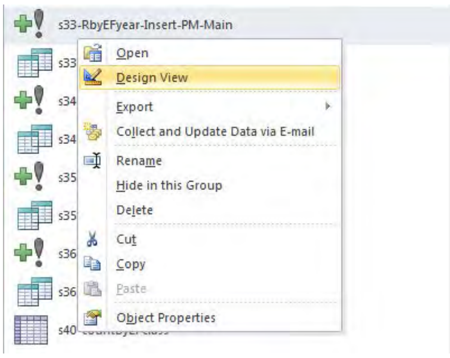


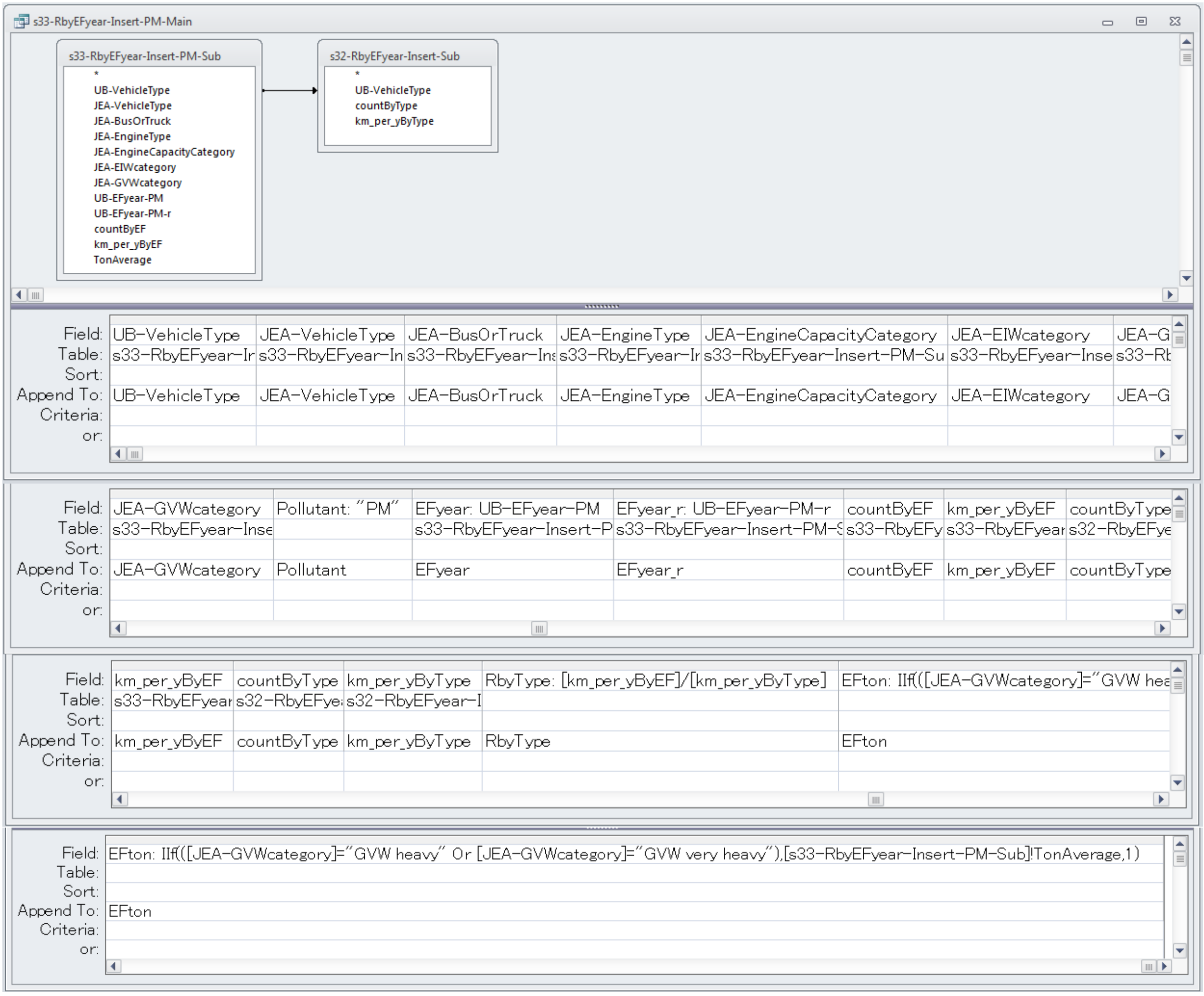


Right-click "s33-RbyEFyear-Insert-PM-Sub" query and click [Design View]. In this query, calculate the vehicle count, traffic volume, and averaged vehicle weight by vehicle type by the regulation year of exhaust gas of vehicle of PM.

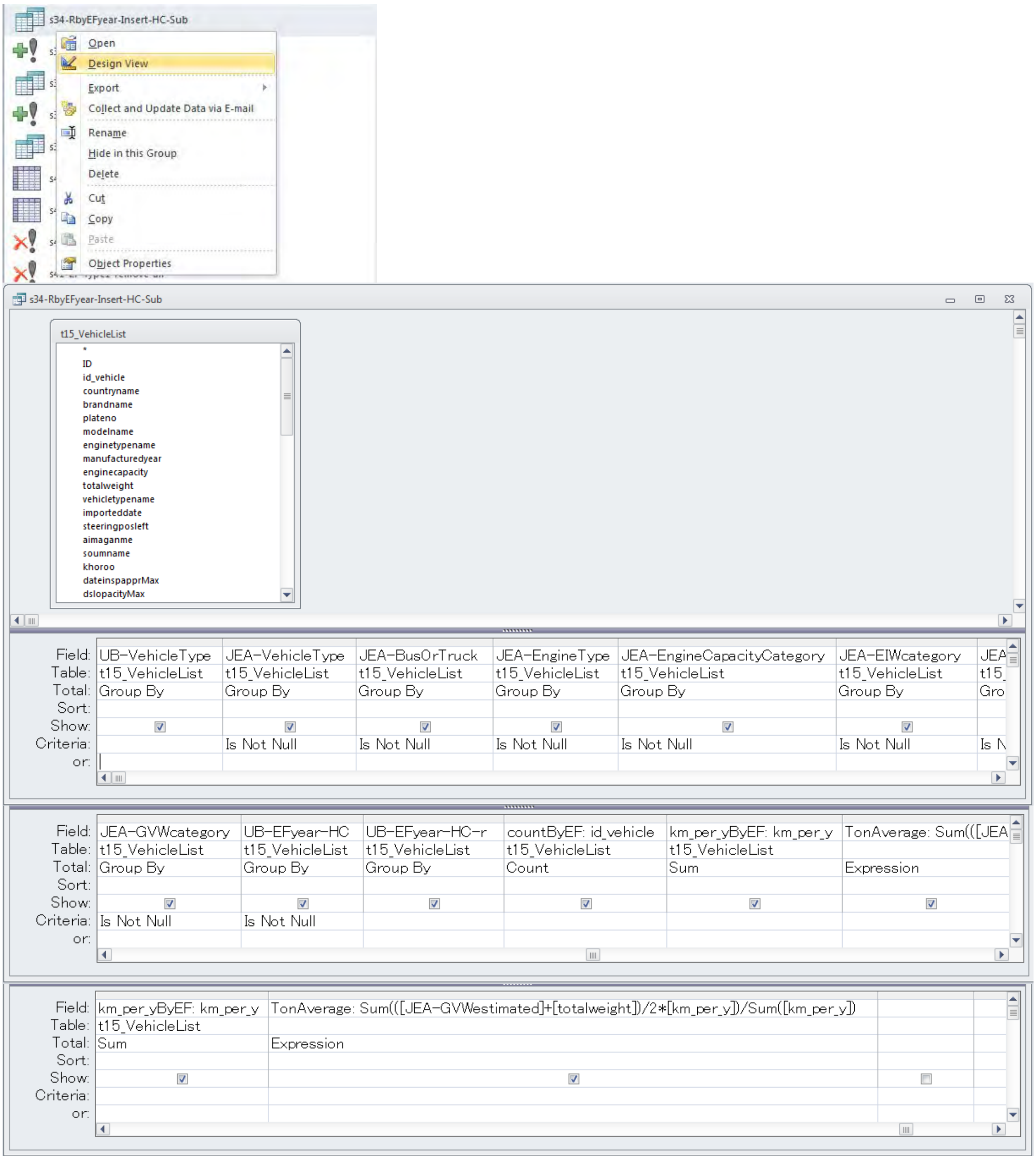


Right-click “s33-RbyEFyear-Insert-PM-Main” query and click [Design View]. In this query, calculate the vehicle type composition ratio of PM by the regulation year of exhaust gas of vehicle and averaged vehicle weight. After clicking [Run] and executing, add this query result to “t31_RbyEFyear” table.

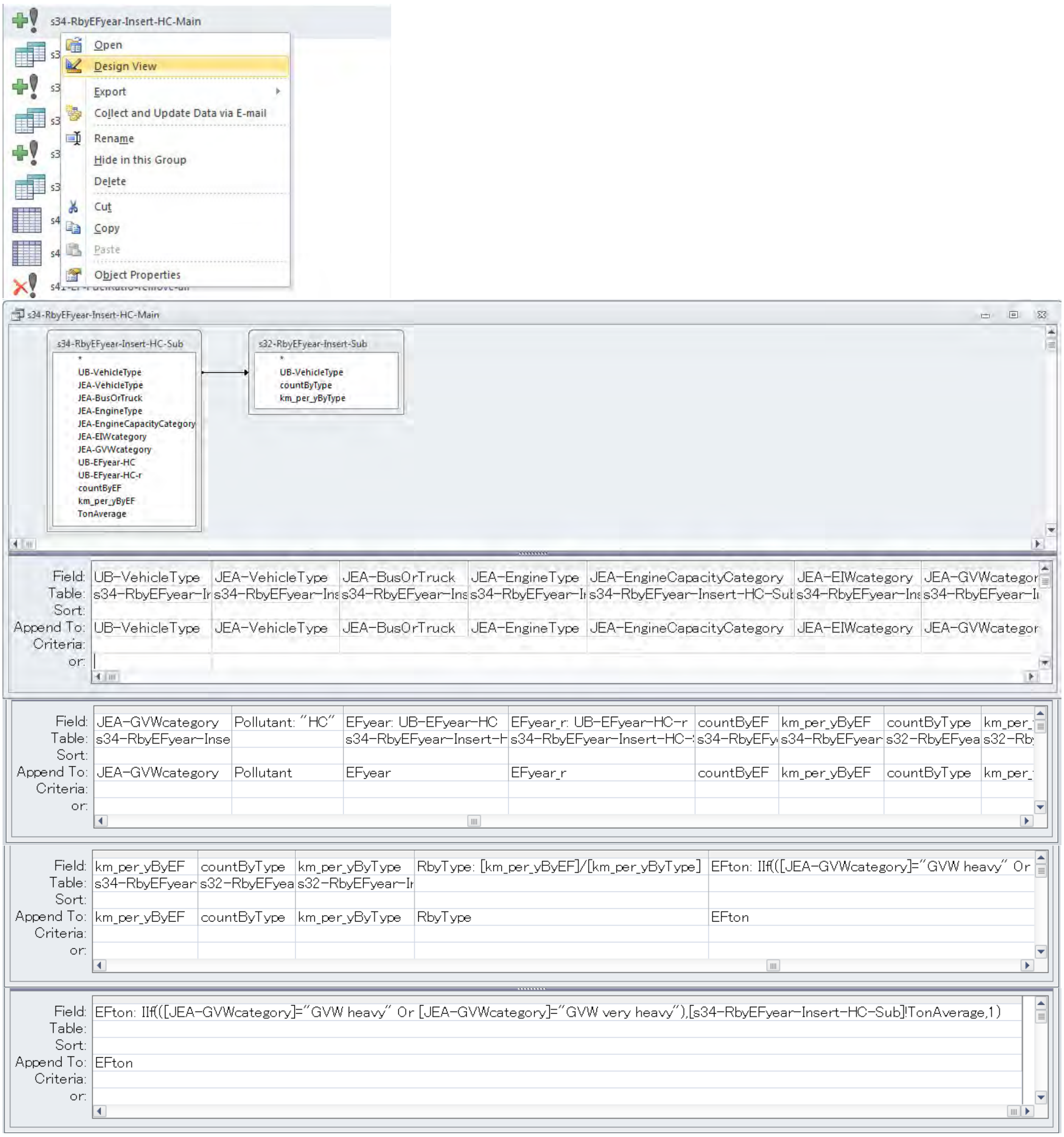




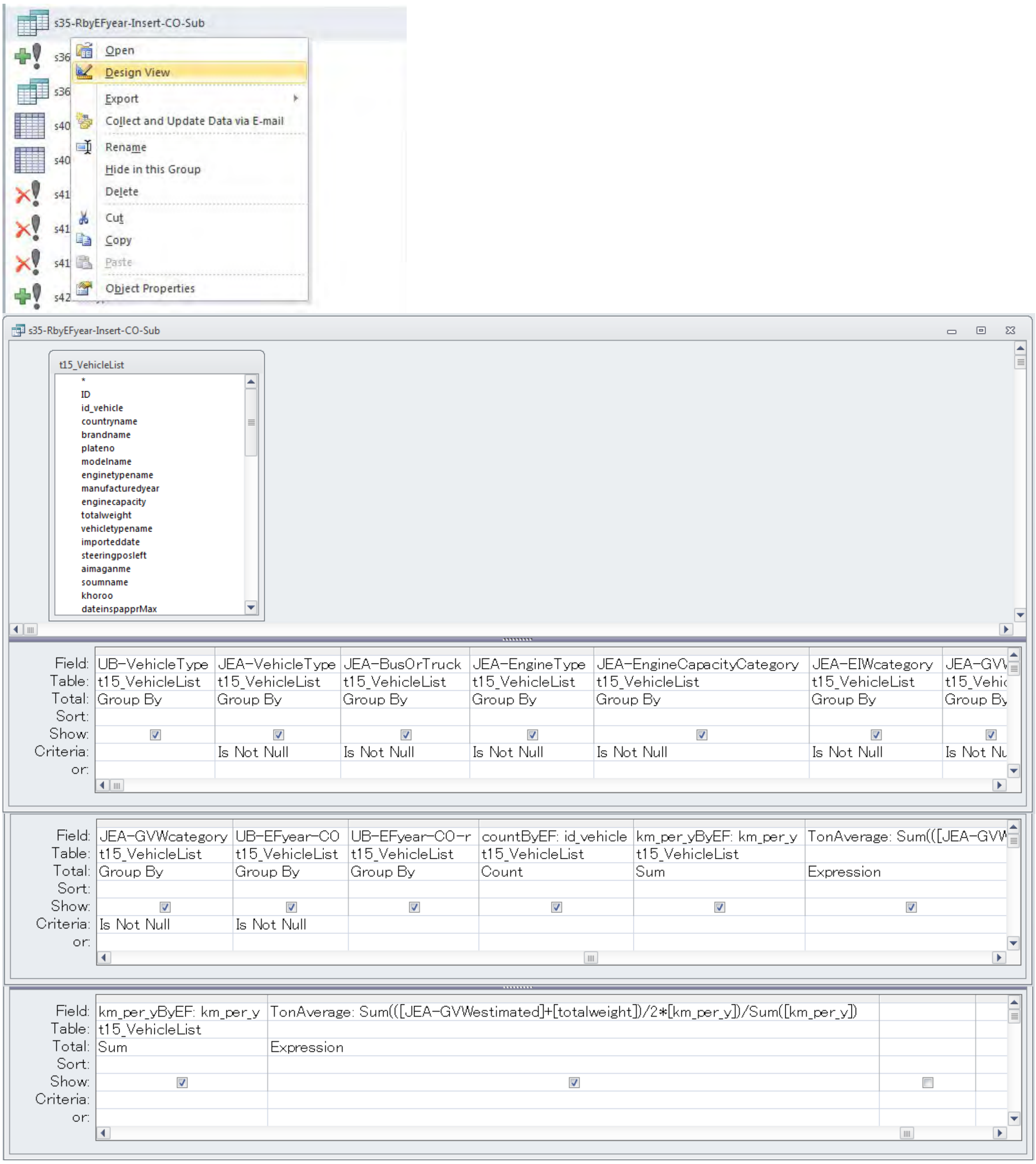
Right-click "s34-RbyEFyear-Insert-HC-Sub" query and click [Design View]. In this query, calculate the vehicle count, traffic volume, and averaged vehicle weight by vehicle type by the regulation year of exhaust gas of vehicle of HC.



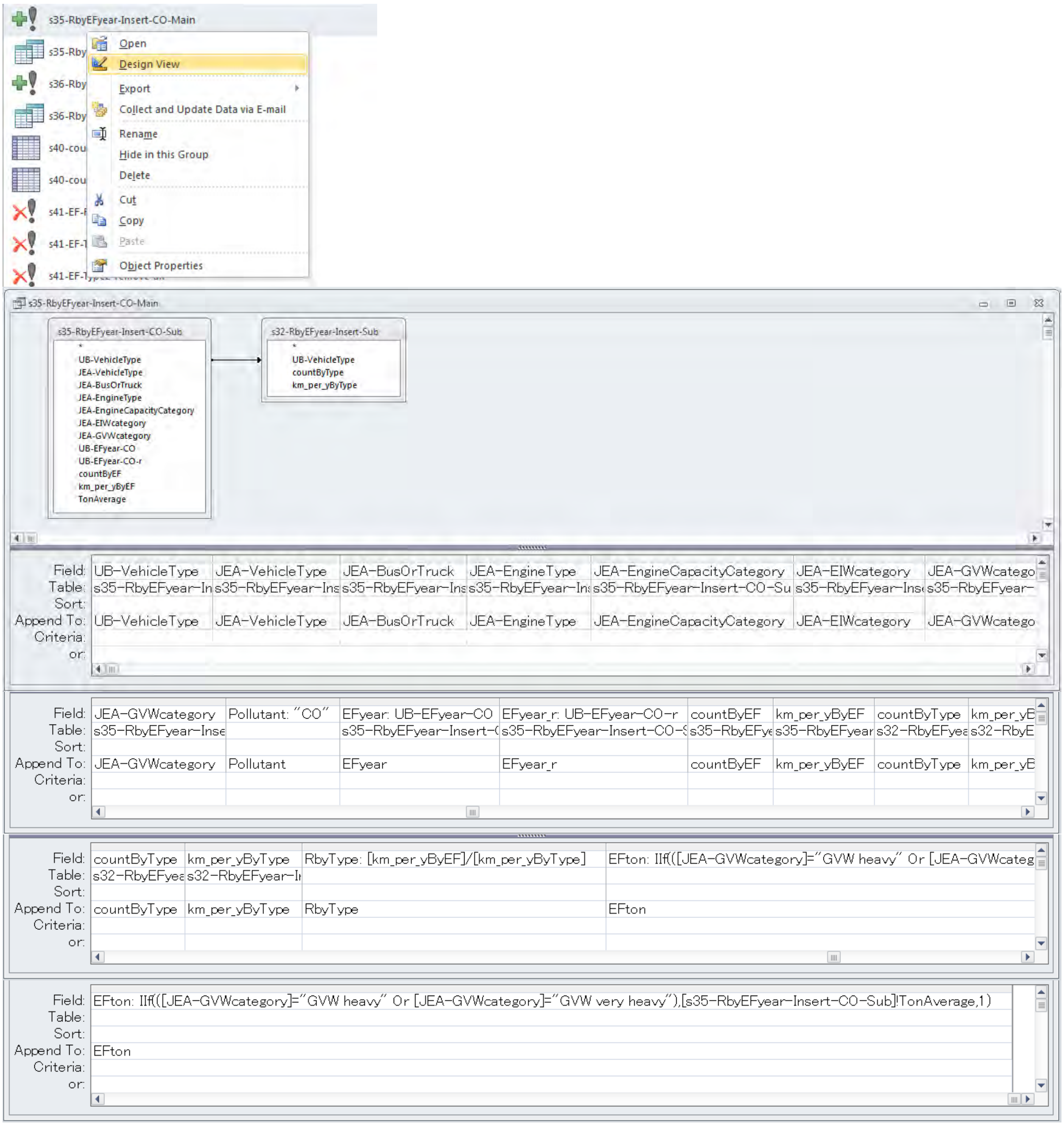
Right-click “s34-RbyEFyear-Insert-HC-Main” query and click [Design View]. In this query, calculate the vehicle type composition ratio of HC by the regulation year of exhaust gas of vehicle and averaged vehicle weight. After clicking [Run] and executing, add this query result to “t31_RbyEFyear” table.



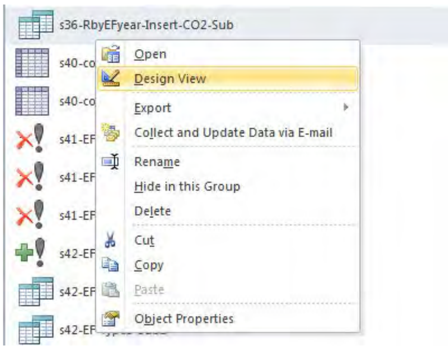
Right-click "s35-RbyEFyear-Insert-CO-Sub" query and click [Design View]. In this query, calculate the vehicle count, traffic volume, and averaged vehicle weight by vehicle type by the regulation year of exhaust gas of vehicle of CO.

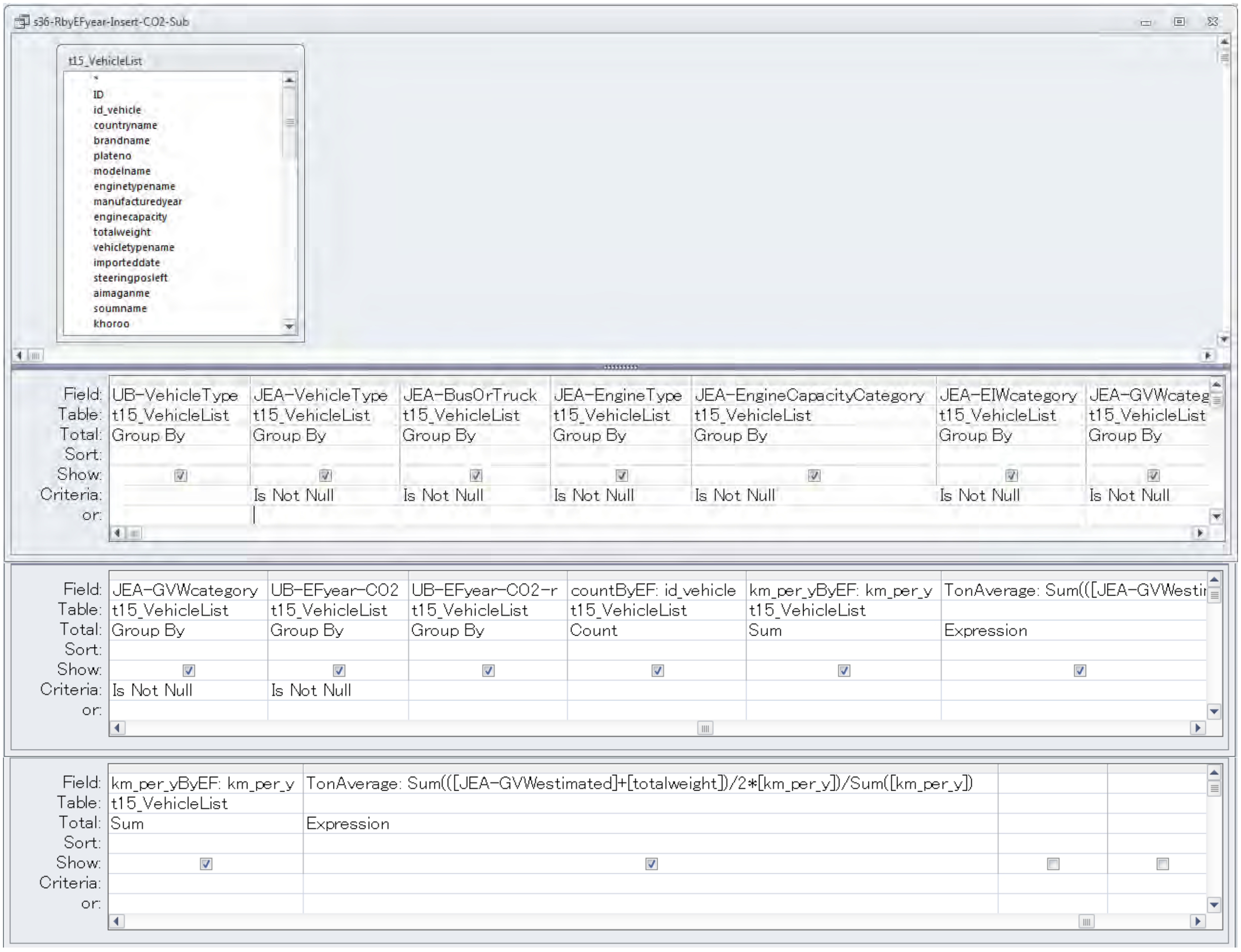


Right-click “s35-RbyEFyear-Insert-CO-Main” query and click [Design View]. In this query, calculate the vehicle type composition ratio of CO by the regulation year of exhaust gas of vehicle and averaged vehicle weight. After clicking [Run] and executing, add this query result to “t31_RbyEFyear” table.

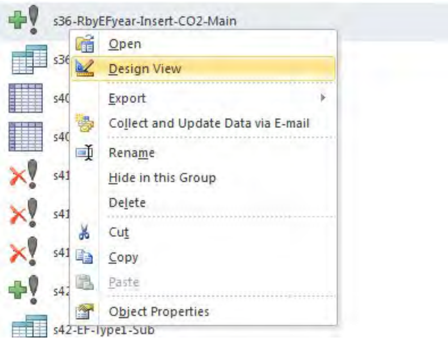


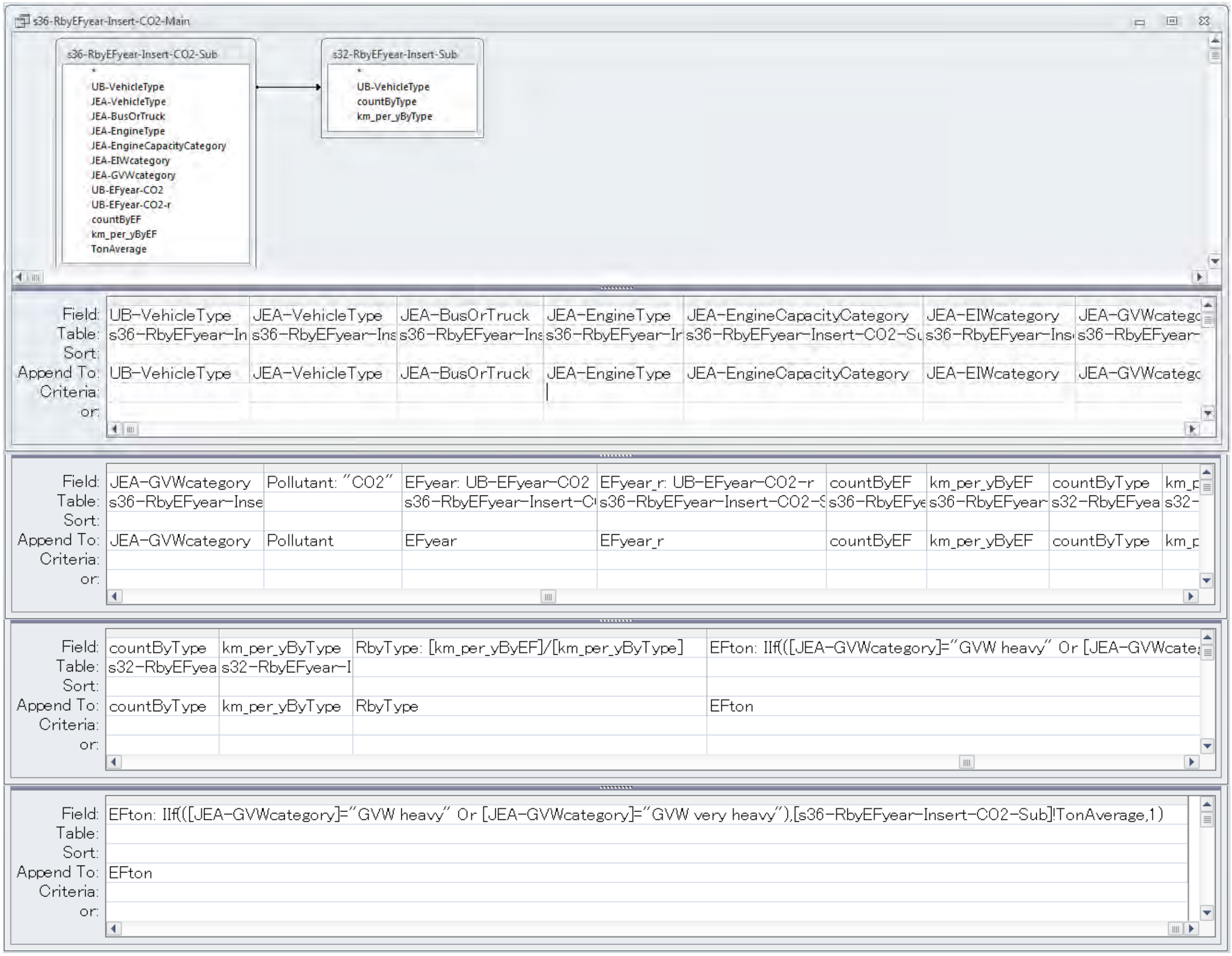
Right-click "s36-RbyEFyear-Insert-CO2-Sub" query and click [Design View]. In this query, calculate the vehicle count, traffic volume, and averaged vehicle weight by vehicle type by the regulation year of exhaust gas of vehicle of CO2.





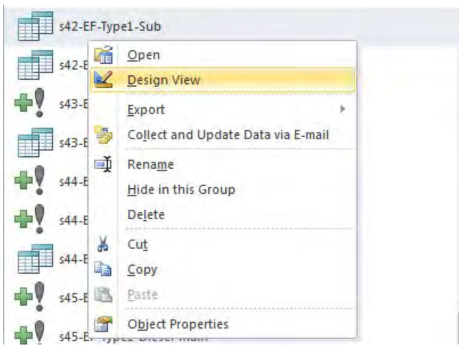
Right-click “s36-RbyEFyear-Insert-CO2-Main” query and click [Design View]. In this query, calculate the vehicle type composition ratio of CO2 by the regulation year of exhaust gas of vehicle and averaged vehicle weight. After clicking [Run] and executing, add this query result to “t31_RbyEFyear” table.

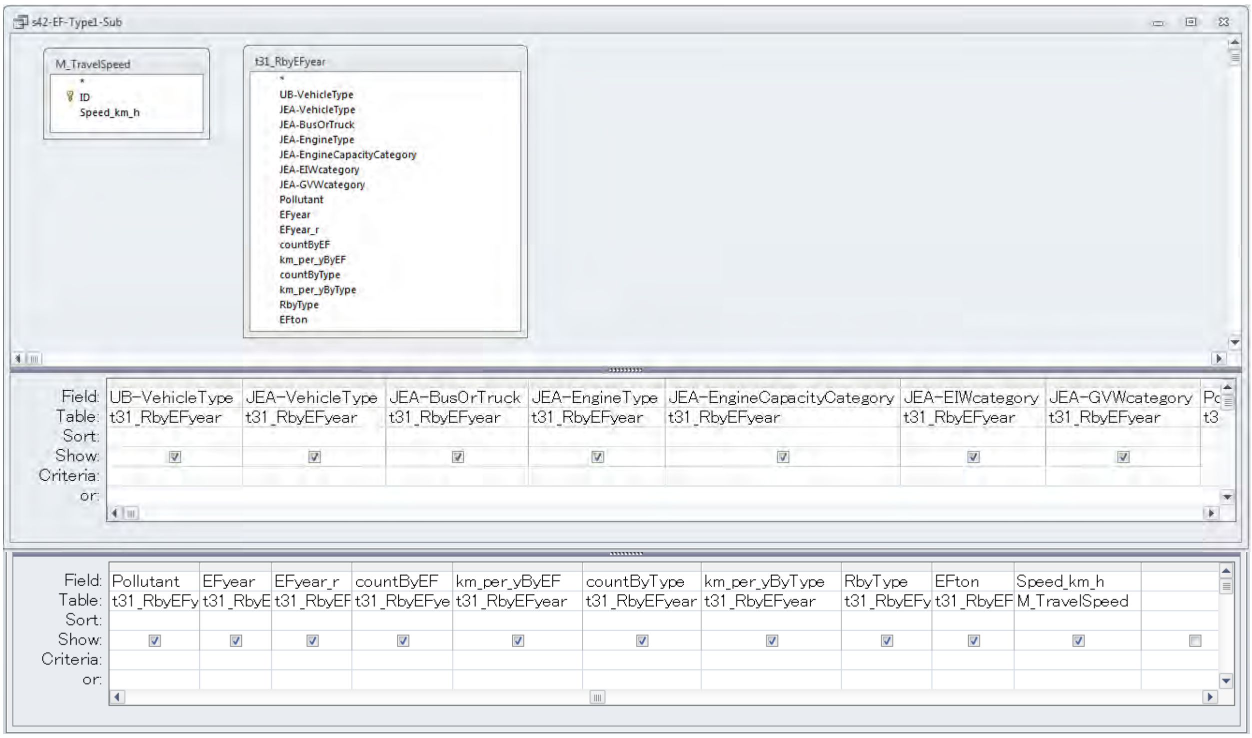




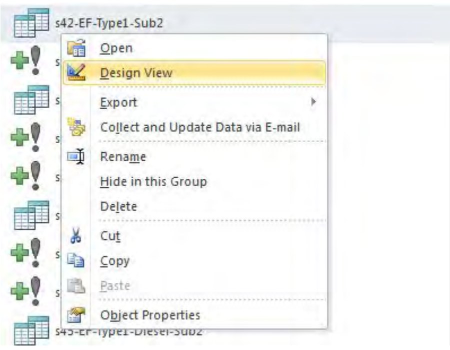
6.1.3.8 Calculation of Emission Factor by Vehicle Type

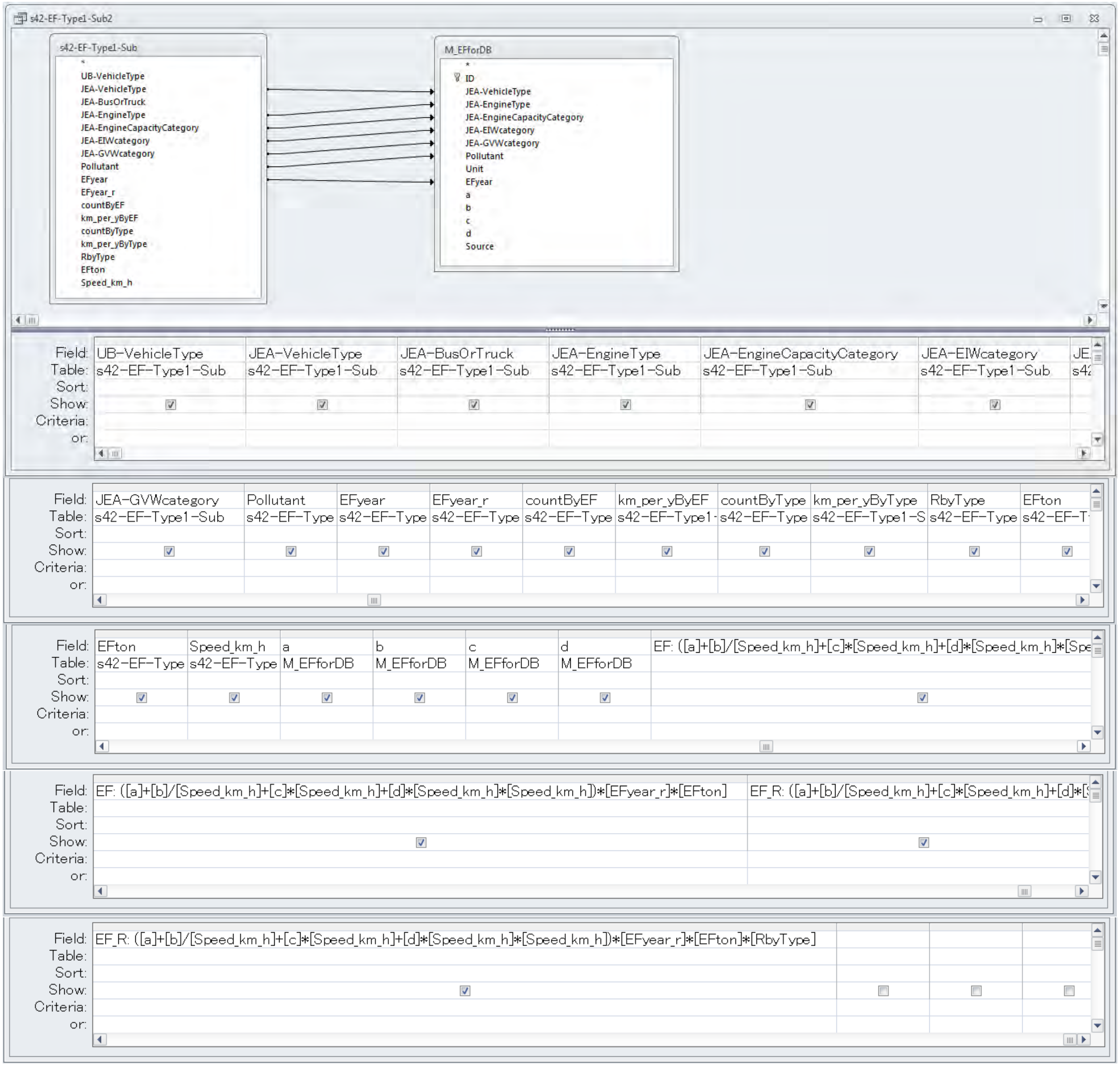
Right-click "s42-EF-Type1-Sub" query and click [Design View]. In this query, cross the table of vehicle type composition ratio by the regulation year of exhaust gas of vehicle and the table of travel speed.



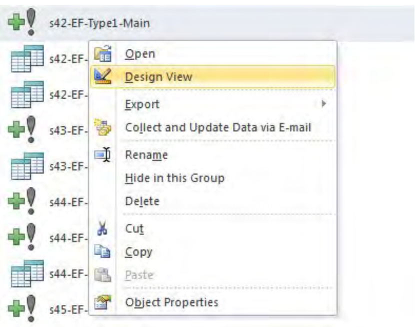


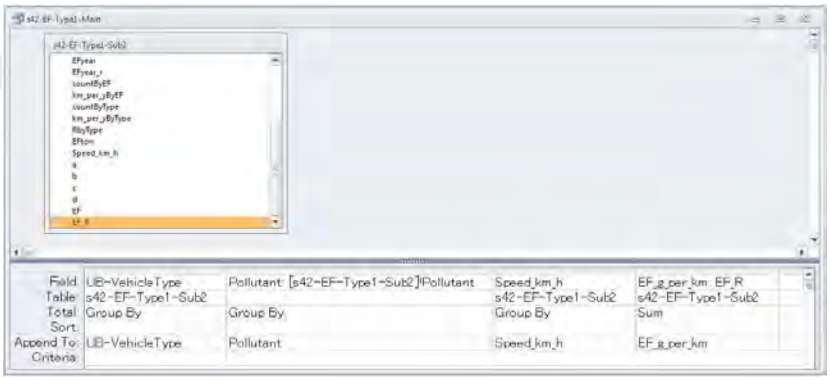
Right-click "s42-EF-Type1-Sub2" query and click [Design View]. In this query, calculate emission factor by joining to the coefficient table of emission unit by vehicle type by regulation year of exhaust gas of vehicle.



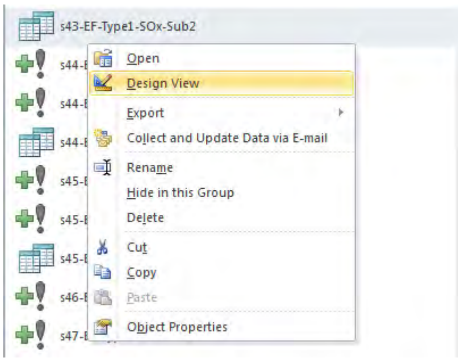


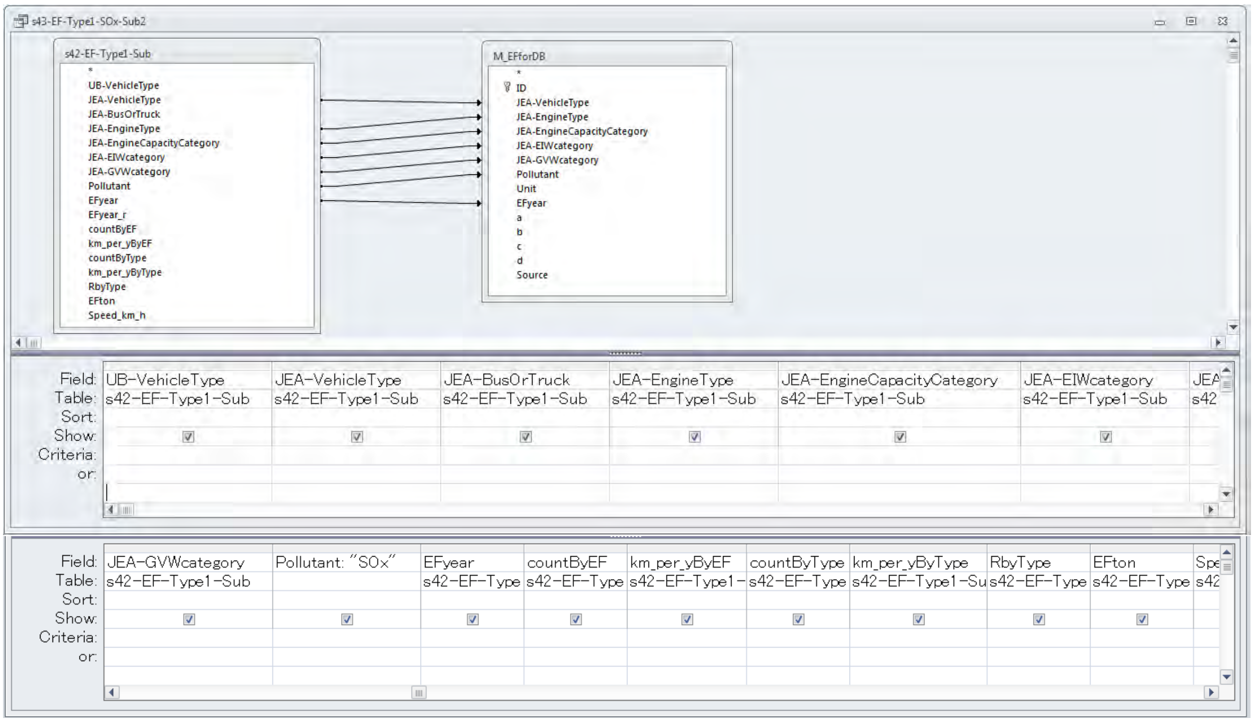
Right-click "s42-EF-Type1-Main" query and click [Design View]. In this query, organize the emission factor by pollutant by vehicle type by traffic speed.

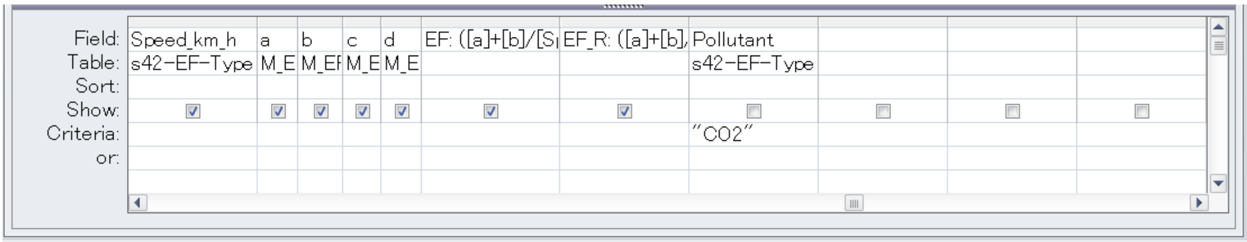


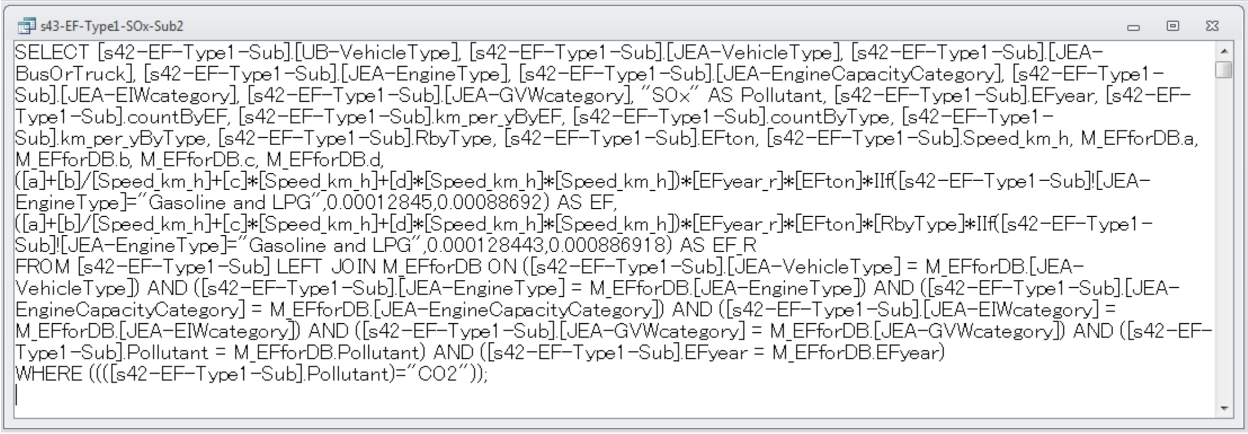


Right-click "s43-EF-Type1-SOx-Sub2" query and click [Design View]. In this query, calculate the emission factor of SOx by multiplying the ratio of sulfur content to carbon content in fuel by emission factor of CO2.

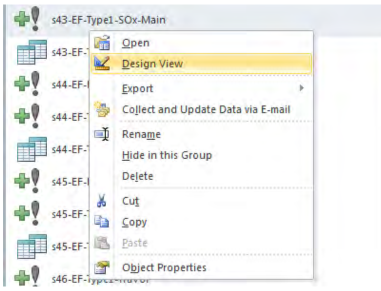




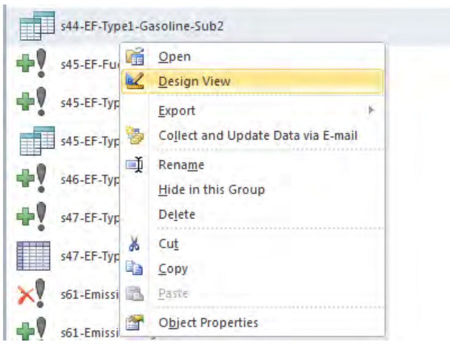




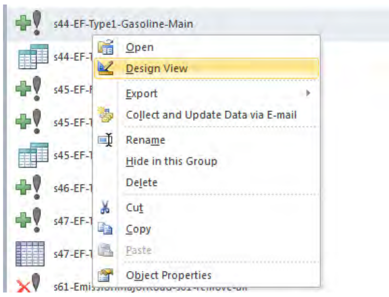
Right-click "s43-EF-Type1-SOx-Main" query and click [Design View]. In this query, organize the emission factor of SOx by vehicle type by traffic speed.

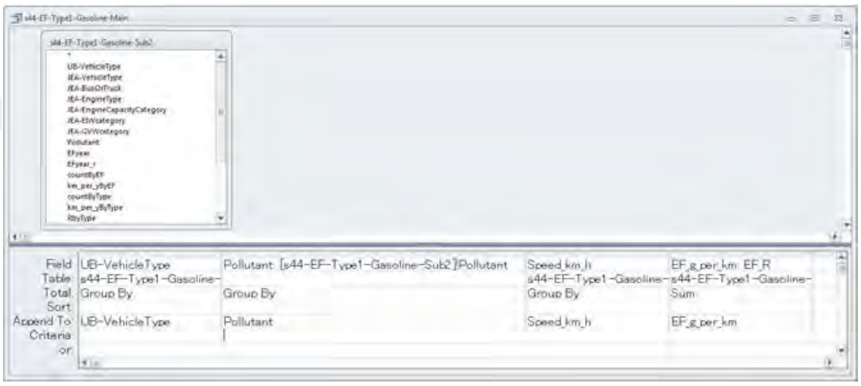


Right-click "s44-EF-Type1-Gasoline-Sub2" query and click [Design View]. In this query, calculate gasoline consumption factor by multiplying the coefficient calculated the carbon content in fuel by emission factor of CO2.

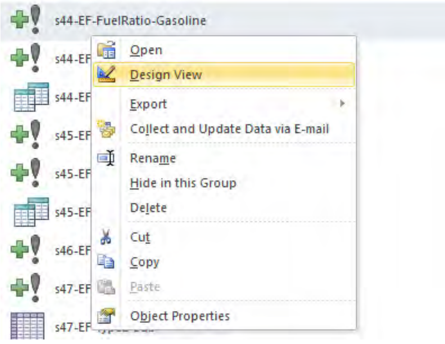


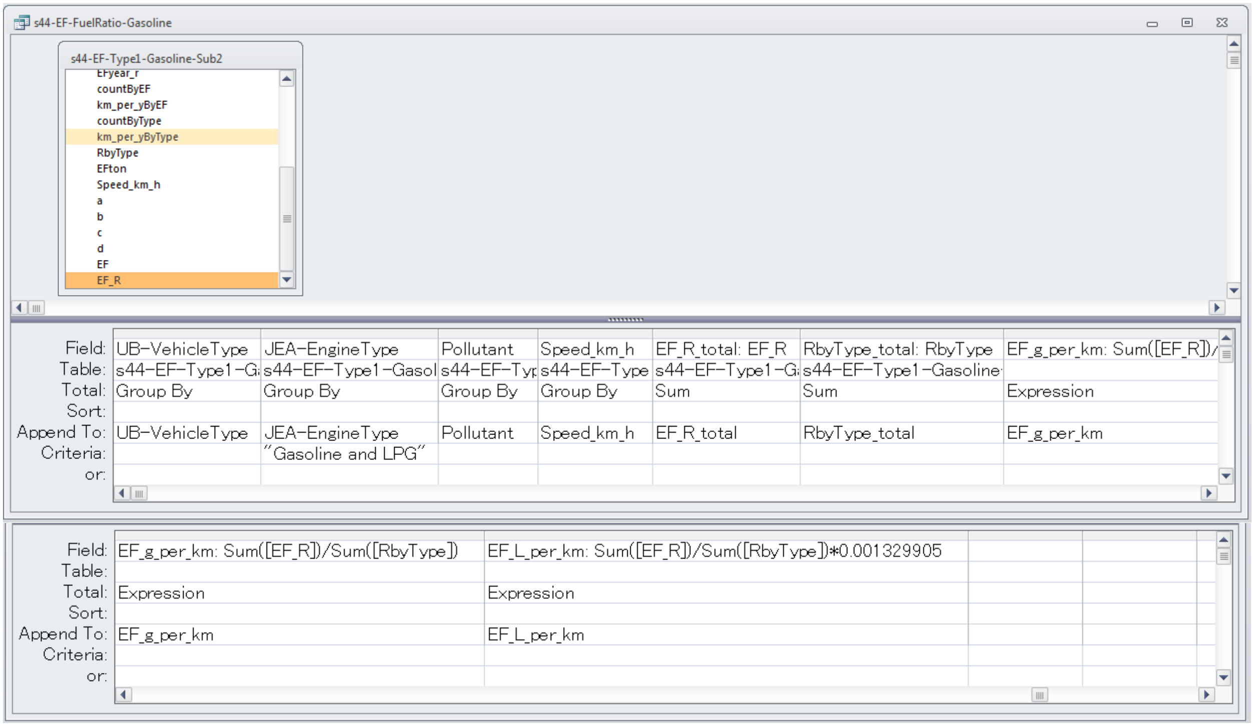
Right-click "s44-EF-Type1-Gasoline-Main" query and click [Design View]. In this query, organize the gasoline consumption factor by vehicle type by traffic speed.



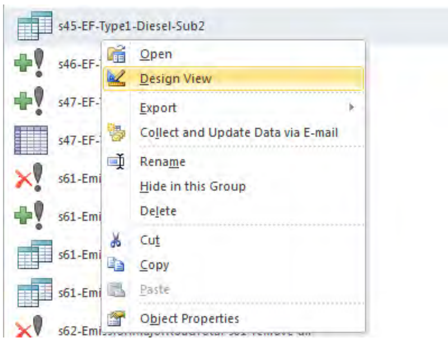


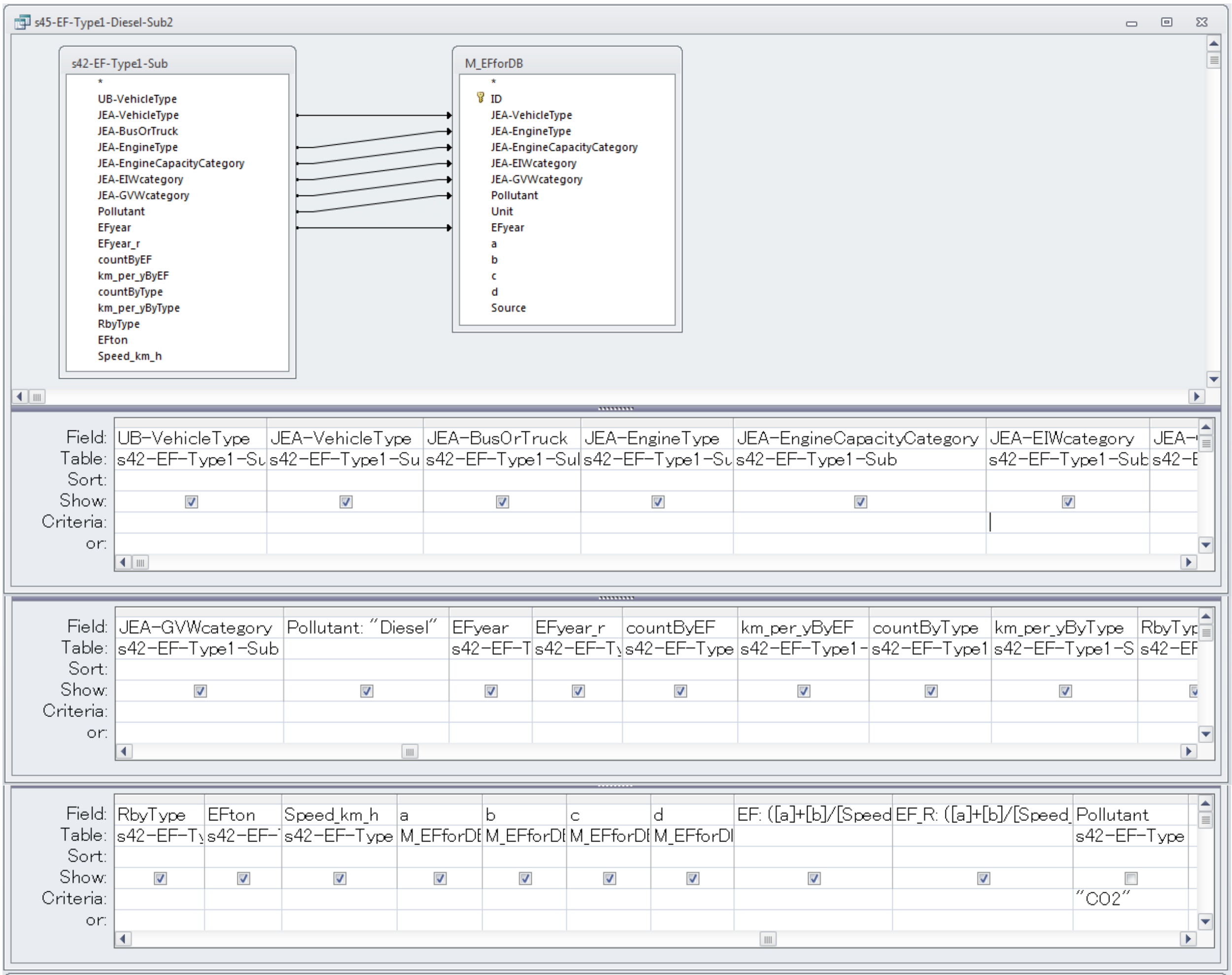
Right-click “s44-EF-FuelRatio-Gasoline” query and click [Design View]. In this query, organize the gasoline consumption by vehicle type by traffic speed.

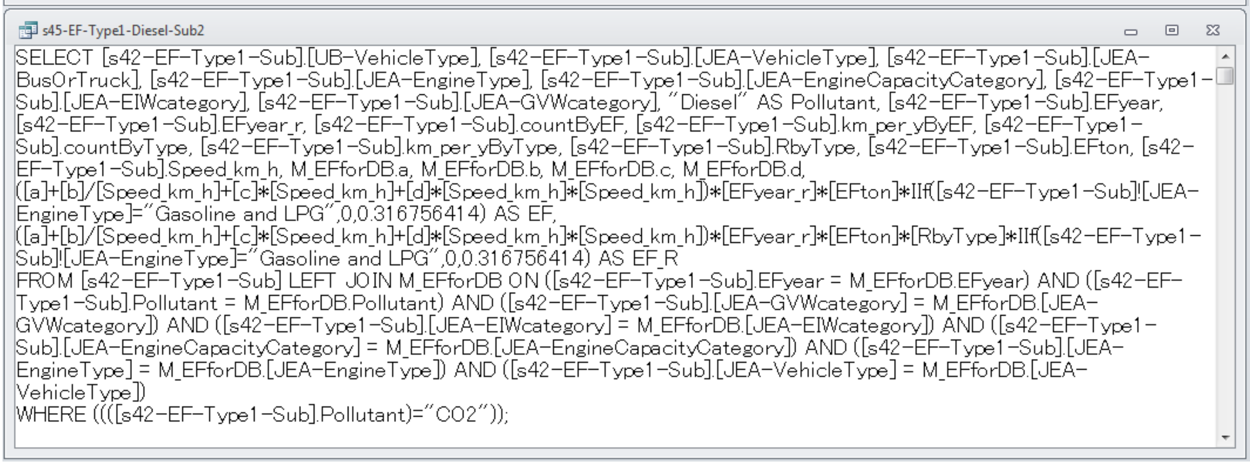




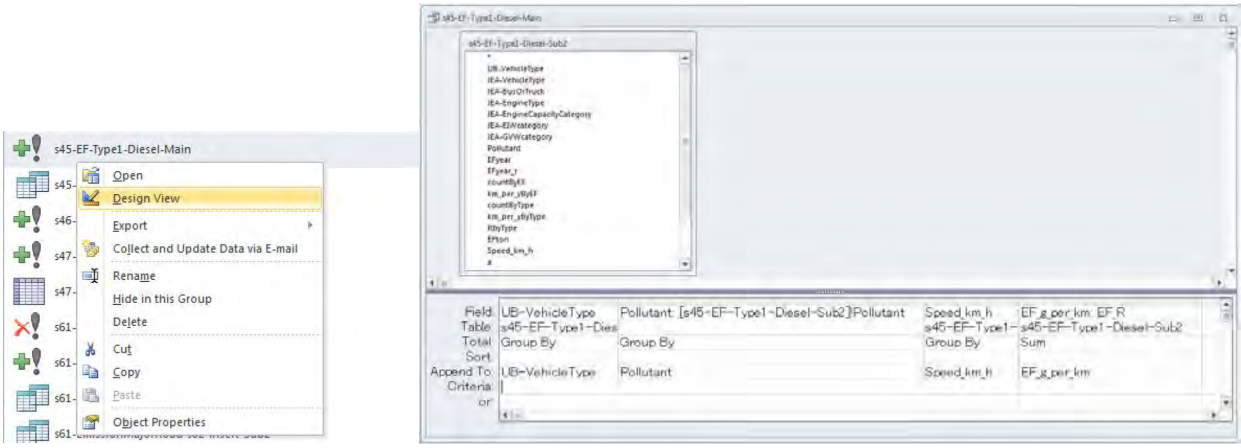
Right-click “s45-EF-Type1-Diesel-Sub2” query and click [Design View]. In this query, calculate diesel oil consumption factor by multiplying the coefficient calculated the carbon content in fuel by emission factor of CO2.


s45-EF-Type1-Diesel-Sub2
Open
Design View
Export
Collect and Update Data via E-mail
Rename
Hide in this Group
Delete
Cut
Copy
Paste
Object Properties

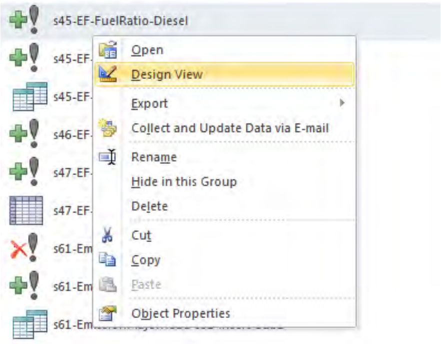

s45-EF-Type1-Diesel-Sub2
s42-EF-Type1-Sub
UB-VehicleType
JEA-VehicleType
JEA-BusOrTruck
JEA-EngineType
JEA-EngineCapacityCategory
JEA-EIWcategory
JEA-GVWcategory
Pollutant
EFyear
EFyear_r
countByEF
km_per_yByEF
countByType
km_per_yByType
RbyType
EFton
Speed_km_h
M_EFforDB
ID
JEA-VehicleType
JEA-EngineType
JEA-EngineCapacityCategory
JEA-EIWcategory
JEA-GVWcategory
Pollutant
Unit
EFyear
a
b
c
d
Source
Field:
Table:
Sort:
Show:
Criteria:
or:
Pollutant: "Diesel"
EF: ([a]+[b]/[Speed
EF_R: ([a]+[b]/[Speed
"CO2"

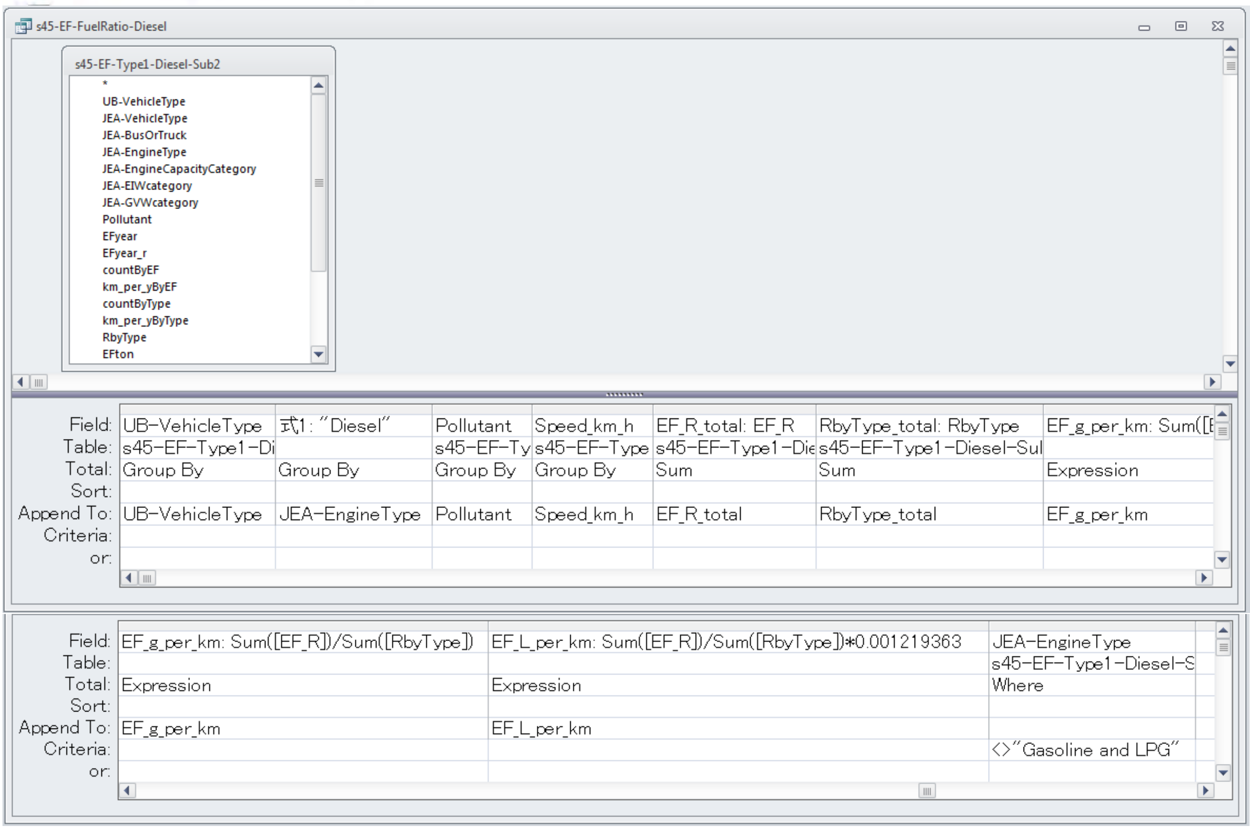

s45-EF-Type1-Diesel-Sub2
SELECT [s42-EF-Type1-Sub].[UB-VehicleType], [s42-EF-Type1-Sub].[JEA-VehicleType], [s42-EF-Type1-Sub].[JEA-BusOrTruck], [s42-EF-Type1-Sub].[JEA-EngineType], [s42-EF-Type1-Sub].[JEA-EngineCapacityCategory], [s42-EF-Type1-Sub].[JEA-EIWcategory], [s42-EF-Type1-Sub].[JEA-GVWcategory], "Diesel" AS Pollutant, [s42-EF-Type1-Sub].EFyear, [s42-EF-Type1-Sub].EFyear_r, [s42-EF-Type1-Sub].countByEF, [s42-EF-Type1-Sub].km_per_yByEF, [s42-EF-Type1-Sub].countByType, [s42-EF-Type1-Sub].km_per_yByType, [s42-EF-Type1-Sub].RbyType, [s42-EF-Type1-Sub].EFton, [s42-EF-Type1-Sub].Speed_km_h, M_EFforDB.a, M_EFforDB.b, M_EFforDB.c, M_EFforDB.d,
([a]+[b]/[Speed_km_h]+[c]*[Speed_km_h]+[d]*[Speed_km_h]*[Speed_km_h])*[EFyear_r]*[EFton]*IIf([s42-EF-Type1-Sub]![JEA-EngineType]="Gasoline and LPG",0,0.3167564114) AS EF,
([a]+[b]/[Speed_km_h]+[c]*[Speed_km_h]+[d]*[Speed_km_h]*[Speed_km_h])*[EFyear_r]*[EFton]*[RbyType]*IIf([s42-EF-Type1-Sub]![JEA-EngineType]="Gasoline and LPG",0,0.3167564114) AS EF_R
FROM [s42-EF-Type1-Sub] LEFT JOIN M_EFforDB ON ([s42-EF-Type1-Sub].EFyear = M_EFforDB.EFyear) AND ([s42-EF-Type1-Sub].Pollutant = M_EFforDB.Pollutant) AND ([s42-EF-Type1-Sub].[JEA-GVWcategory] = M_EFforDB.[JEA-GVWcategory]) AND ([s42-EF-Type1-Sub].[JEA-EIWcategory] = M_EFforDB.[JEA-EIWcategory]) AND ([s42-EF-Type1-Sub].[JEA-EngineCapacityCategory] = M_EFforDB.[JEA-EngineCapacityCategory]) AND ([s42-EF-Type1-Sub].[JEA-EngineType] = M_EFforDB.[JEA-EngineType]) AND ([s42-EF-Type1-Sub].[JEA-VehicleType] = M_EFforDB.[JEA-VehicleType])
WHERE ((([s42-EF-Type1-Sub].Pollutant)="CO2"));

Right-click “s45-EF-Type1-Diesel-Main” query and click [Design View]. In this query, organize the diesel oil consumption factor by vehicle type by traffic speed.

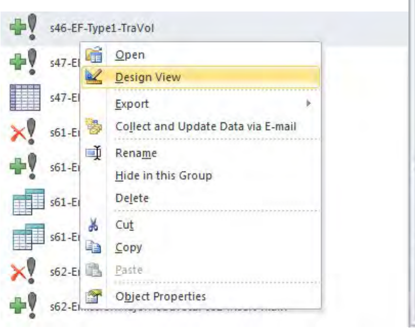


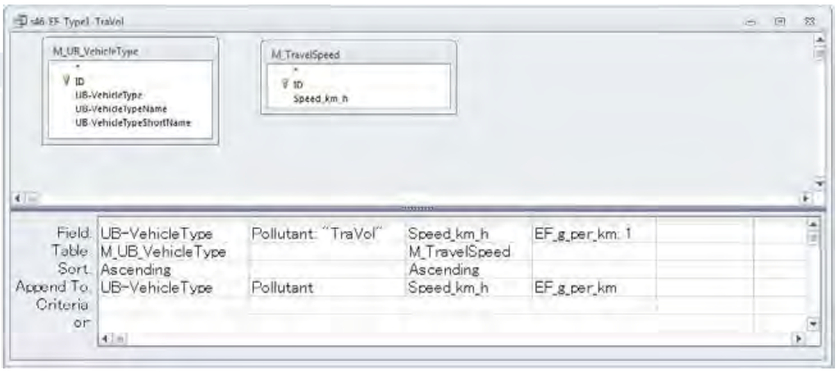
Right-click “s45-EF-FuelRatio-Diesel” query and click [Design View]. In this query, organize the diesel consumption by vehicle type by travel speed.



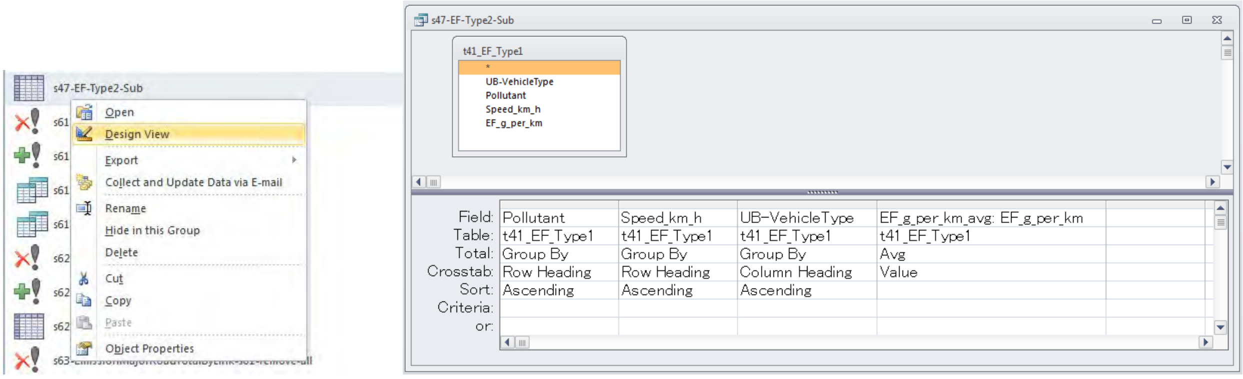


Right-click "s46-EF-Type1-TraVol" query and click [Design View]. In this query, set the coefficient of traffic volume by vehicle type by travel speed.

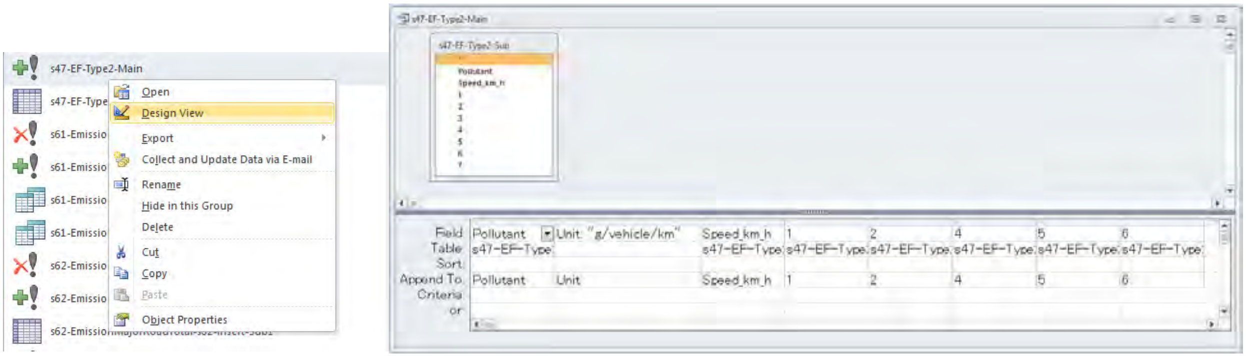




Right-click “s47-EF-Type2-Sub” query and click [Design View]. In this query, organize the emission factor and fuel consumption factor by vehicle type.

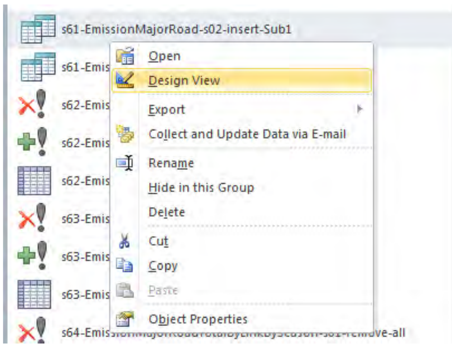


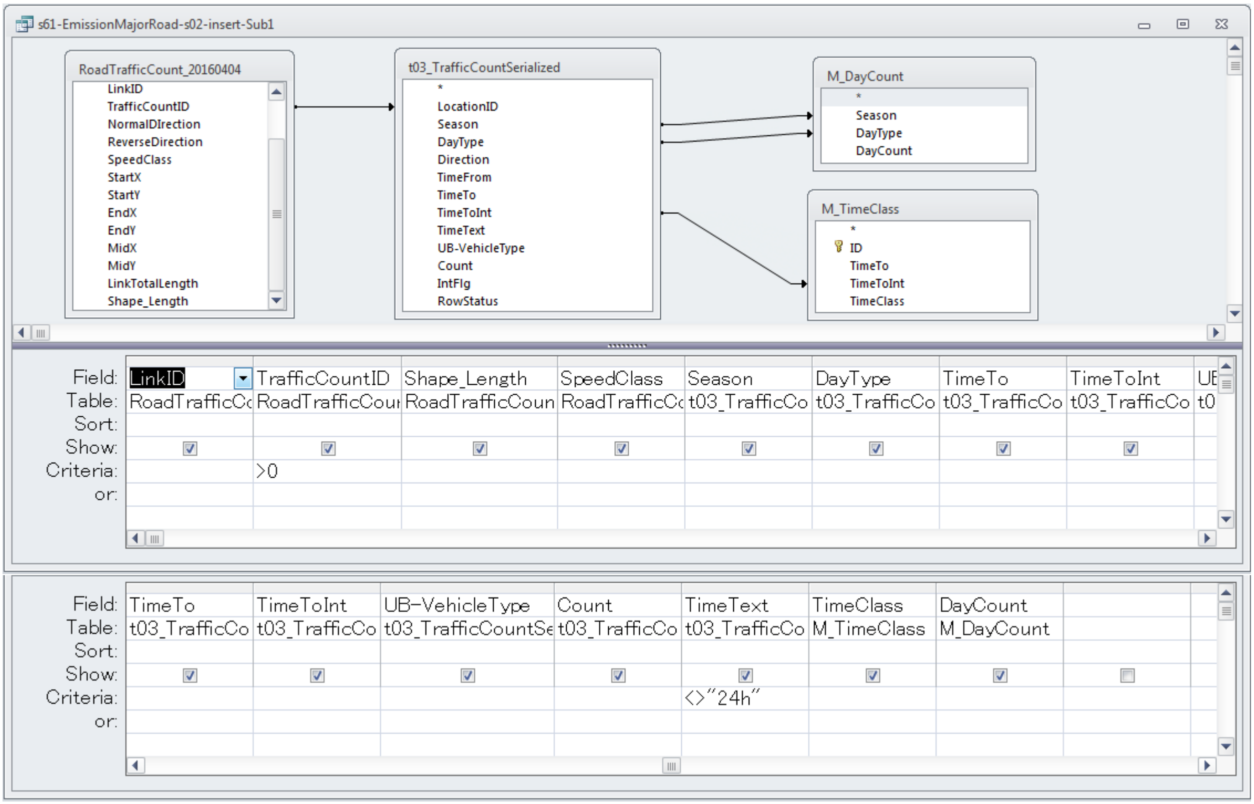
Right-click “s47-EF-Type2-Main” query and click [Design View]. In this query, crate the table organized by “s47-EF-Type2-Sub” query.



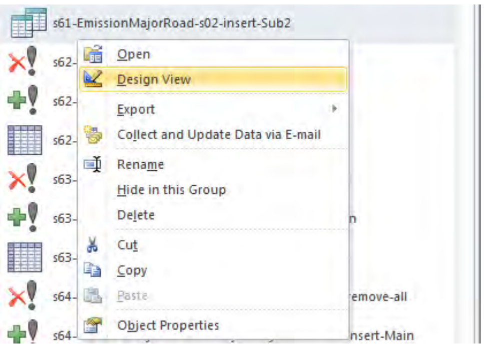
6.1.3.9 Calculation of the Emission of Vehicle Exhaust Gas from Major Road

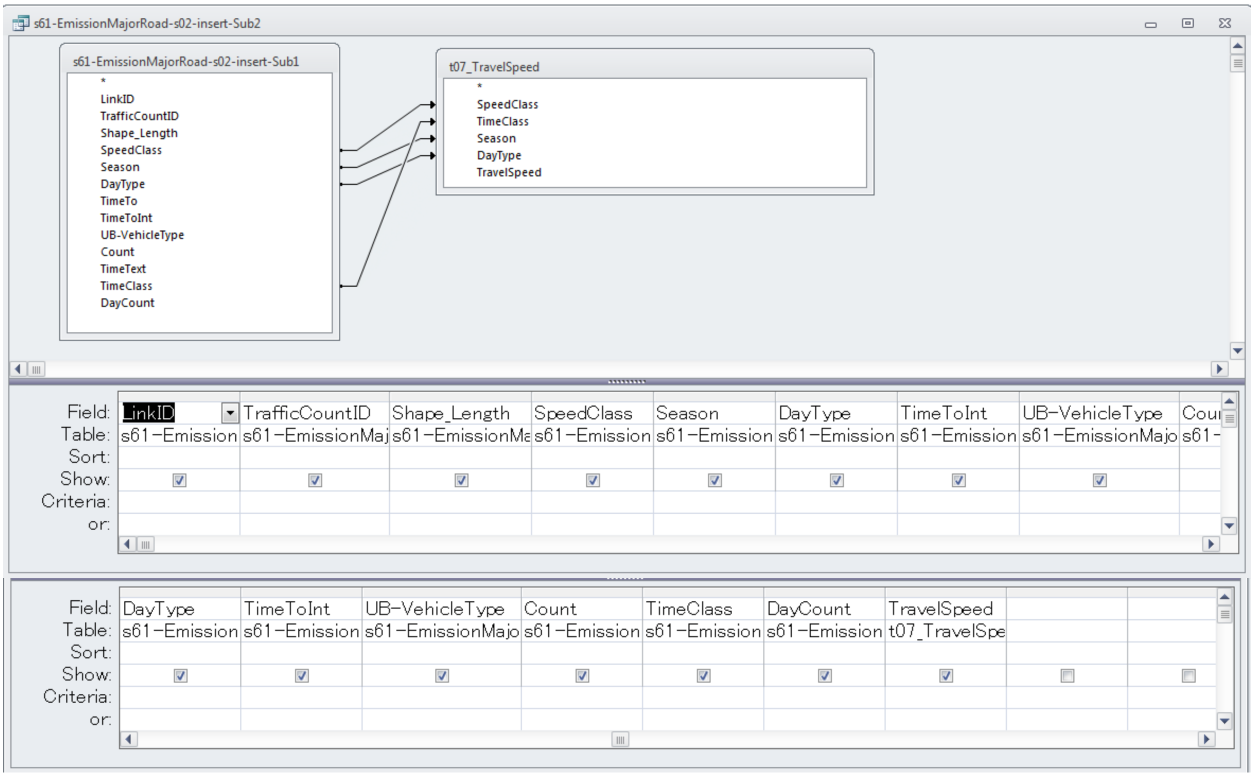
Right-click “s61-EmissionMajorRoad-s02-insert-Sub1” query and click [Design View]. In this query, calculate the traffic count by link, season, weekday or holiday, hour, and vehicle type.



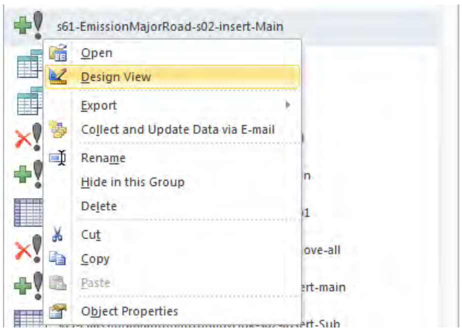


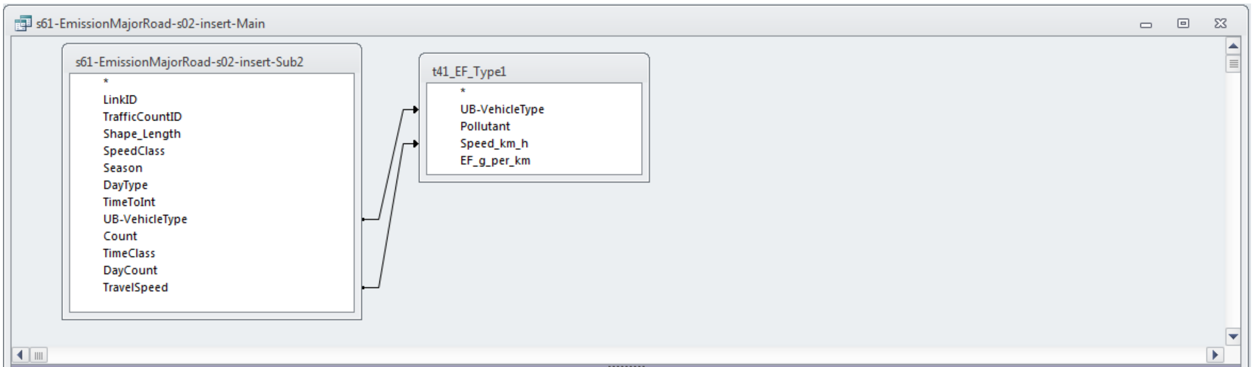
Right-click "s61-EmissionMajorRoad-s02-insert-Sub2" query and click [Design View]. In this query, add averaged travel speed to "s61-EmissionMajorRoad-s02-insert-Sub1" query.





Right-click "s61-EmissionMajorRoad-s02-insert-Main" query and click [Design View]. In this query, select the emission factor by pollutant from vehicle type and travel speed and calculate the emission by link, season, weekday or holiday, hour vehicle type, and pollutant.





Field:	LinkID	TrafficCountID	Shape_Length	SpeedClass	Season	DayType	TimeToInt	UB-VehicleType	Cou
Table:	s61-Emission	s61-EmissionMajc	s61-EmissionM	s61-Emission	s61-Emission	s61-Emission	s61-Emission	s61-EmissionMajc	s61
Sort:									
Append To:	LinkID	TrafficCountID	Shape_Length	SpeedClass	Season	DayType	TimeToInt	UB-VehicleType	Cou
Criteria:									
or:									

Field:	UB-VehicleType	Count	TimeClass	DayCount	TravelSpeed	EF_g_per_km: IIf([s61-EmissionMajorRoad-s02-inser
Table:	s61-EmissionMajc	s61-Emission	s61-Emission	s61-Emission	s61-Emission	
Sort:						
Append To:	UB-VehicleType	Count	TimeClass	DayCount	TravelSpeed	EF_g_per_km
Criteria:						
or:						

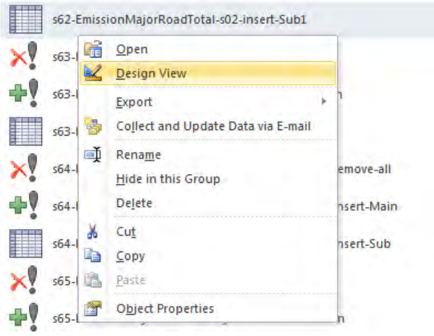
Field:	EF_g_per_km: I	EF_g_per_km_org: EF	Emission_g_per_km: [E	Emission_g_per_km_org: t4	Emmission_g: [E	Emmission_g_org: t	Emiss
Table:		t41_EF_Type1					
Sort:							
Append To:	EF_g_per_km	EF_g_per_km_org	Emission_g_per_km	Emission_g_per_km_org	Emmission_g	Emmission_g_org	Emiss
Criteria:							
or:							

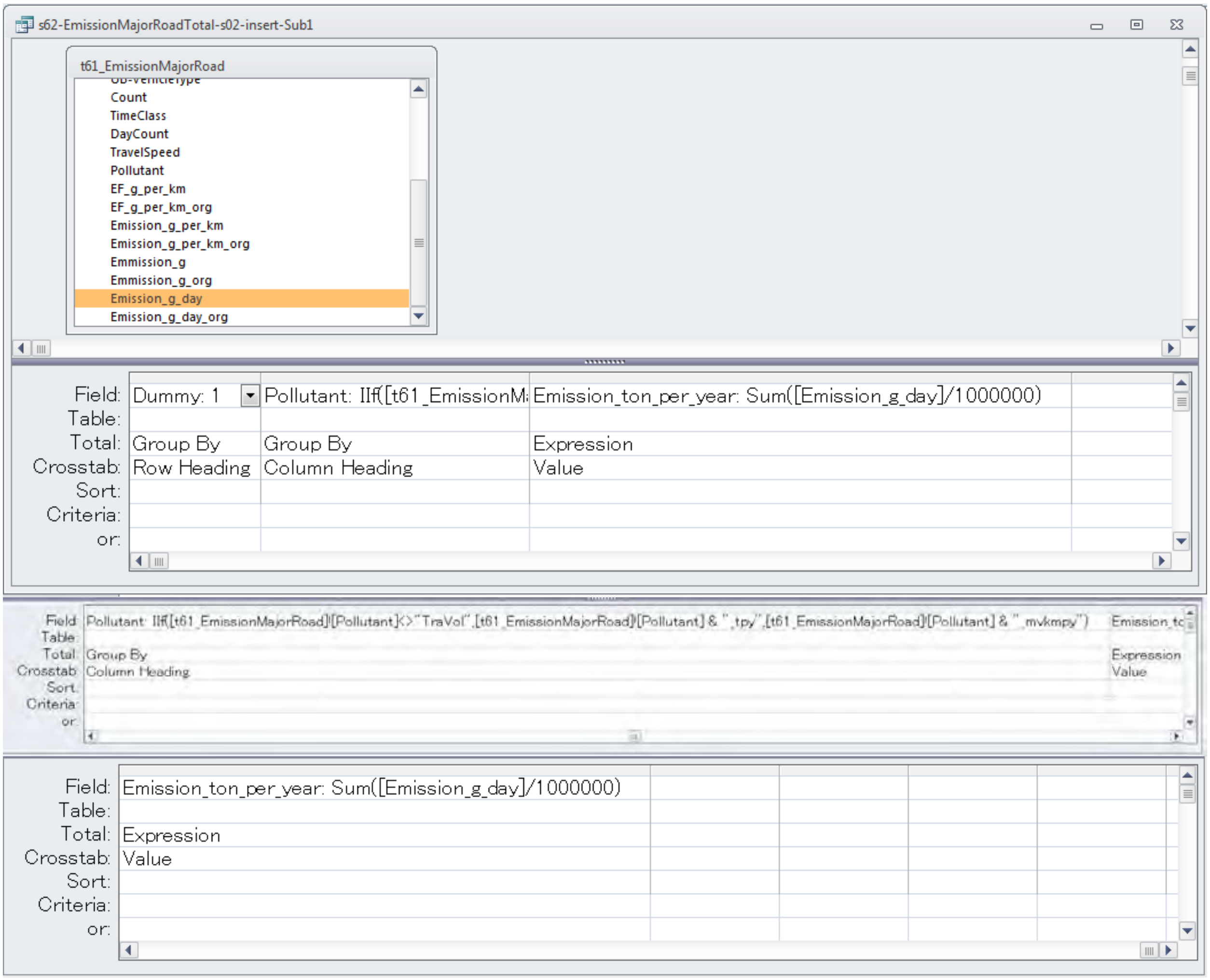
Field:	Emission_g_per_km_org: t4	Emmission_g: [E	Emmission_g_org: t	Emission_g_day: [E	Emission_g_day_org: t4	Pollutant	
Table:						t41_EF_Type1	
Sort:							
Append To:	Emission_g_per_km_org	Emmission_g	Emmission_g_org	Emission_g_day	Emission_g_day_org	Pollutant	
Criteria:						Is Not Null	
or:							

s61-EmissionMajorRoad-s02-insert-Main

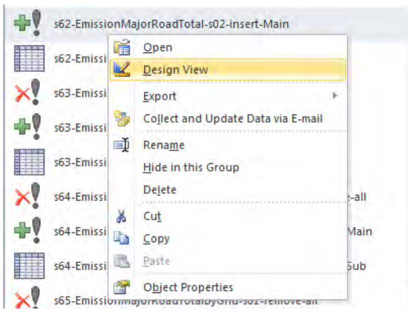
```
INSERT INTO t61_EmissionMajorRoad ( LinkID, TrafficCountID, Shape_Length, SpeedClass, Season, DayType, TimeToInt,
[UB-VehicleType], [Count], TimeClass, DayCount, TravelSpeed, EF_g_per_km, EF_g_per_km_org, Emission_g_per_km,
Emission_g_per_km_org, Emmission_g, Emmission_g_org, Emission_g_day, Emission_g_day_org, Pollutant )
SELECT [s61-EmissionMajorRoad-s02-insert-Sub2].LinkID, [s61-EmissionMajorRoad-s02-insert-Sub2].TrafficCountID,
[s61-EmissionMajorRoad-s02-insert-Sub2].Shape_Length, [s61-EmissionMajorRoad-s02-insert-Sub2].SpeedClass, [s61-
EmissionMajorRoad-s02-insert-Sub2].Season, [s61-EmissionMajorRoad-s02-insert-Sub2].DayType, [s61-
EmissionMajorRoad-s02-insert-Sub2].TimeToInt, [s61-EmissionMajorRoad-s02-insert-Sub2].[UB-VehicleType], [s61-
EmissionMajorRoad-s02-insert-Sub2].Count, [s61-EmissionMajorRoad-s02-insert-Sub2].TimeClass, [s61-
EmissionMajorRoad-s02-insert-Sub2].DayCount, [s61-EmissionMajorRoad-s02-insert-Sub2].TravelSpeed,
IIf([s61-EmissionMajorRoad-s02-insert-Sub2]!Season="winter" And (t41_EF_Type1!Pollutant="CO2" Or
t41_EF_Type1!Pollutant="Diesel" Or t41_EF_Type1!Pollutant="Gasoline" Or
t41_EF_Type1!Pollutant="SOx"),t41_EF_Type1!EF_g_per_km*1.32,t41_EF_Type1!EF_g_per_km) AS EF_g_per_km,
t41_EF_Type1.EF_g_per_km AS EF_g_per_km_org,
[EF_g_per_km]*[Count] AS Emission_g_per_km,
t41_EF_Type1!EF_g_per_km*[Count] AS Emission_g_per_km_org,
[EF_g_per_km]*[Count]*[Shape_Length]/1000 AS Emmission_g,
t41_EF_Type1!EF_g_per_km*[Count]*[Shape_Length]/1000 AS Emmission_g_org,
[EF_g_per_km]*[Count]*[Shape_Length]/1000*[DayCount] AS Emission_g_day,
t41_EF_Type1!EF_g_per_km*[Count]*[Shape_Length]/1000*[DayCount] AS Emission_g_day_org,
t41_EF_Type1.Pollutant
FROM [s61-EmissionMajorRoad-s02-insert-Sub2] LEFT JOIN t41_EF_Type1 ON ([s61-EmissionMajorRoad-s02-insert-
Sub2].TravelSpeed = t41_EF_Type1.Speed_km_h) AND ([s61-EmissionMajorRoad-s02-insert-Sub2].[UB-VehicleType] =
t41_EF_Type1.[UB-VehicleType])
WHERE (((t41_EF_Type1.Pollutant) Is Not Null));
```

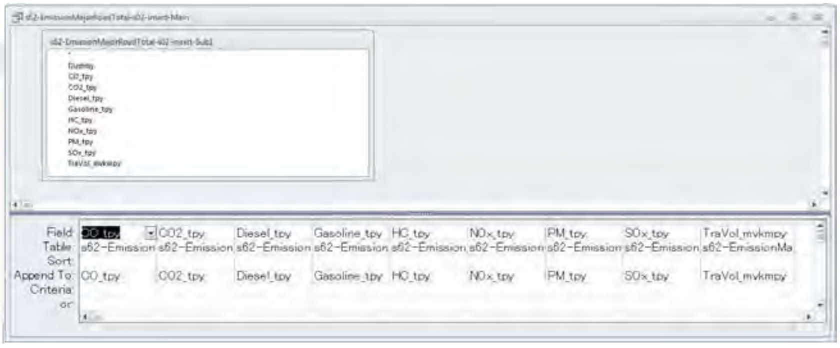
Right-click “s62-EmissionMajorRoadTotal-s02-insert-Sub1” query and click [Design View]. In this query, cross tabulation of the emission by link, season, weekday or holiday, hour vehicle type, and pollutant is conducted.





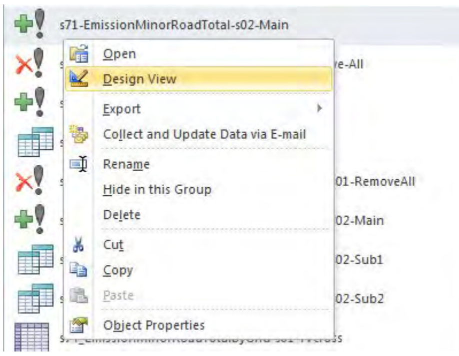
Right-click “s62-EmissionMajorRoadTotal-s02-insert-Main” query and click [Design View]. In this query, add the result by “s62-EmissionMajorRoadTotal-s02-insert-Sub1” query to table.

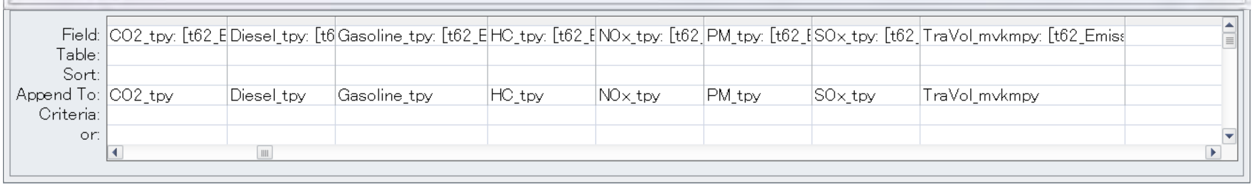




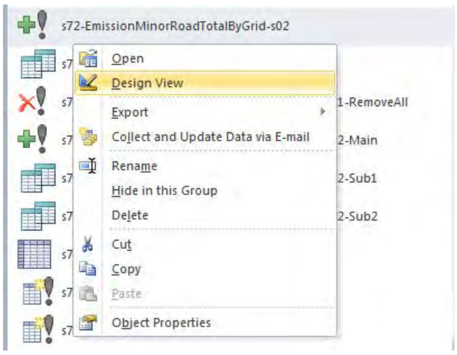
6.1.3.10 Calculation of the Emission of Vehicle Exhaust Gas from Minor Road

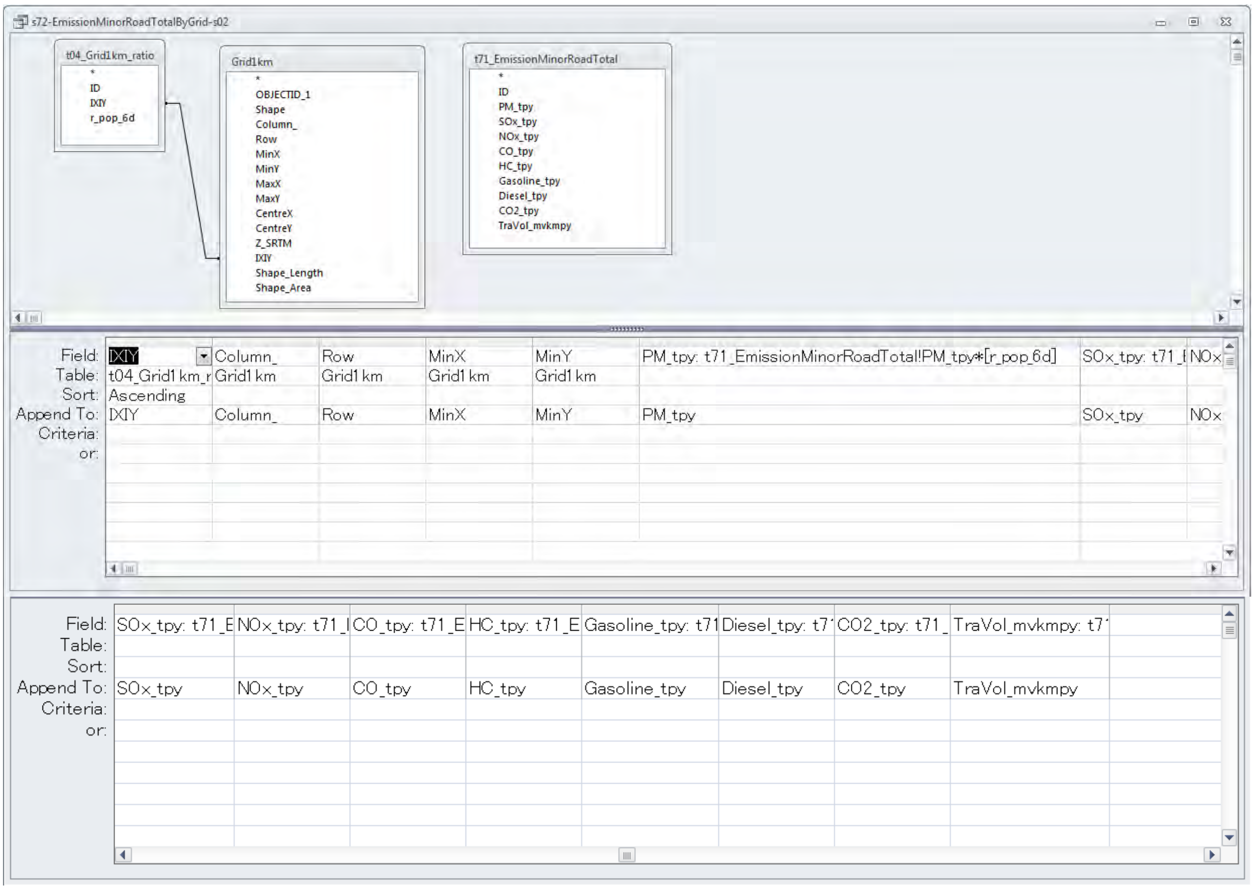
Right-click "s28-VehList-UpdateUBfield04-GasSulfur-Sub" query and click [Design View]. In this query, calculate the emission in minor road by multiplying the emission in major road by the ratio of traffic volume in minor road to traffic volume in major road in last year.



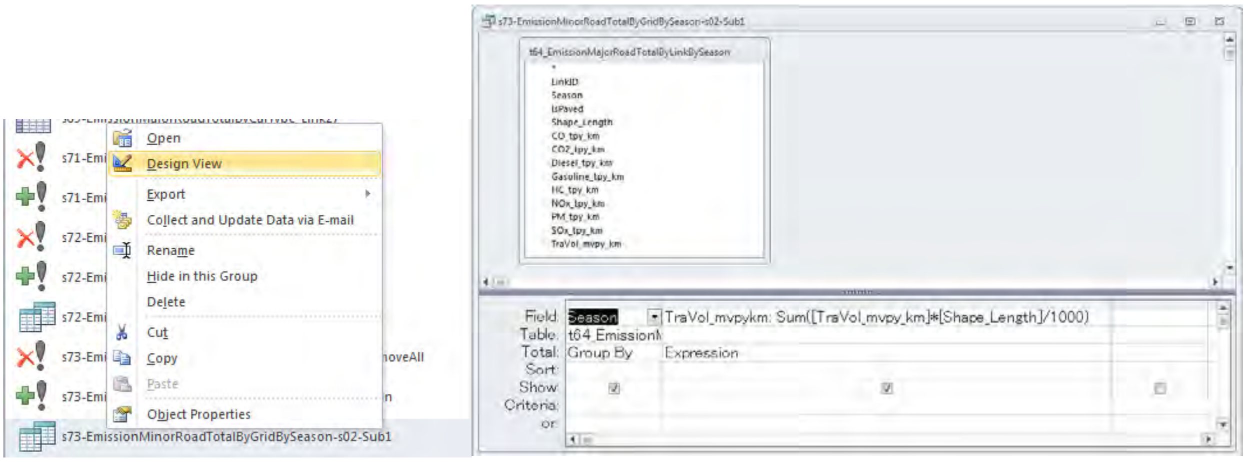


Right-click "s72-EmissionMinorRoadTotalByGrid-s02" query and click [Design View]. In this query, calculate the emission by grid in minor road by multiplying the total emission in minor road by the population ratio by grid.

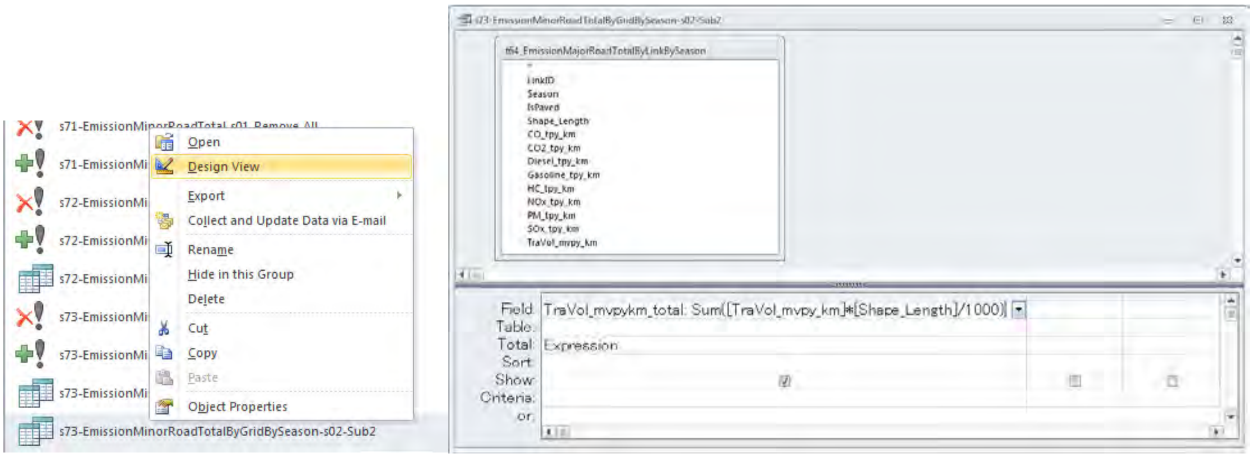




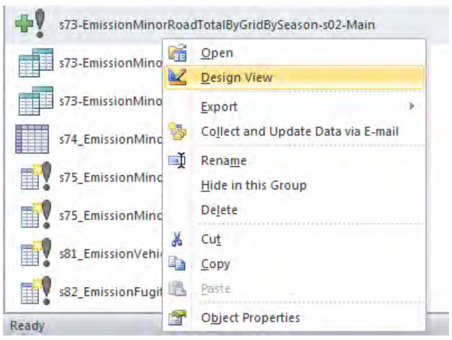
Right-click “s73-EmissionMinorRoadTotalByGridBySeason-s02-Sub1” query and click [Design View]. In this query, calculate the seasonal traffic volume by grid in minor road.

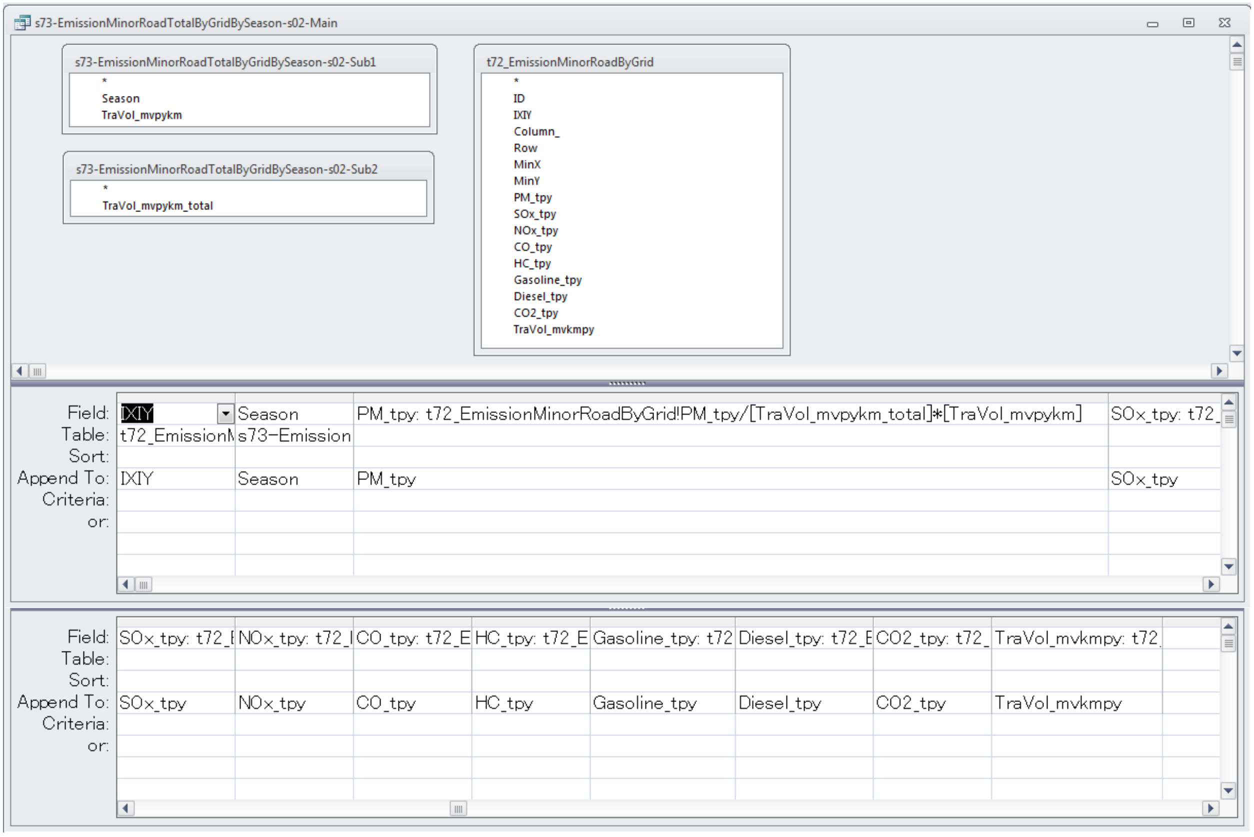


Right-click “s73-EmissionMinorRoadTotalByGridBySeason-s02-Sub2” query and click [Design View]. In this query, calculate the total traffic volume in minor road.



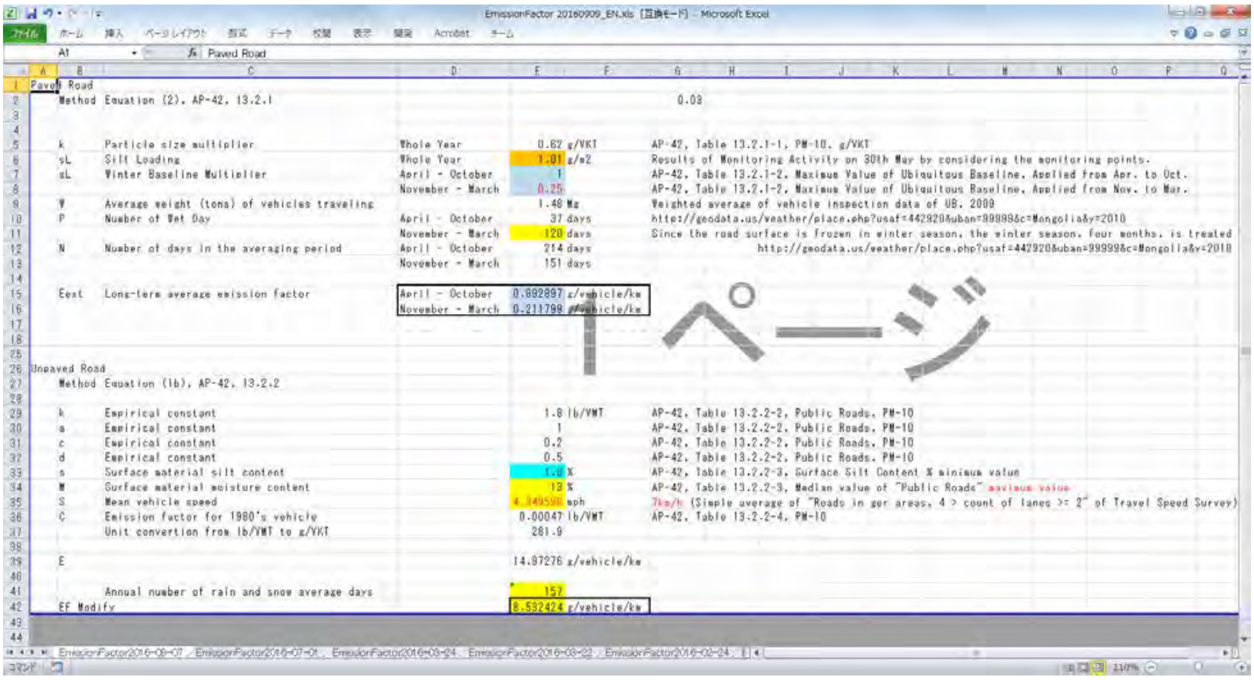
Right-click “s73-EmissionMinorRoadTotalByGridBySeason-s02-Main” query and click [Design View]. In this query, calculate the seasonal emission of grid by multiplying the emission of grid in minor road by the ratio of seasonal traffic volume to total traffic volume.



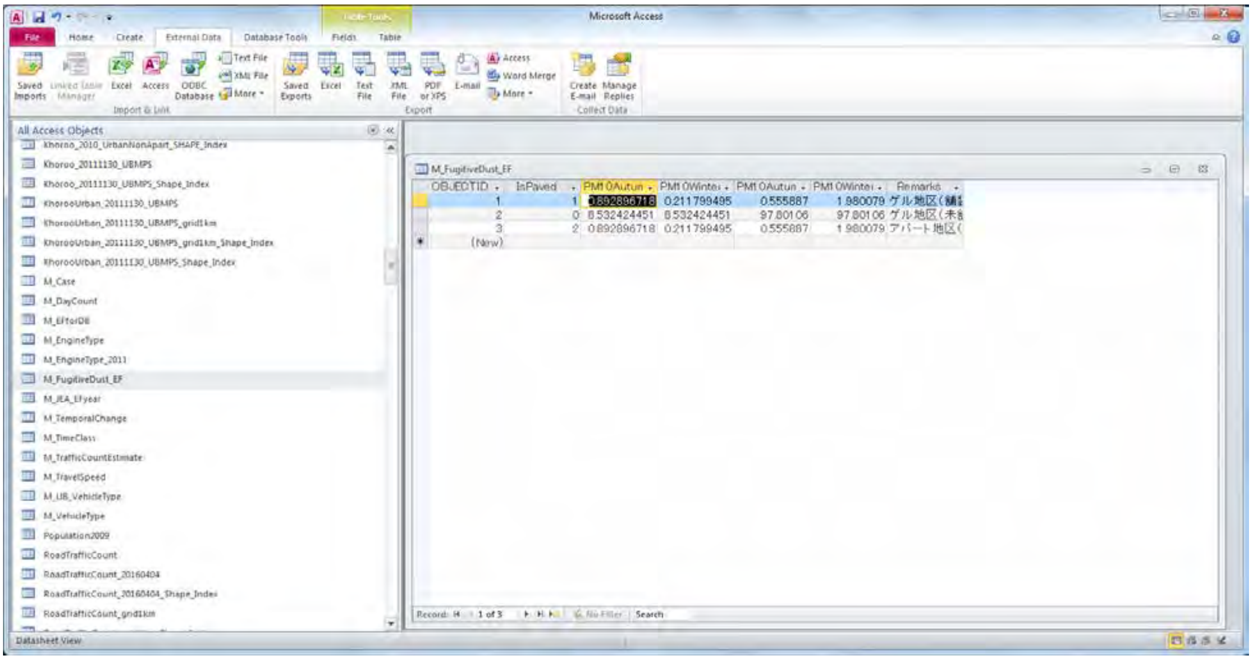


6.1.3.11 Emission Factor of Fugitive Dust from Road

Calculate the emission factor of fugitive dust from road by inputting and updating the value of the calculation sheet for calculating the emission factor by the method shown in 6.1.2.2 (EmissionFactor_20160909_EN.xls).



Update the result of the above calculation sheet to [PM10_Autumn_Min] and [PM10_Winter_Min] columns in “M_FugitiveDust_EF” table



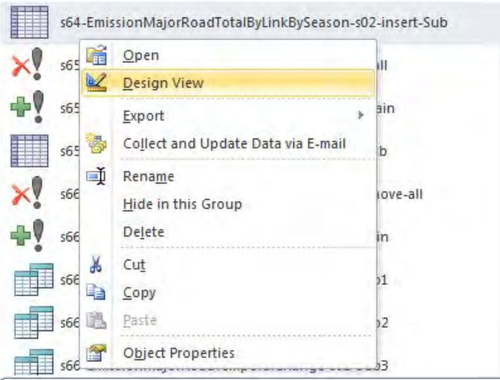
6.1.3.12 Calculation of Fugitive Dust Amount by Vehicle Travelling in Major Road

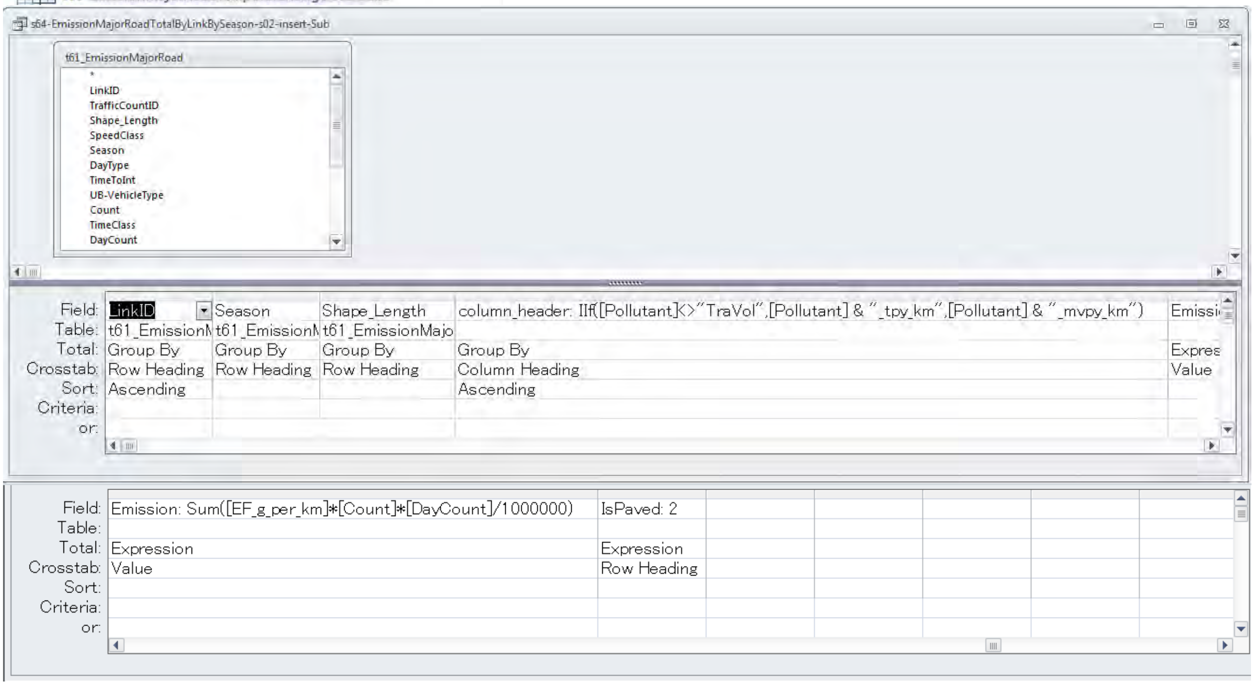
Fugitive road dust by road traveling is calculated by the following formula. In the database, we create queries to calculate this.

> Figitive dust amount (ton) = traffic volume (unit x km) x fugitive emission factor of major road (g/unit x km)

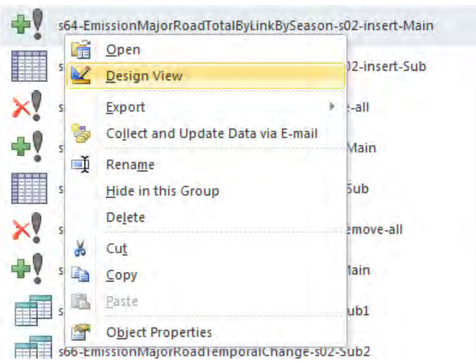
Since the emission factor is seasonal, it is necessary to calculate traffic volume by season as well. This calculation formula is the same for the calculation of the fugitive dust in minor road.

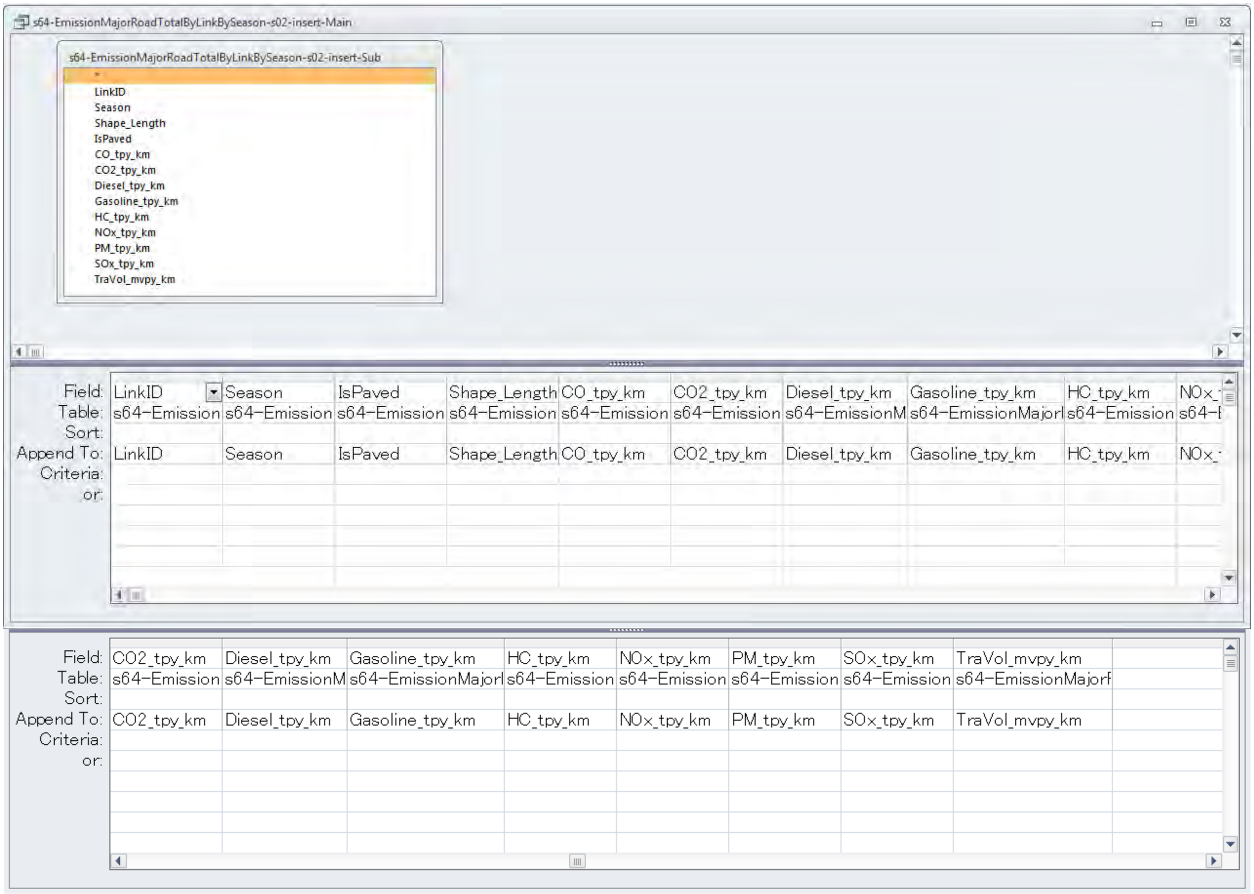
Right-click “s64-EmissionMajorRoadTotalByLinkBySeason-s02-insert-sub” query and click [Design View]. In this query, cross tabulation of the emission by link by season is conducted.



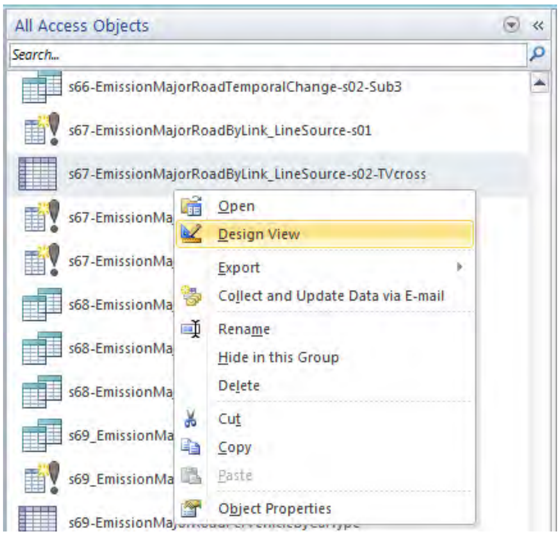


Right-click "s64-EmissionMajorRoadTotalByLinkBySeason-s02-insert-Main" query and click [Design View]. Add table to the result of cross tabulation in "s64-EmissionMajorRoadTotalByLinkBySeason-s02-insert-sub" query.

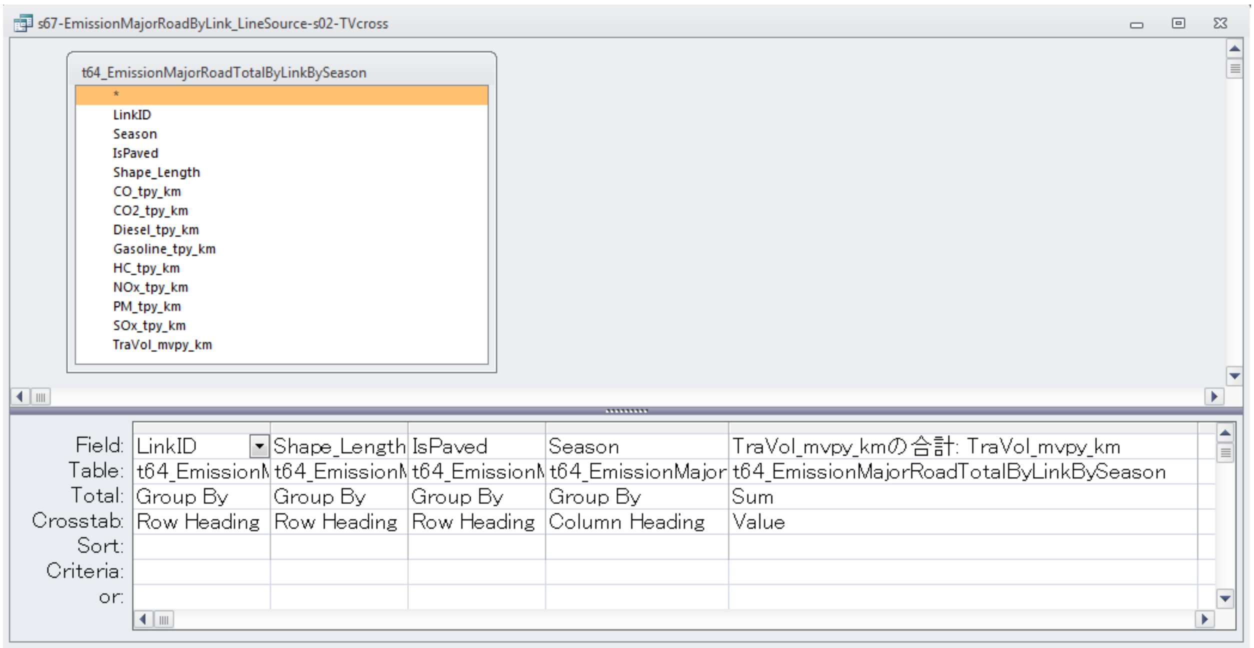




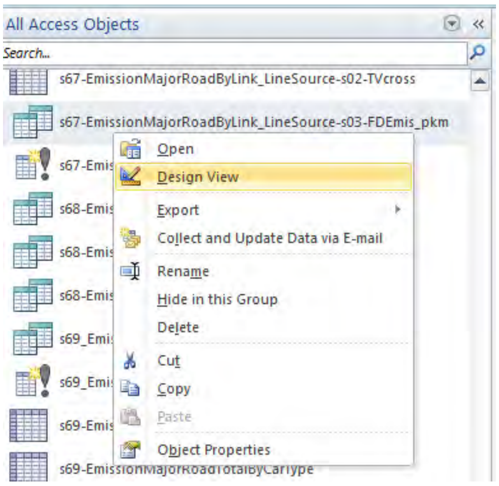
To cross tabulation of the traffic volume per 1km by link by season, right-click "s67_EmissionMajorRoadTotalByLinkLineSource-s02-TVcross" query and click [Design View].



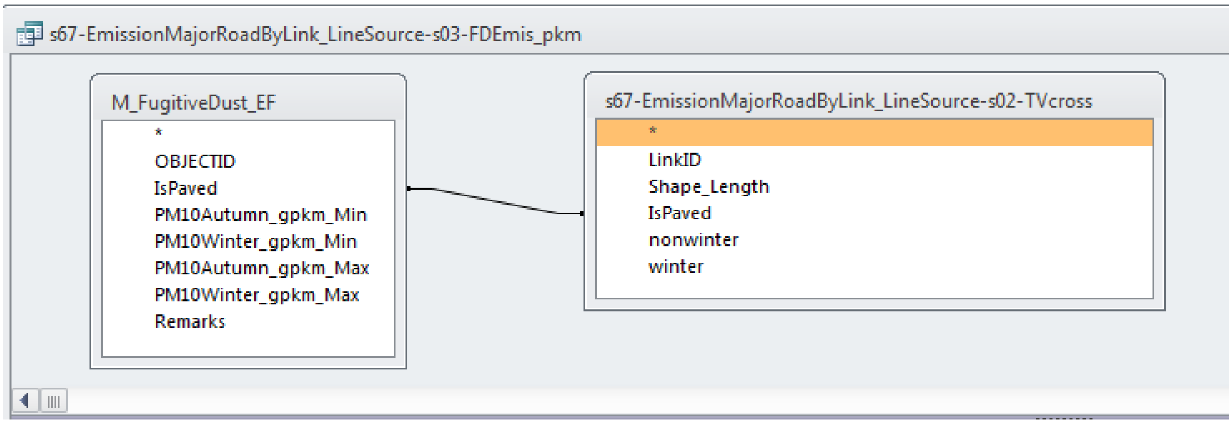
Show "t64_EmissionMajorRoadTotalByLinkBySeason" table on this query and set the output item as follows.



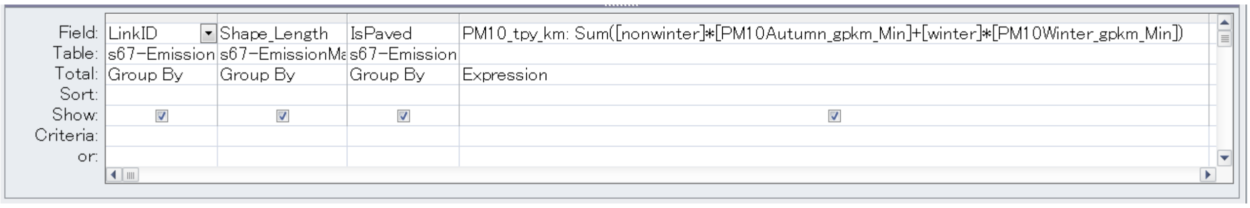
To calculate the fugitive road dust per 1km by multiplying traffic volume by emission factor, right-click "s28-VehList-UpdateUBfield04-GasSulfur-Sub" query and click [Design View]. In this query, extract the regulation year of exhaust gas of vehicle by pollutant in 2004.



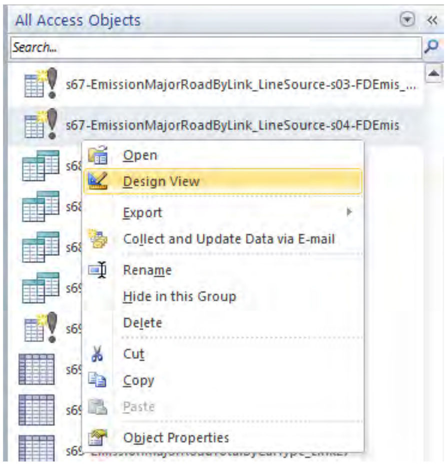
Join "s67_EmissionMajorRoadTotalByLink_LineSource-s02-TVcross" query and "M_FugitiveDust_EF" table on [IsPaved] column.



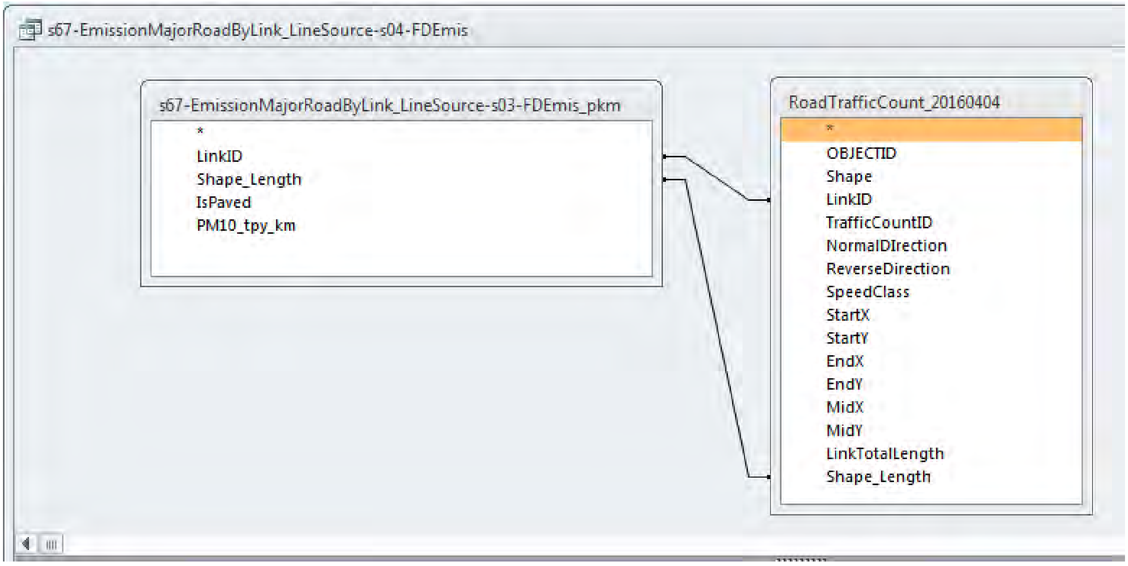
Set the output item as follows. Calculate the annual emission per 1km by summing the emission by multiplying the seasonal traffic volume by seasonal emission factor emission per traffic volume.



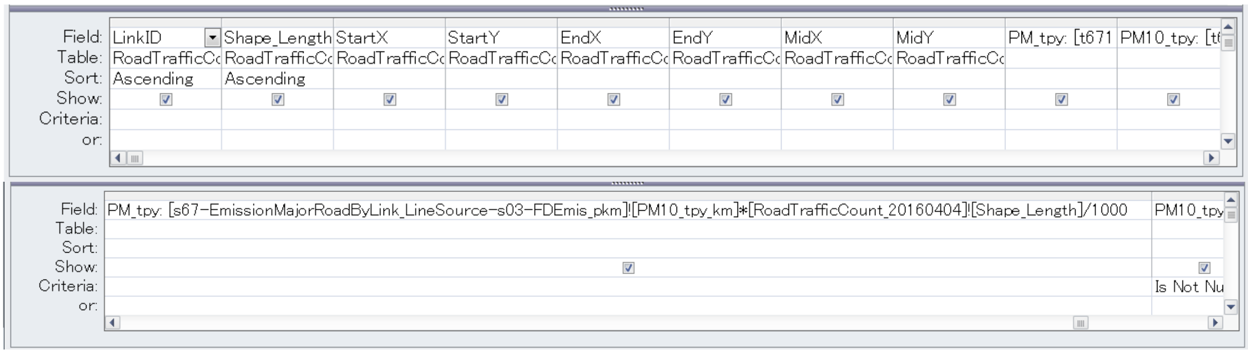
Calculate the annual fugitive road dust by link by multiplying the annual emission per 1km by the link length.
Right-click “s28-VehList-UpdateUBfield04-GasSulfur-Sub” query and click [Design View].



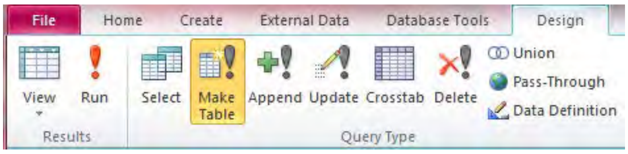
Join “RoadTrafficCount_20160404” table, “s67-EmissionMajorRoadByLink_LineSource-s03-FDEmis_pkm” query on [LinkID] and [Shape_Length] column.



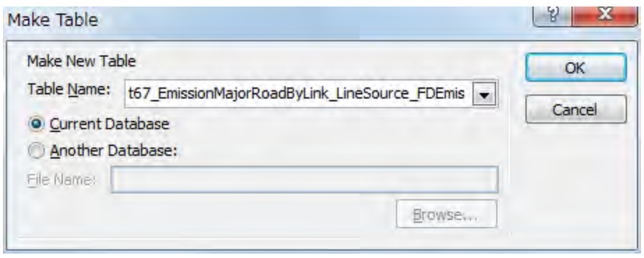
Set the output item as follows. Calculate the emission by multiplying the annual emission per 1km by link length. PM10 emission is the same as PM emission.



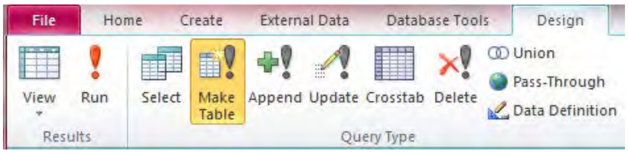
Click [Design]-[Create Table]



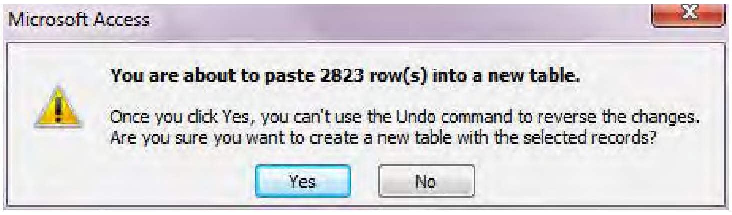
Set the table name (Here it is “t67_EmissionMajorRoadByLink_LineSource_FDEmis”).



Click [Design]-[Run]



Click [Yes].



Create the input data table of fugitive road dust in major road for simulation.

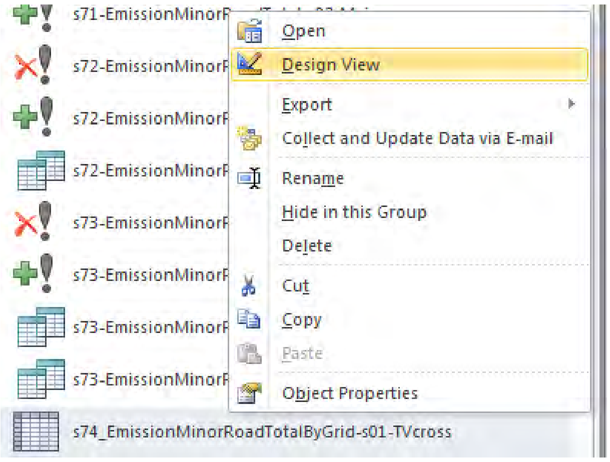
t67_EmissionMajorRoadByLink_LineSource_FDEmis

LinkID	Shape_Leng	StartX	StartY	EndX	EndY	MidX	MidY	PM_tpy	PM10_tpy
01	1044.023094	643072.6911	5313512.434	642957.6074	5314549.164	643017.8677	5314030.741	13.56640036	13.56640036
01	2245.763941	642957.6074	5314549.164	643161.8106	5316777.705	643116.7758	5315660.633	29.18224024	29.18224024
02	395.5026814	643072.6911	5313512.434	642709.134	5313389.335	642879.916	5313479.422	2.444424471	2.444424471
02	397.5723472	642349.8118	5312542.938	642317.5325	5312153.035	642348.0633	5312345.429	2.457216146	2.457216146
02	923.1456535	642709.134	5313389.335	642349.8118	5312542.938	642525.5759	5312967.613	5.705548740	5.705548740
03	1209.605961	643264.9285	5312318.442	643072.6911	5313512.434	643175.1124	5312916.517	7.79639649	7.79639649
04-1	525.119773	644003.8064	5312975.935	643580.2832	5313264.833	643816.3518	5313149.902	3.861315654	3.861315654
04-1	548.1167005	644016.2185	5312430.67	644003.8064	5312975.935	644022.1812	5312704.663	4.030416877	4.030416877
04-2	566.0409513	643580.2832	5313264.833	643072.6911	5313512.434	643325.0641	5313387.154	4.162217647	4.162217647
05	268.4971198	650045.4804	5312880.068	649882.5456	5313092.888	649965.4221	5312987.825	1.768069073	1.768069073
05	1331.543557	649185.1587	5311924.781	650045.4804	5312880.068	649647.7668	5312350.107	8.768291386	8.768291386
05	1664.165269	647550.0909	5311869.518	649185.1587	5311924.781	648381.3428	5311849.736	10.95862460	10.95862460
06	1019.388816	649466.8904	5310696.863	648454.1278	5310607.976	648960.6679	5310663.966	9.425499985	9.425499985
06	2947.619489	652093.2292	5309394.567	649466.8904	5310696.863	650730.7867	5309956.461	27.25435772	27.25435772
07-1	342.7335578	646389.8393	5311785.838	646047.155	5311781.26	646218.4892	5311784.108	2.996556536	2.996556536
07-1	366.3030836	647550.0909	5311869.518	647184.7626	5311868.129	647367.2286	5311879.785	3.202627448	3.202627448
07-1	396.4294566	646783.6397	5311825.415	646389.8393	5311785.838	646587.7722	5311795.42	3.466025583	3.466025583
07-1	403.4246696	647184.7626	5311868.129	646783.6397	5311825.415	646984.1171	5311847.449	3.527185486	3.527185486
07-2	271.4137808	646047.155	5311781.26	645776.1876	5311770.216	645911.6386	5311774.172	2.373000018	2.373000018
07-2	419.7468191	645776.1876	5311770.216	645404.4167	5311956.218	645581.9255	5311844.251	3.669891803	3.669891803
07-2	444.3617308	645404.4167	5311956.218	645021.3234	5312155.891	645217.7159	5312076.649	3.885102636	3.885102636
08	895.6319456	647497.8094	5310975.858	647550.0909	5311869.518	647522.7040	5311422.552	5.168709276	5.168709276
09-1	1445.260449	636407.3808	5315190.260	637835.3977	5315157.084	637121.6867	5315083.196	13.60825207	13.60825207
09-1	3262.236954	637835.3977	5315157.084	640628.2669	5313520.120	639256.7854	5314380.095	30.71650015	30.71650015
09-2	1577.572629	640628.2669	5313520.120	641366.5725	5312166.238	640947.825	5312813.611	14.85407424	14.85407424
09-3	984.8372116	641366.5725	5312166.238	642011.8287	5311433.635	641720.5787	5311824.037	9.273008916	9.273008916
10-1	639.8694567	635734.3443	5313735.225	636278.7996	5314059.801	636013.5144	5313888.740	5.948666858	5.948666858
10-1	1623.499705	635771.8187	5312168.865	635734.3443	5313735.225	635609.3957	5312954.534	15.09317063	15.09317063
10-1	2004.281710	636278.7996	5314059.801	636552.4073	5316031	636404.6820	5315050.488	18.63318222	18.63318222
10-2	2157.070241	635976.3479	5310041.36	635771.8187	5312168.865	635815.8751	5311100.294	20.05360956	20.05360956
11	1413.783097	634737.6083	5309953.032	633386.3353	5310065.473	634031.2022	5309930.032	6.320679662	6.320679662
11	1701.255001	633386.3353	5310065.473	631778.775	5309647.098	632609.2280	5309793.559	7.605896484	7.605896484
11	3614.302613	631778.775	5309647.098	629229.6174	5312102.305	630562.0073	5310932.053	16.15866612	16.15866612
12	1207.627784	633709.0052	5304182.906	633581.8829	5305343.371	633787.9695	5304779.666	4.480709971	4.480709971

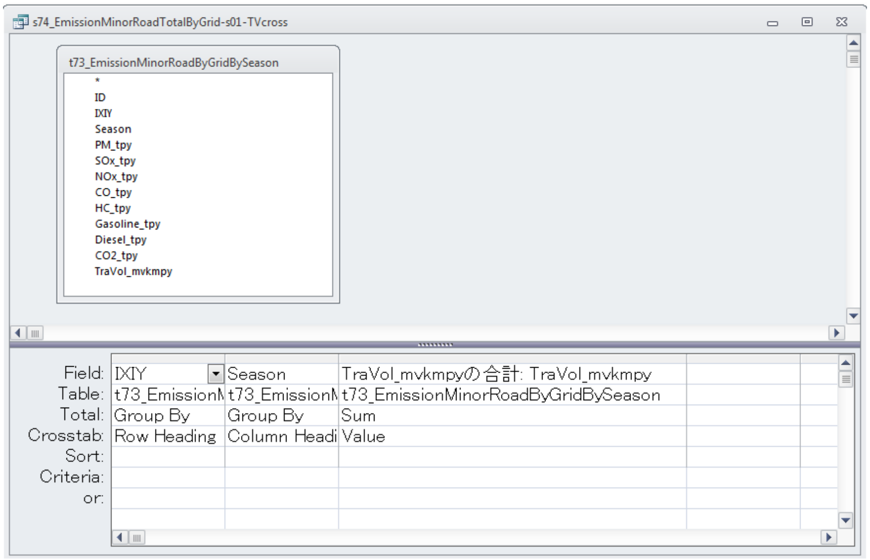
Record: 1 of 197 No Filter Search

6.1.3.13 Calculation of Fugitive Dust Amount by Vehicle Travelling in Minor Road (Paved Road)

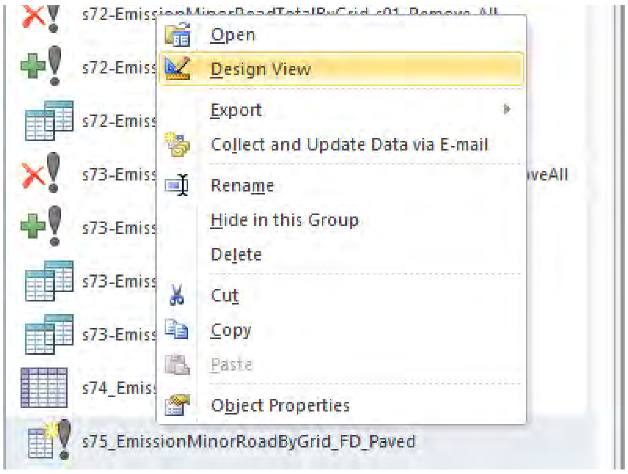
Right-click “s74_EmissionMinorRoadTotalByGrid-s01-TVcross” query and click [Design View].



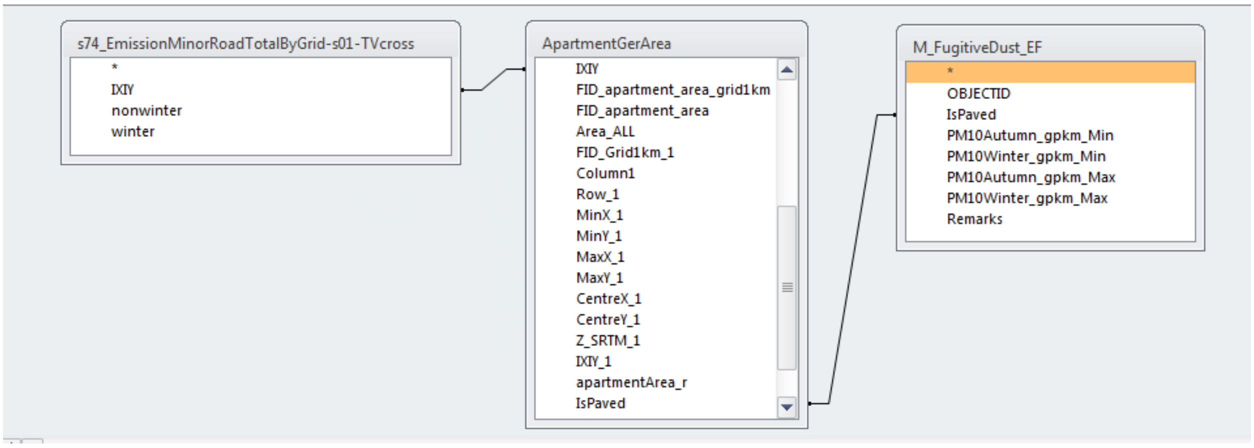
Show “t73_EmissionMinorRoadByGridBySeason” table on this query and set the output item as follows. In this query, cross tabulation of the emission by grid by season is conducted.



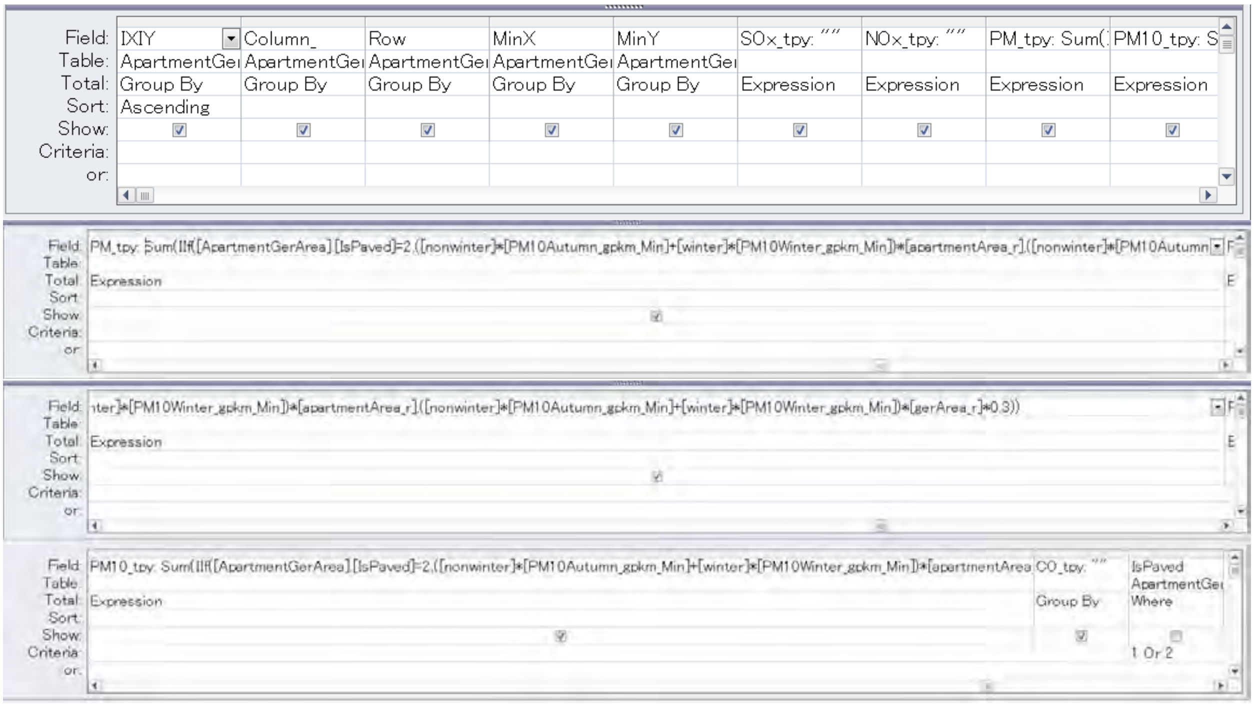
Right-click the “s75_EmissionMinorRoadByGrid_FD_Paved” query and click [Design View].



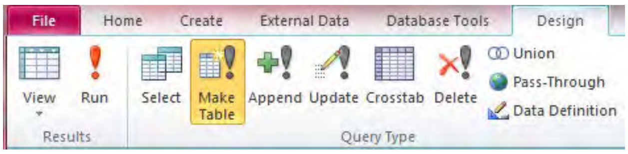
Join “ApartmentGerArea” table, “s74_EmissionMinorRoadByGrid-s01-TVcross” query on [IXIY] column and join “ApartmentGerArea” table, “M_FugitiveDust_EF” query on [IsPaved].



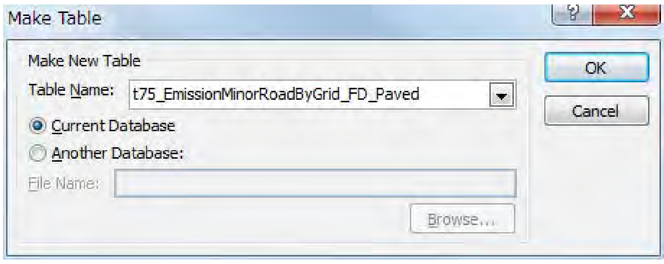
Set the output item as follows. Calculate the emission by multiplying the traffic volume by season by grid by emission factor per traffic volume and by the area ratio of apartment area or ger area by grid.



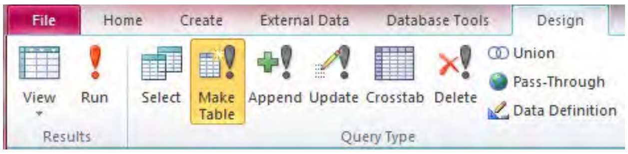
Click [Make Table] in [Design]



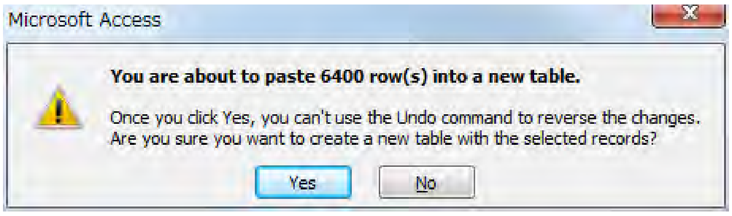
Set the table name (Here it is “t75_EmissionMinorRoadByGridForSimulation_FD_Paved”).



Click [Design]- [Run].



Click [Yes].



Create the input data table of fugitive road dust in minor road (paved road) for simulation.

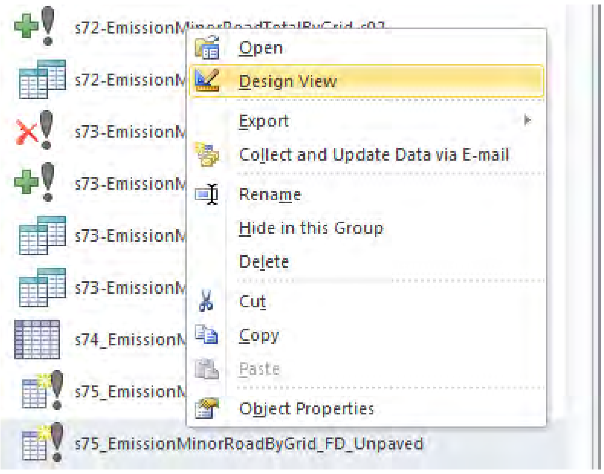
t75_EmissionMinorRoadByGrid_FD_Paved

IXIY	Column_	Row	MinX	MinY	SOx_tpy	NOx_tpy	PM_tpy	PM10_tpy	CO_tpy
230018	23	18	633000	5298000			0	0	
230019	23	19	633000	5299000			0	0	
230020	23	20	633000	5300000			6.07252E-05	6.07252E-05	
230021	23	21	633000	5301000			0.023006337	0.023006337	
230022	23	22	633000	5302000			0.015364939	0.015364939	
230023	23	23	633000	5303000			0.022025292	0.022025292	
230024	23	24	633000	5304000			0.008413580	0.008413580	
230025	23	25	633000	5305000			0.033075443	0.033075443	
230026	23	26	633000	5306000			0	0	
230027	23	27	633000	5307000			0.008777032	0.008777032	
230028	23	28	633000	5308000			0.014722454	0.014722454	
230029	23	29	633000	5309000			0.016201156	0.016201156	
230030	23	30	633000	5310000			0.100132815	0.100132815	
230031	23	31	633000	5311000			0.223428697	0.223428697	
230032	23	32	633000	5312000			0.056197601	0.056197601	
230033	23	33	633000	5313000			0.019578247	0.019578247	
230034	23	34	633000	5314000			0	0	
230035	23	35	633000	5315000			1.18567E-05	1.18567E-05	
230036	23	36	633000	5316000			2.92555E-05	2.92555E-05	
230037	23	37	633000	5317000			6.50662E-05	6.50662E-05	
230038	23	38	633000	5318000			0.00035344	0.00035344	
230039	23	39	633000	5319000			0.002860292	0.002860292	
230040	23	40	633000	5320000			0.00208683	0.00208683	
230041	23	41	633000	5321000			0.001900787	0.001900787	
230042	23	42	633000	5322000			0.000408433	0.000408433	
230043	23	43	633000	5323000			0	0	
230044	23	44	633000	5324000			0	0	
230045	23	45	633000	5325000			0	0	

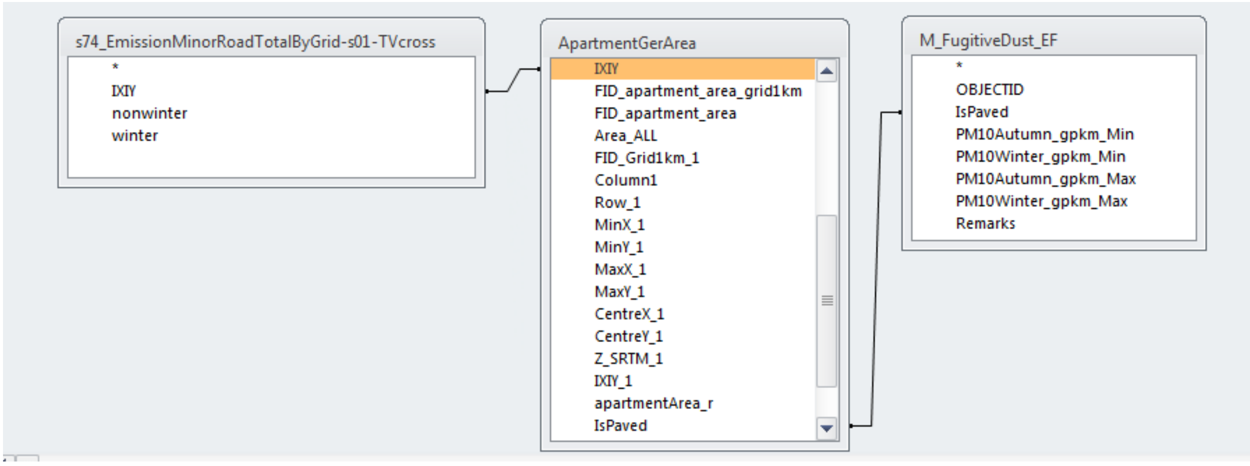
Record: 1859 of 6400 No Filter Search

6.1.3.14 Calculation of Fugitive Dust Amount by Vehicle Travelling in Minor Road (Unpaved Road)

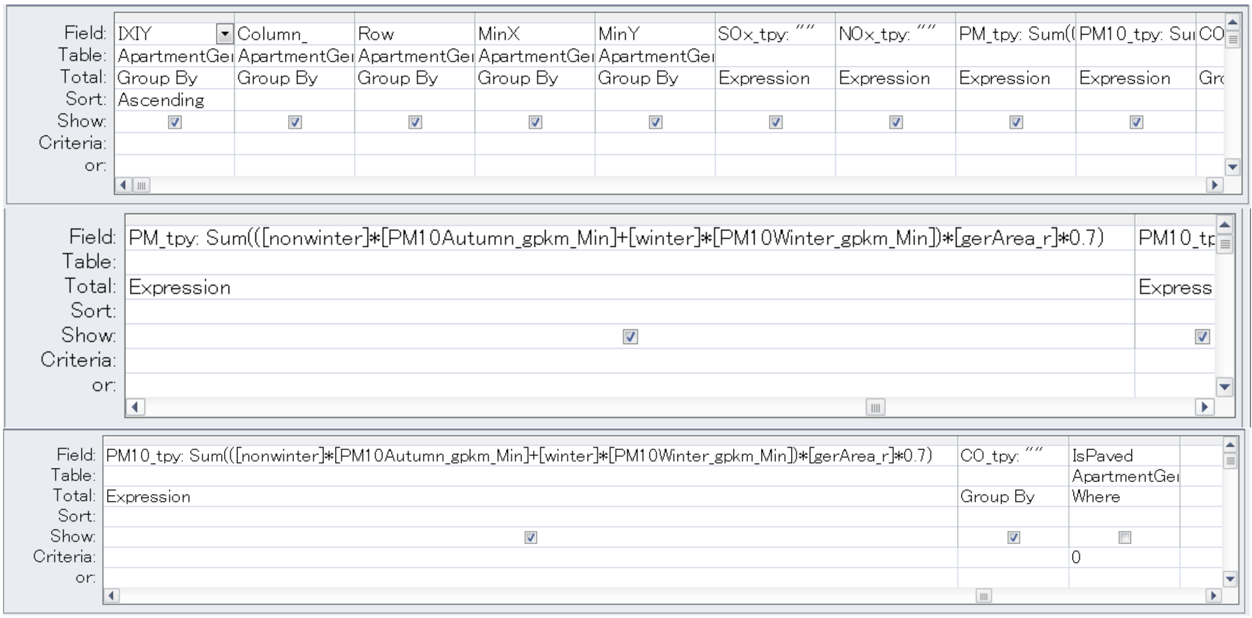
Right-click the "s75_EmissionMinorRoadByGridForSimulation_FD_Unpaved" query and click [Design View].



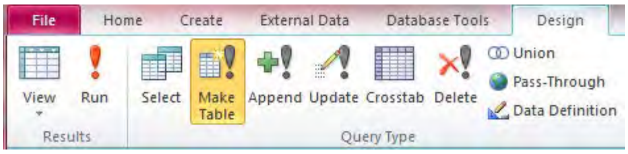
Join "ApartmentGerArea" table, "s74_EmissionMinorRoadByGrid-s01-TVcross" query on [IXIY] column and join "ApartmentGerArea" table, "M_FugitiveDust_EF" query on [IsPaved].



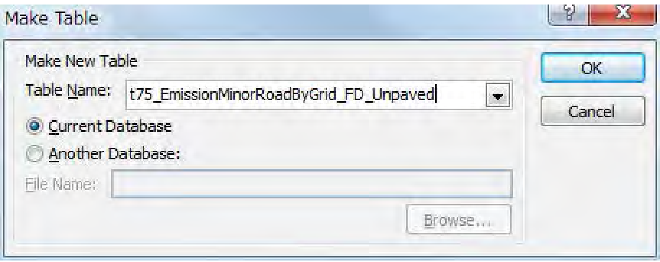
Set the output item as follows. Calculate the emission by multiplying the traffic volume by season by grid by emission factor per traffic volume and by the area ratio of apartment area or ger area by grid.



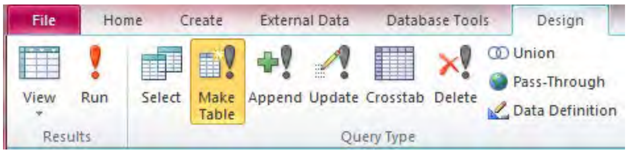
Click [Make Table] in [Design]



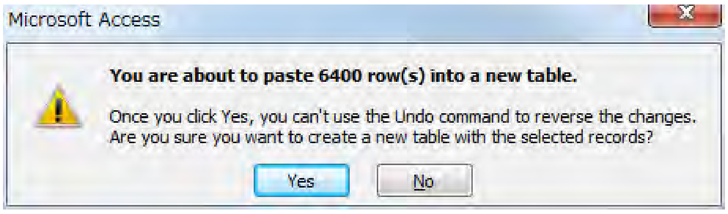
Set the table name (Here it is “t75_EmissionMinorRoadByGridForSimulation_FD_Unpaved”).



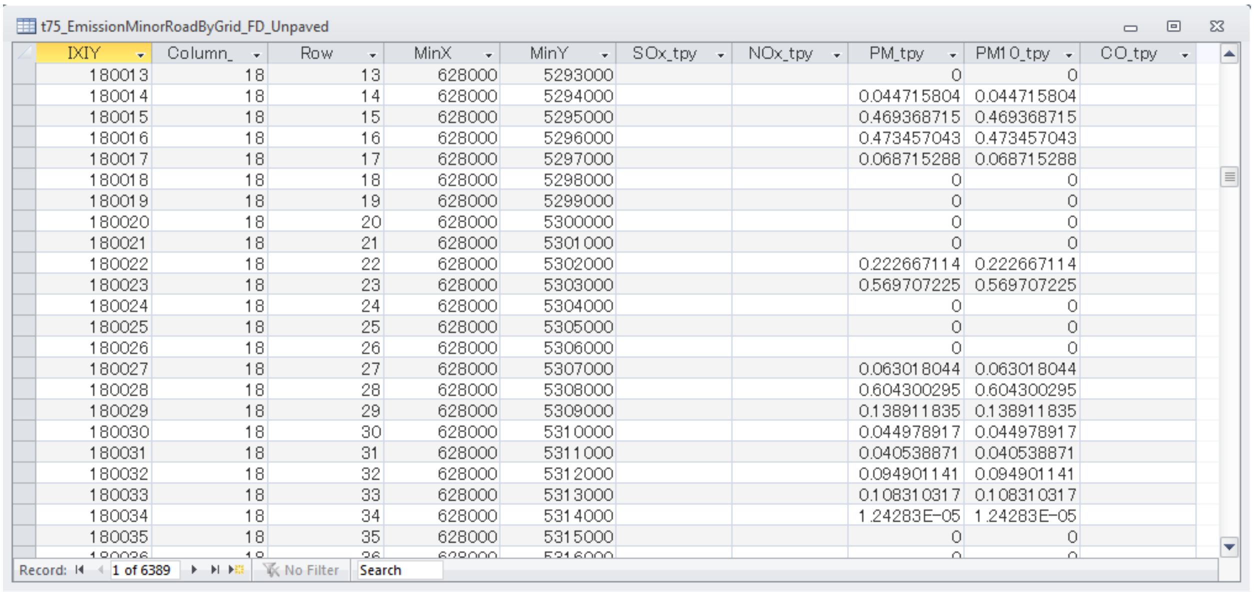
Click [Design]- [Run].



Click [Yes].



Create the input data table of fugitive road dust in minor road (unpaved road) for simulation.



t75_EmissionMinorRoadByGrid_FD_Unpaved

IXIY	Column_	Row	MinX	MinY	SOx_tpy	NOx_tpy	PM_tpy	PM10_tpy	CO_tpy
180013	18	13	628000	5293000			0	0	
180014	18	14	628000	5294000			0.044715804	0.044715804	
180015	18	15	628000	5295000			0.469368715	0.469368715	
180016	18	16	628000	5296000			0.473457043	0.473457043	
180017	18	17	628000	5297000			0.068715288	0.068715288	
180018	18	18	628000	5298000			0	0	
180019	18	19	628000	5299000			0	0	
180020	18	20	628000	5300000			0	0	
180021	18	21	628000	5301000			0	0	
180022	18	22	628000	5302000			0.222667114	0.222667114	
180023	18	23	628000	5303000			0.569707225	0.569707225	
180024	18	24	628000	5304000			0	0	
180025	18	25	628000	5305000			0	0	
180026	18	26	628000	5306000			0	0	
180027	18	27	628000	5307000			0.063018044	0.063018044	
180028	18	28	628000	5308000			0.604300295	0.604300295	
180029	18	29	628000	5309000			0.138911835	0.138911835	
180030	18	30	628000	5310000			0.044978917	0.044978917	
180031	18	31	628000	5311000			0.040538871	0.040538871	
180032	18	32	628000	5312000			0.094901141	0.094901141	
180033	18	33	628000	5313000			0.108310317	0.108310317	
180034	18	34	628000	5314000			1.24283E-05	1.24283E-05	
180035	18	35	628000	5315000			0	0	

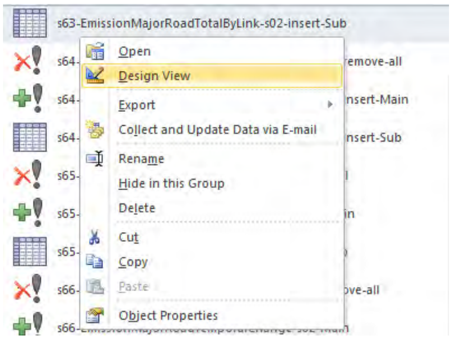
Record: 1 of 6389 No Filter Search

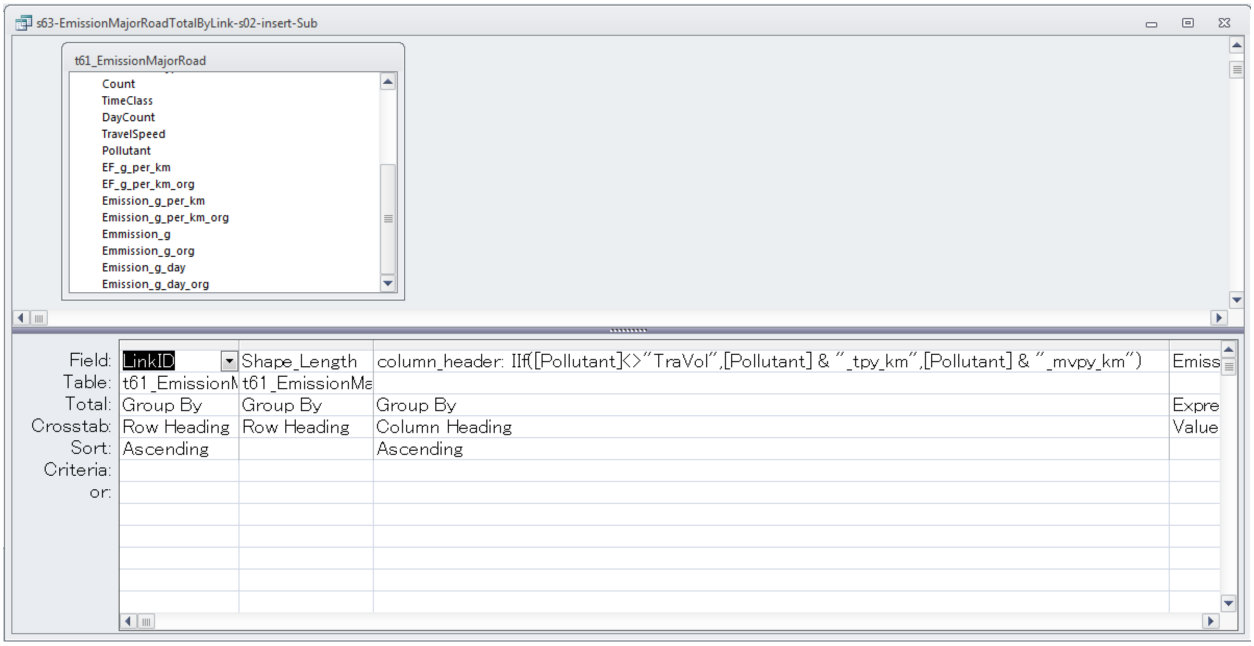
6.2 Conversion Method of Mobile Source Inventory to the Input Data for Dispersion Simulation

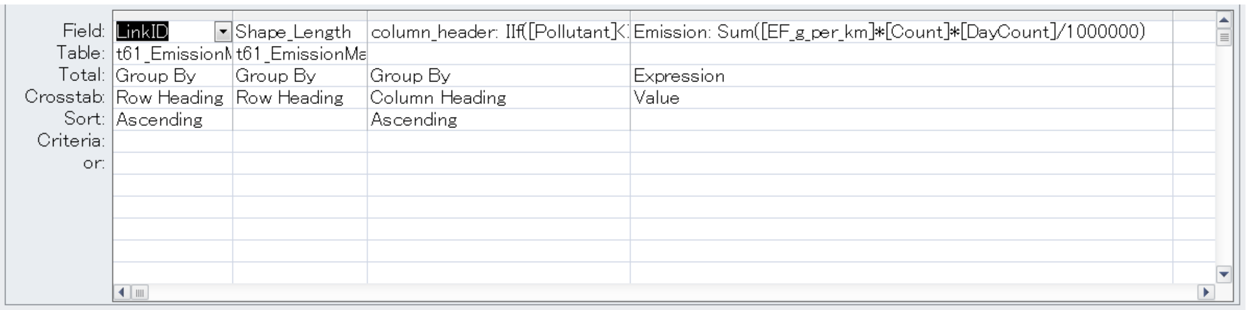
Open "EmissionFromTransport Inv01 2015.mdb".

1 Developing the Input Data for Dispersion Simulation of Vehicle Exhaust Gas from Major Road

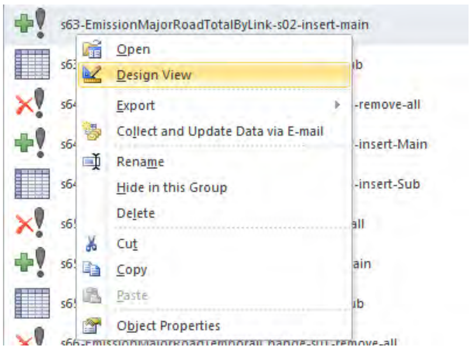
Right-click "s63-EmissionMajorRoadTotalByLink-s02-insert-Sub" query and click [Design View]. Cross tabulation of the emission by link by pollutant is conducted in this query.

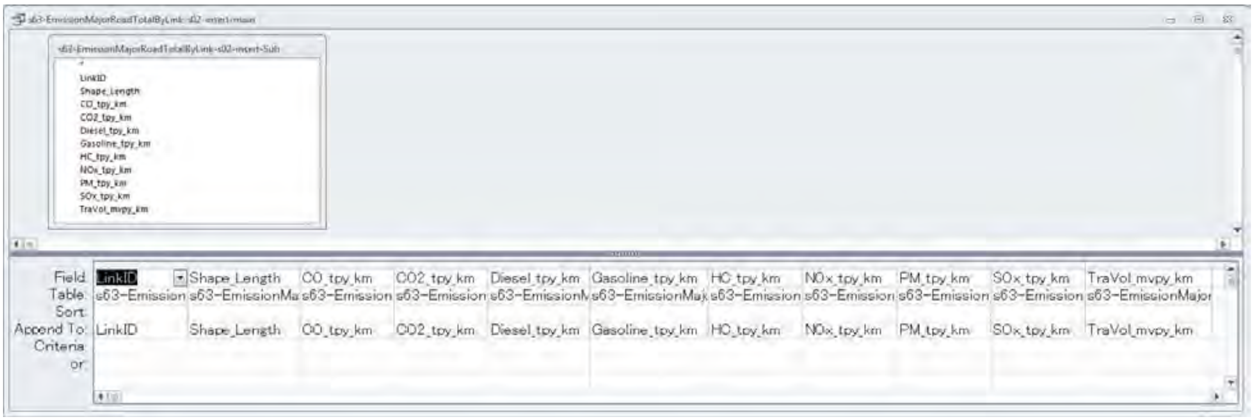




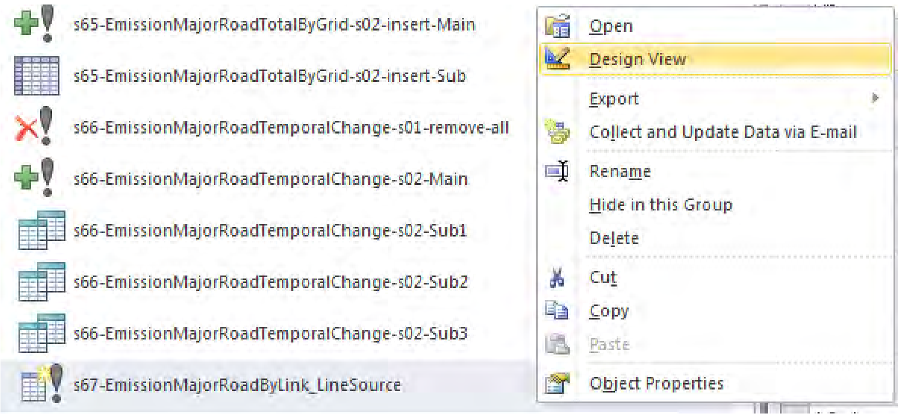


Right-click “s63-EmissionMajorRoadTotalByLink-s02-insert-Main” query and click [Design View]. Add table to the result of cross tabulation in “s63-EmissionMajorRoadTotalByLink-s02-insert-Sub” query.

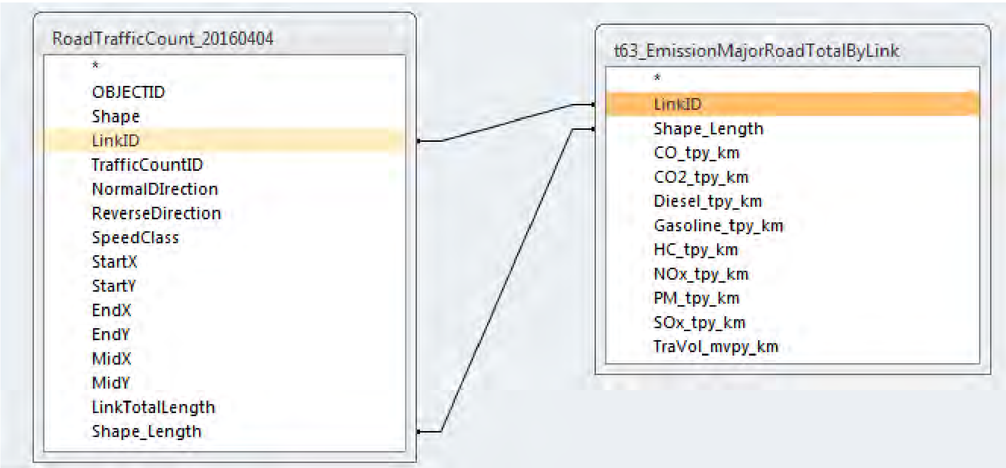




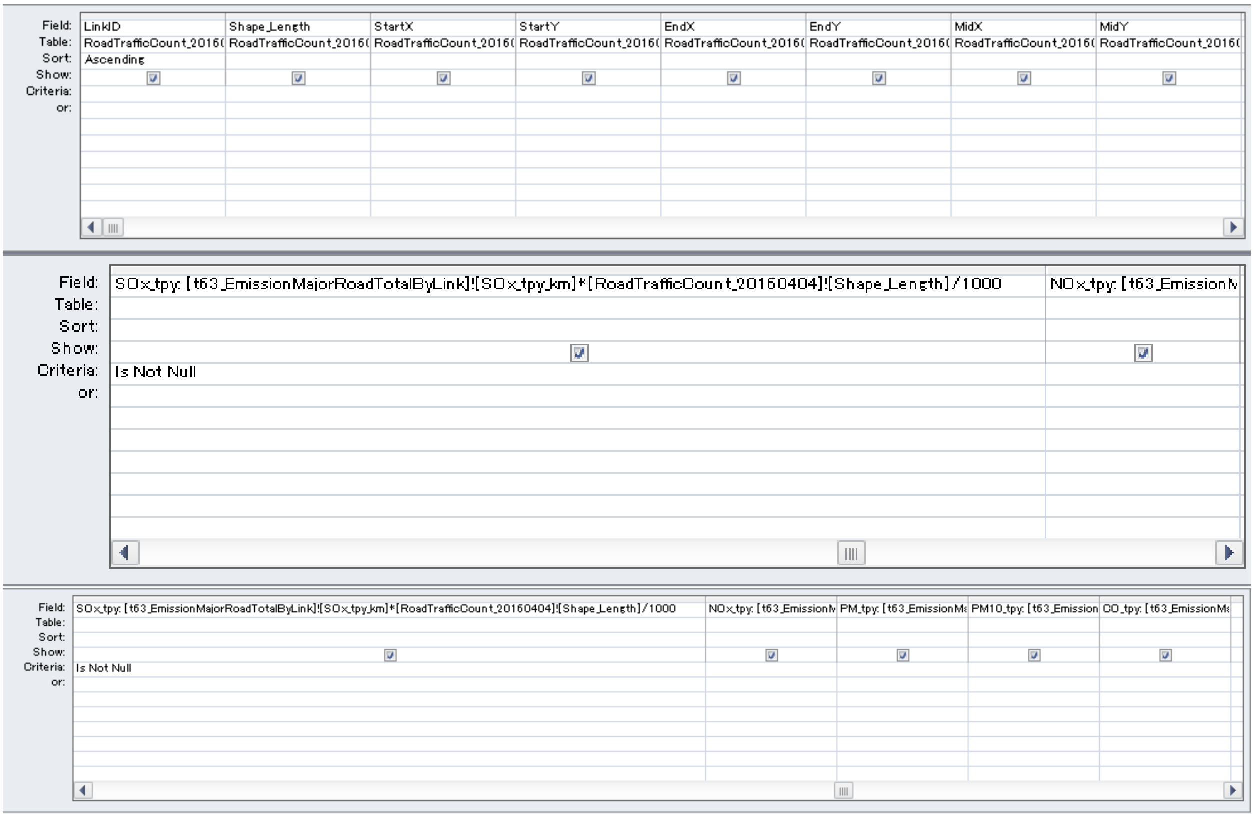
Right-click "s67-EmissionMajorRoadByLink_LineSource" query and click [Design View].



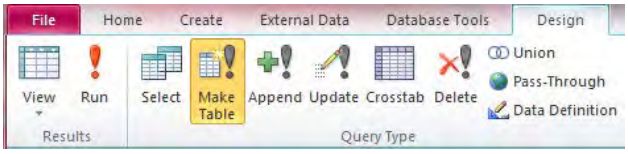
Join "RoadTrafficCount_20160404" table, "t63_EmissionMajorRoadTotalByLink" table on [LinkID] and [Shape_Length] column.



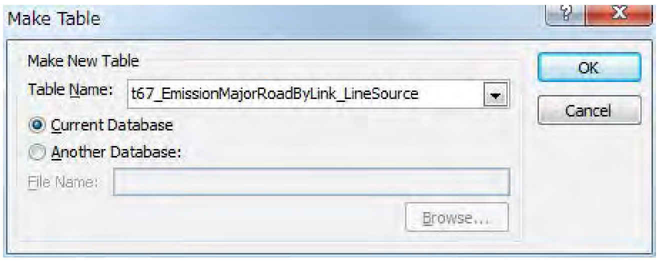
Set the output item as follows. Calculate the emission by multiplying the emission per vehicle x 1km by traffic count and length of link.



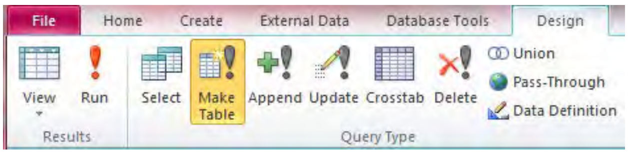
Click [Design]-[Create Table]



Set the table name (Here it is “t67_EmissionMajorRoadByLink_LineSource”).

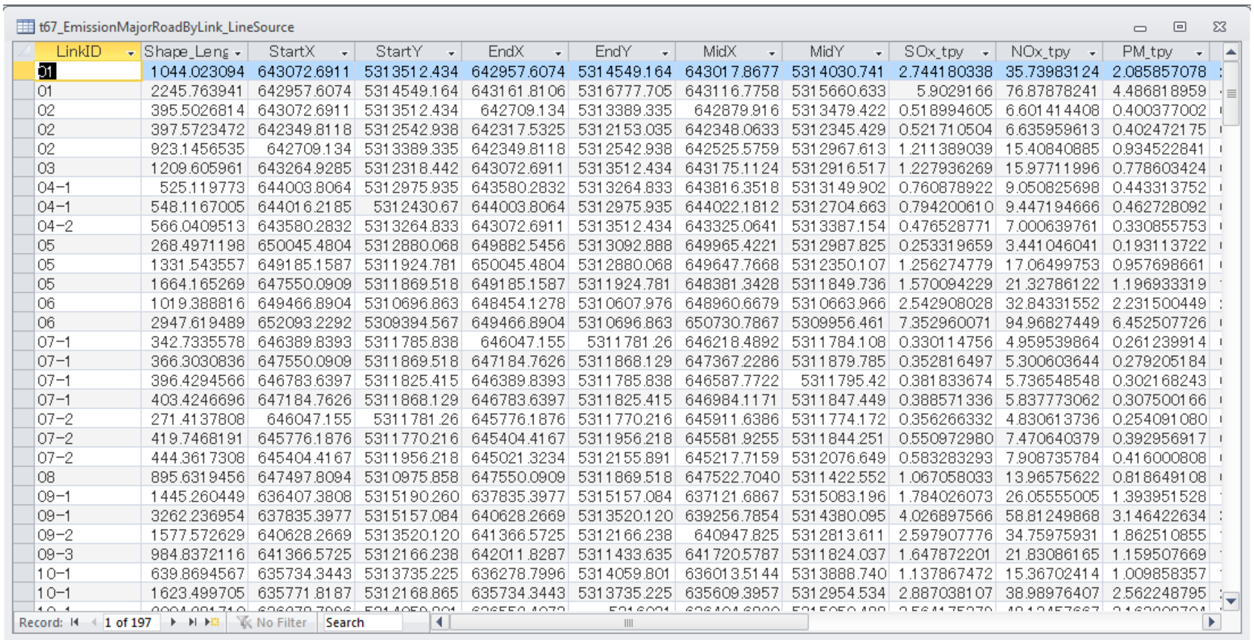


Click [Design]-[Run]



Click [Yes].

Create the input data table of major road for simulation.



t67_EmissionMajorRoadByLink_LineSource

LinkID	Shape_Leng	StartX	StartY	EndX	EndY	MidX	MidY	SOx_tpy	NOx_tpy	PM_tpy
01	1044.023094	643072.6911	5313512.434	642957.6074	5314549.164	643017.8677	5314030.741	2.744180338	35.73983124	2.085857078
01	2245.763941	642957.6074	5314549.164	643161.8106	5316777.705	643116.7758	5315660.633	5.902916 6	76.87878241	4.486818959
02	395.5026814	643072.6911	5313512.434	642709.134	5313389.335	642879.916	5313479.422	0.518994605	6.601414408	0.400377002
02	397.5723472	642349.8118	5312542.938	642317.5325	5312153.035	642348.0633	5312345.429	0.521710504	6.635959613	0.40247217 5
02	923.1456535	642709.134	5313389.335	642349.8118	5312542.938	642525.5759	5312967.613	1.211389039	15.40840885	0.934522841
03	1209.605961	643264.9285	5312318.442	643072.6911	5313512.434	643175.1124	5312916.517	1.227936269	15.97711996	0.778603424
04-1	525.119773	644003.8064	5312975.935	643580.2832	5313264.833	643816.3518	5313149.902	0.760878922	9.050825698	0.443313752
04-1	548.1167005	644016.2185	5312430.67	644003.8064	5312975.935	644022.1812	5312704.663	0.794200610	9.447194666	0.462728092
04-2	566.0409513	643580.2832	5313264.833	643072.6911	5313512.434	643325.0641	5313387.154	0.476528771	7.000639761	0.330855753
05	268.4971198	650045.4804	5312880.068	649882.5456	5313092.888	649965.4221	5312987.825	0.253319659	3.441046041	0.193113722
05	1331.543557	649185.1587	5311924.781	650045.4804	5312880.068	649647.7668	5312350.107	1.256274779	17.06499753	0.957698661
05	1664.165269	647550.0909	5311869.518	649185.1587	5311924.781	648381.3428	5311849.736	1.570094229	21.32786122	1.196933319
06	1019.388816	649466.8904	5310696.863	648454.1278	5310607.976	648960.6679	5310663.966	2.542908028	32.84331552	2.231500449
06	2947.619489	652093.2292	5309394.567	649466.8904	5310696.863	650730.7867	5309956.461	7.352960071	94.96827449	6.452507726
07-1	342.7335578	646389.8393	5311785.838	646047.155	5311781.26	646218.4892	5311784.108	0.330114756	4.959539864	0.261239914
07-1	366.3030836	647550.0909	5311869.518	647184.7626	5311868.129	647367.2286	5311879.785	0.352816497	5.300603644	0.27920518 4
07-1	396.4294566	646783.6397	5311825.415	646389.8393	5311785.838	646587.7722	5311795.42	0.381833674	5.736548548	0.302168243
07-1	403.4246696	647184.7626	5311868.129	646783.6397	5311825.415	646984.1171	5311847.449	0.388571336	5.837773062	0.307500166
07-2	271.4137808	646047.155	5311781.26	645776.1876	5311770.216	645911.6386	5311774.172	0.356266332	4.830613736	0.254091080
07-2	419.7468191	645776.1876	5311770.216	645404.4167	5311956.218	645581.9255	5311844.251	0.550972980	7.470640379	0.392956917
07-2	444.3617308	645404.4167	5311956.218	645021.3234	5312155.891	645217.7159	5312076.649	0.583283293	7.908735784	0.416000808
08	895.6319456	647497.8094	5310975.858	647550.0909	5311869.518	647522.7040	5311422.552	1.067058033	13.96575622	0.81864910 8
09-1	1445.260449	636407.3808	5315190.260	637835.3977	5315157.084	637121.6867	5315083.196	1.784026073	26.05555005	1.393951528
09-1	3262.236954	637835.3977	5315157.084	640628.2669	5313520.120	639256.7854	5314380.095	4.026897566	58.81249868	3.146422634
09-2	1577.572629	640628.2669	5313520.120	641366.5725	5312166.238	640947.825	5312813.611	2.597907776	34.75975931	1.862510855
09-3	984.8372116	641366.5725	5312166.238	642011.8287	5311433.635	641720.5787	5311824.037	1.647872201	21.83086165	1.159507669
10-1	639.8694567	635734.3443	5313735.225	636278.7996	5314059.801	636013.5144	5313888.740	1.137867472	15.36702414	1.009858357
10-1	1623.499705	635771.8187	5312168.865	635734.3443	5313735.225	635609.3957	5312954.534	2.887038107	38.98976407	2.562248795

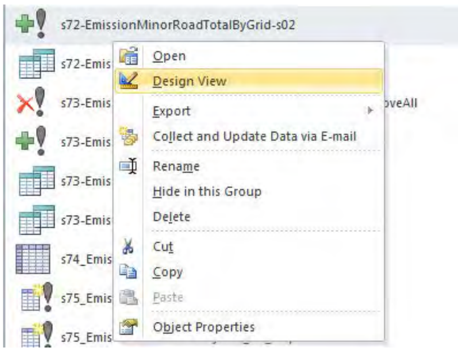
Record: 1 of 197 No Filter Search

2 Developing the Input Data for Dispersion Simulation of Fugitive Dust from Major Road

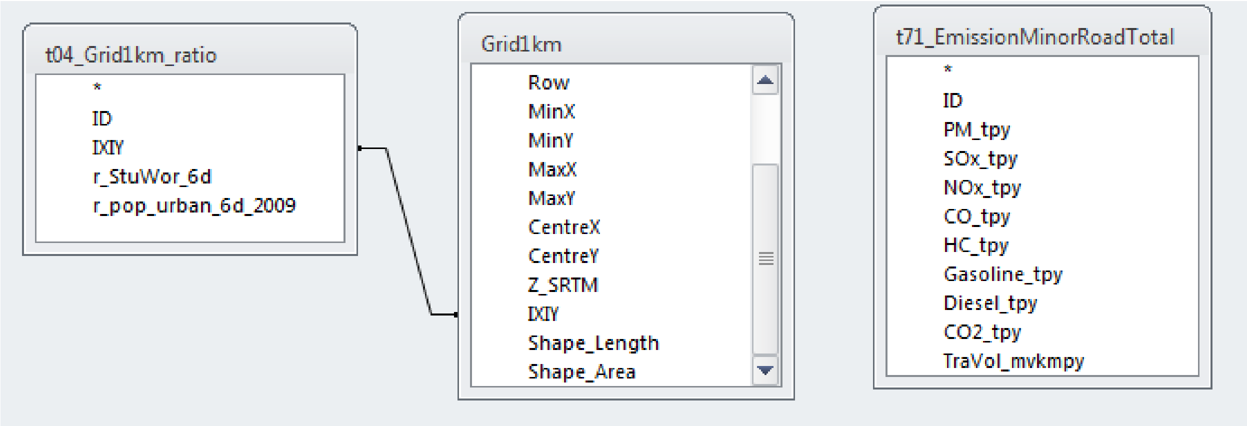
See "6.1.3.12 Calculation of Fugitive Dust Amount by Vehicle Travelling in Major Road".

3 Developing the Input Data for Dispersion Simulation of Vehicle Exhaust Gas from Minor Road

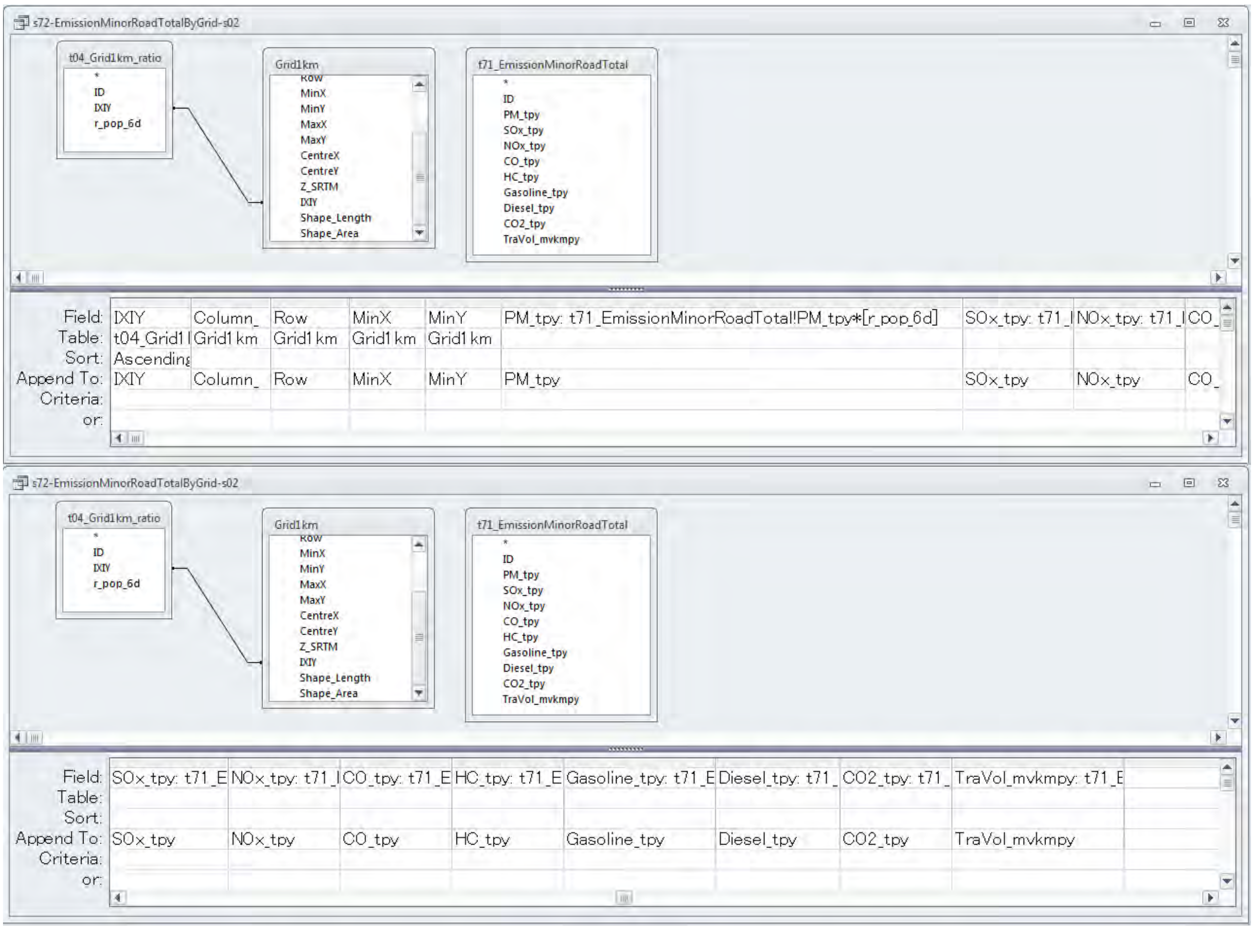
Right-click "s72-EmissionMinorRoadByGrid-s02" query and click [Design View].



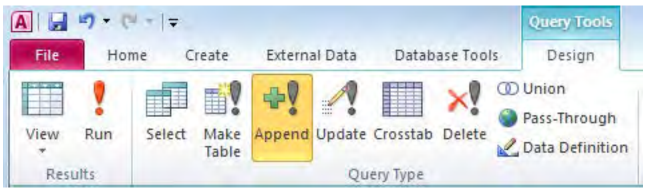
Add these tables such as "Grid1km", "t04_Grid1km_ratio", and "t71_EmissionMinorRoadTotal", and join "Grid1km" table, "t04_Grid1km_ratio" table on [IXIY] column.



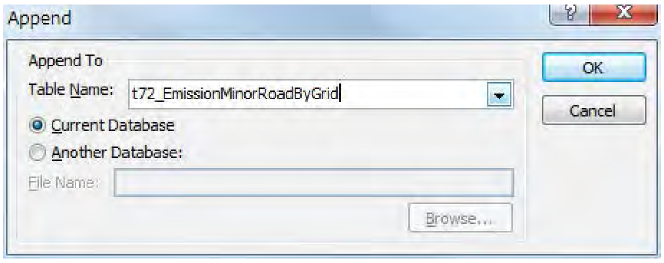
Set the output item as follows.



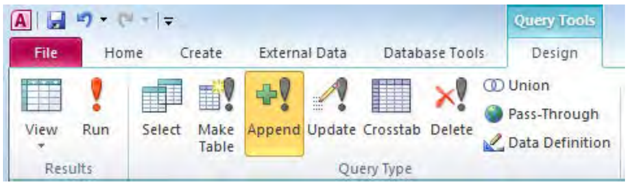
Click [Design]-[Append].



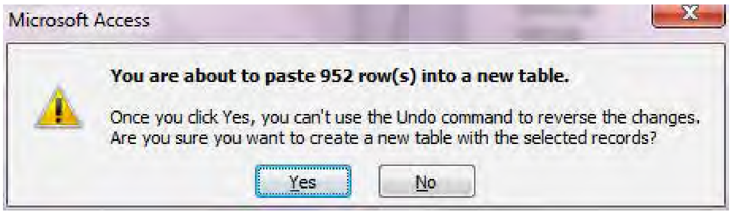
Set the table name (Here it is “t72_EmissionMinorRoadByGrid”).



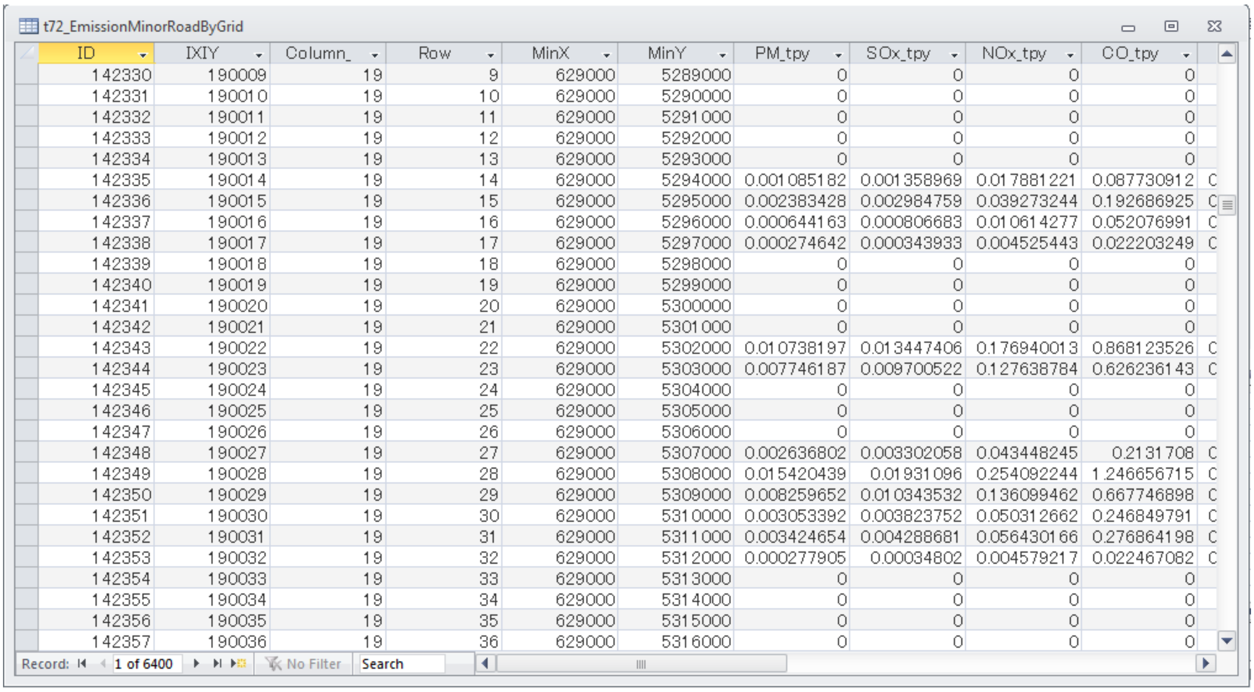
Click [Design]-[Run]



Click [Yes].



Create the input data table of minor road for simulation.



t72_EmissionMinorRoadByGrid

ID	IXIY	Column_	Row	MinX	MinY	PM_tpy	SOx_tpy	NOx_tpy	CO_tpy
142330	190009	19	9	629000	5289000	0	0	0	0
142331	190010	19	10	629000	5290000	0	0	0	0
142332	190011	19	11	629000	5291000	0	0	0	0
142333	190012	19	12	629000	5292000	0	0	0	0
142334	190013	19	13	629000	5293000	0	0	0	0
142335	190014	19	14	629000	5294000	0.00108518 2	0.001358969	0.017881221	0.087730912
142336	190015	19	15	629000	5295000	0.002383428	0.002984759	0.039273244	0.192686925
142337	190016	19	16	629000	5296000	0.000644163	0.000806683	0.010614277	0.052076991
142338	190017	19	17	629000	5297000	0.000274642	0.000343933	0.004525443	0.022203249
142339	190018	19	18	629000	5298000	0	0	0	0
142340	190019	19	19	629000	5299000	0	0	0	0
142341	190020	19	20	629000	5300000	0	0	0	0
142342	190021	19	21	629000	5301000	0	0	0	0
142343	190022	19	22	629000	5302000	0.010738197	0.013447406	0.176940013	0.868123526
142344	190023	19	23	629000	5303000	0.007746187	0.009700522	0.127638784	0.626236143
142345	190024	19	24	629000	5304000	0	0	0	0
142346	190025	19	25	629000	5305000	0	0	0	0
142347	190026	19	26	629000	5306000	0	0	0	0
142348	190027	19	27	629000	5307000	0.002636802	0.003302058	0.043448245	0.2131708
142349	190028	19	28	629000	5308000	0.015420439	0.01931096	0.254092244	1.246656715
142350	190029	19	29	629000	5309000	0.008259652	0.010343532	0.136099462	0.667746898
142351	190030	19	30	629000	5310000	0.003053392	0.003823752	0.050312662	0.246849791
142352	190031	19	31	629000	5311000	0.003424654	0.004288681	0.05643016 6	0.276864198
142353	190032	19	32	629000	5312000	0.000277905	0.00034802	0.004579217	0.022467082
142354	190033	19	33	629000	5313000	0	0	0	0
142355	190034	19	34	629000	5314000	0	0	0	0
142356	190035	19	35	629000	5315000	0	0	0	0
142357	190036	19	36	629000	5316000	0	0	0	0

Record: 1 of 6400 No Filter Search

4 Developing the Input Data for Dispersion Simulation of Fugitive Dust from Minor Road (Paved Road)

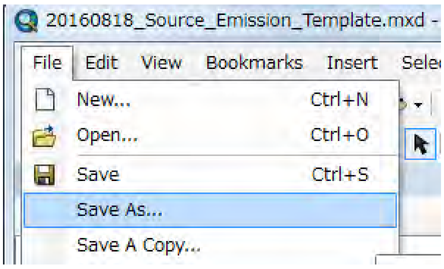
See "6.1.3.13 Calculation of Fugitive Dust Amount by Vehicle Travelling in Minor Road (Paved Road)".

5 Developing the Input Data for Dispersion Simulation of Fugitive Dust from Minor Road (Unpaved Road)

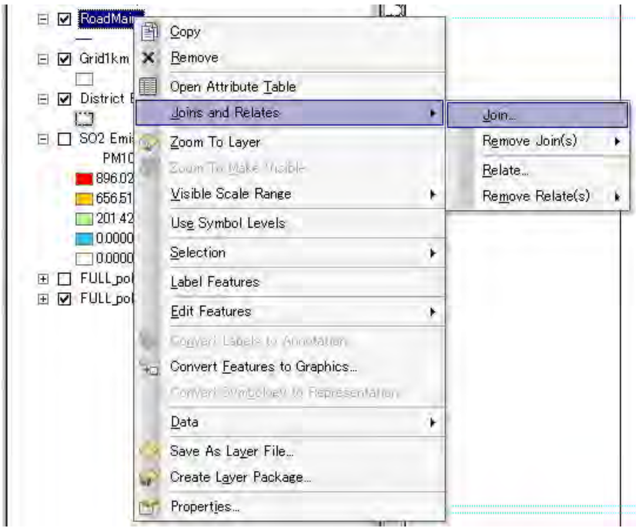
See "6.1.3.14 Calculation of Fugitive Dust Amount by Vehicle Travelling in Minor Road (Unpaved Road)".

6.3 Drawing Emission Distribution Map

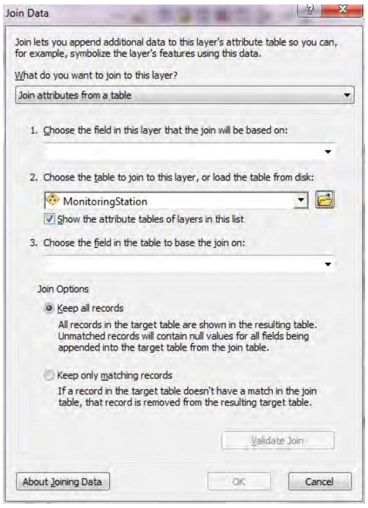
Open template file, click [File]-[Save As], and saved as other name.



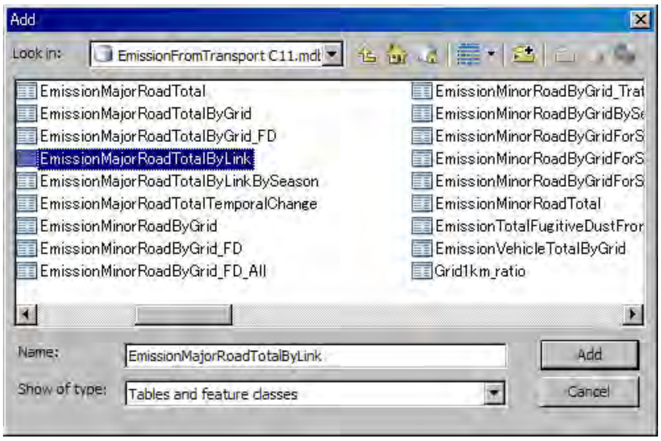
Join the table of emission by grid to "RoadMain" layer. Right-click "RoadMain" layer and select [Joins and Relates]-[Join].



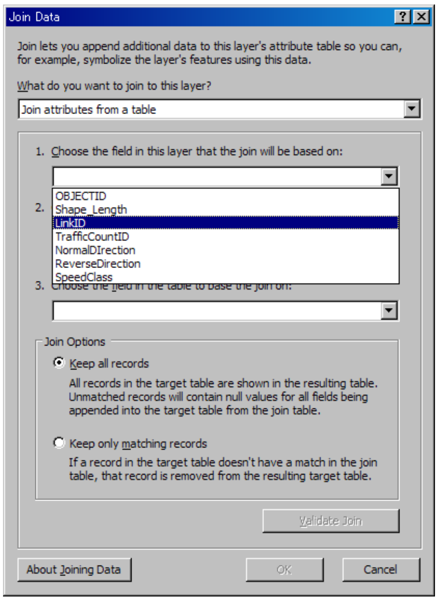
When showing the following dialog, click  button.



Select the table of emission by grid to join and click [Add] (Here it is “EmissionMajorRoadByLink” table).

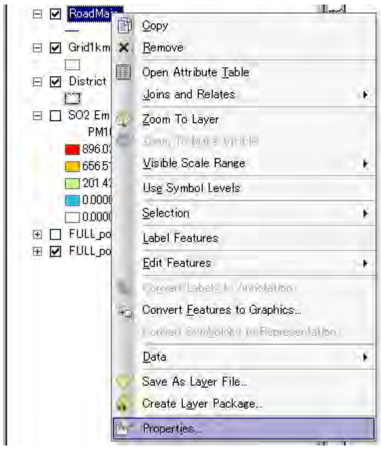


Show the selected table in the dropdown textbox of “2.”. When clicking the dropdown button of “1.” and selecting “LinkID”, show “LinkID” in “3.” automatically. After then, click [OK].

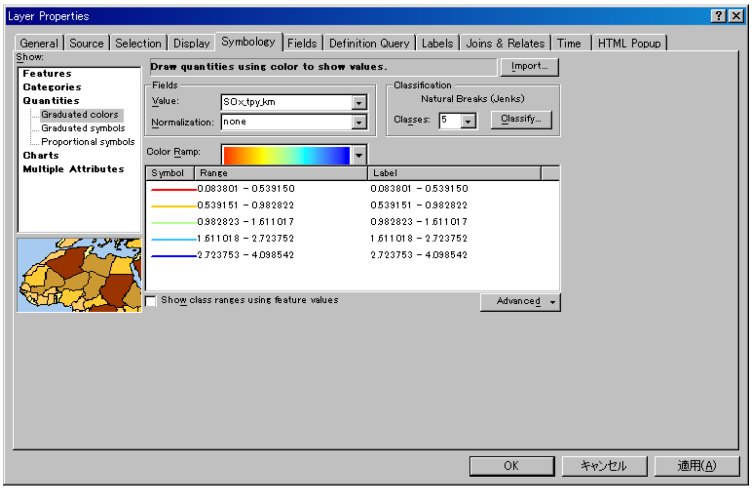


If the following dialog may be shown, click [No].

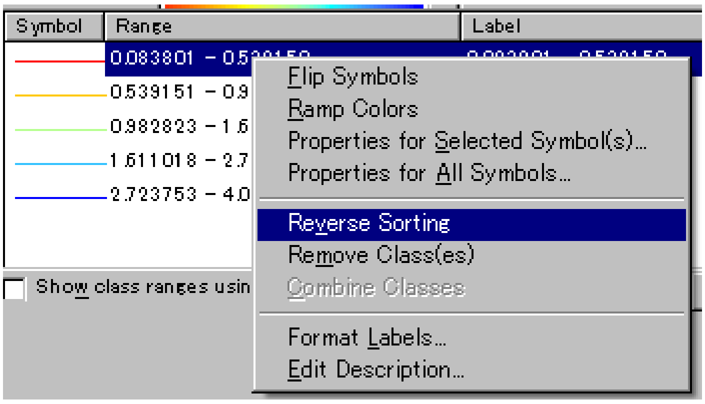
Right-click “RoadMain” layer and click [Properties].



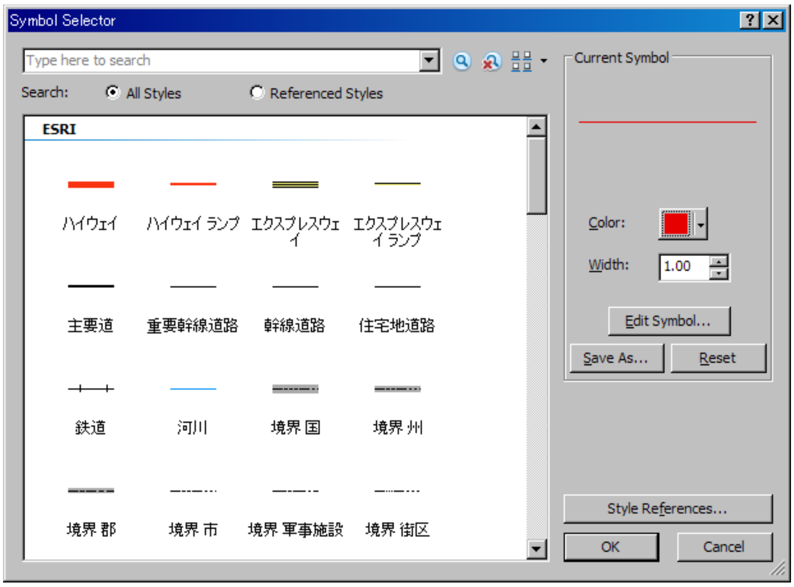
Click [Symbology] tab and select [Quantities]-[Graduated colors]. Click and select the target column name at the drop down button of [Value] (Here it is [SOx_tpy_km].).



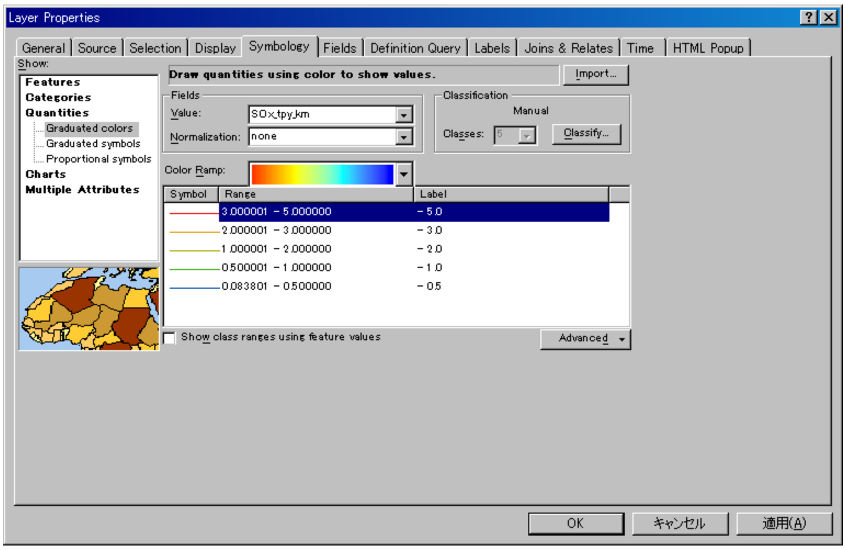
When click [Reverse Sorting] after you right-click on the [Range] column, the display order of rank changes. According to the order of symbol color, decide the display order of rank.



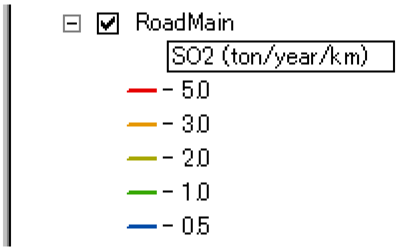
When double-clicking color in [Symbol] column, since the following dialog is shown, select color. Also, set the thickness of line in [Width].



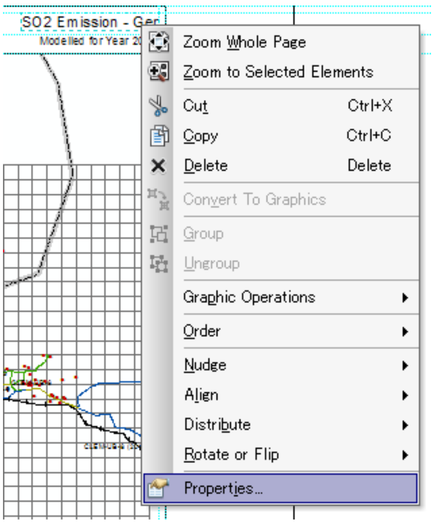
After selecting a rank, click the [Range] of the selected rank and input the maximum of the rank. However, if doing [Reverse Sorting], since the input order of rank is reversed, take care in the input order. When all setting completed, click [OK].



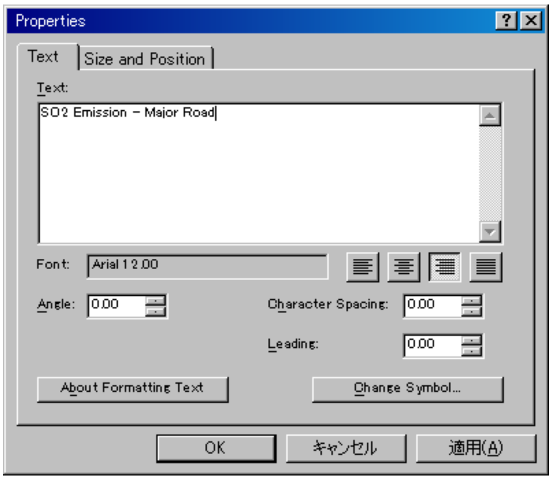
Click “SO2_tpy_km” of “RoadMain” layer and make it editable and change to “ton/year/km”.



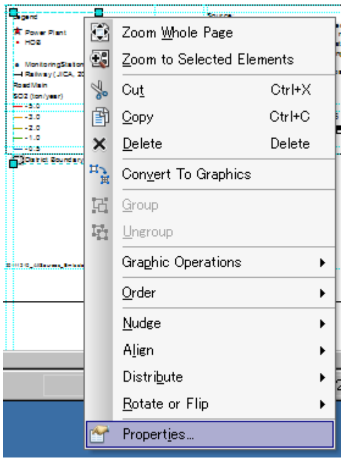
Change the title of this map. Move the cursor to the textbox of title, right-click it, and click [Properties].



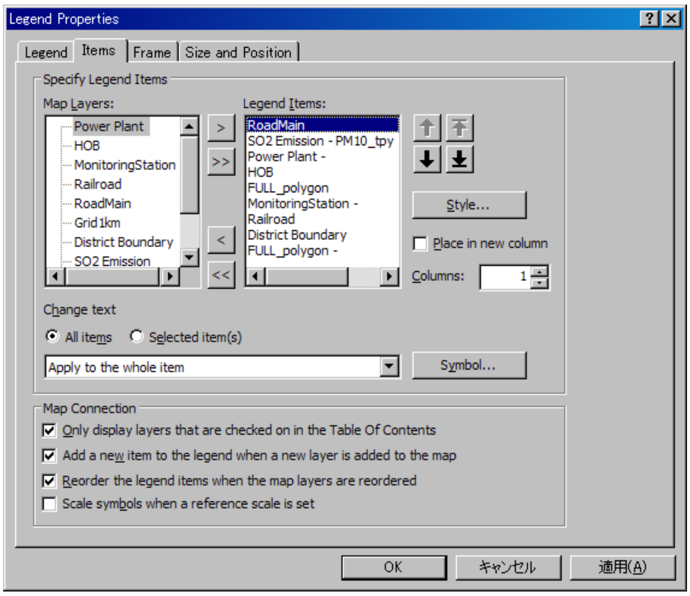
Input a title in [Text] (Here it is “SO2 Emission – Major Road”.).



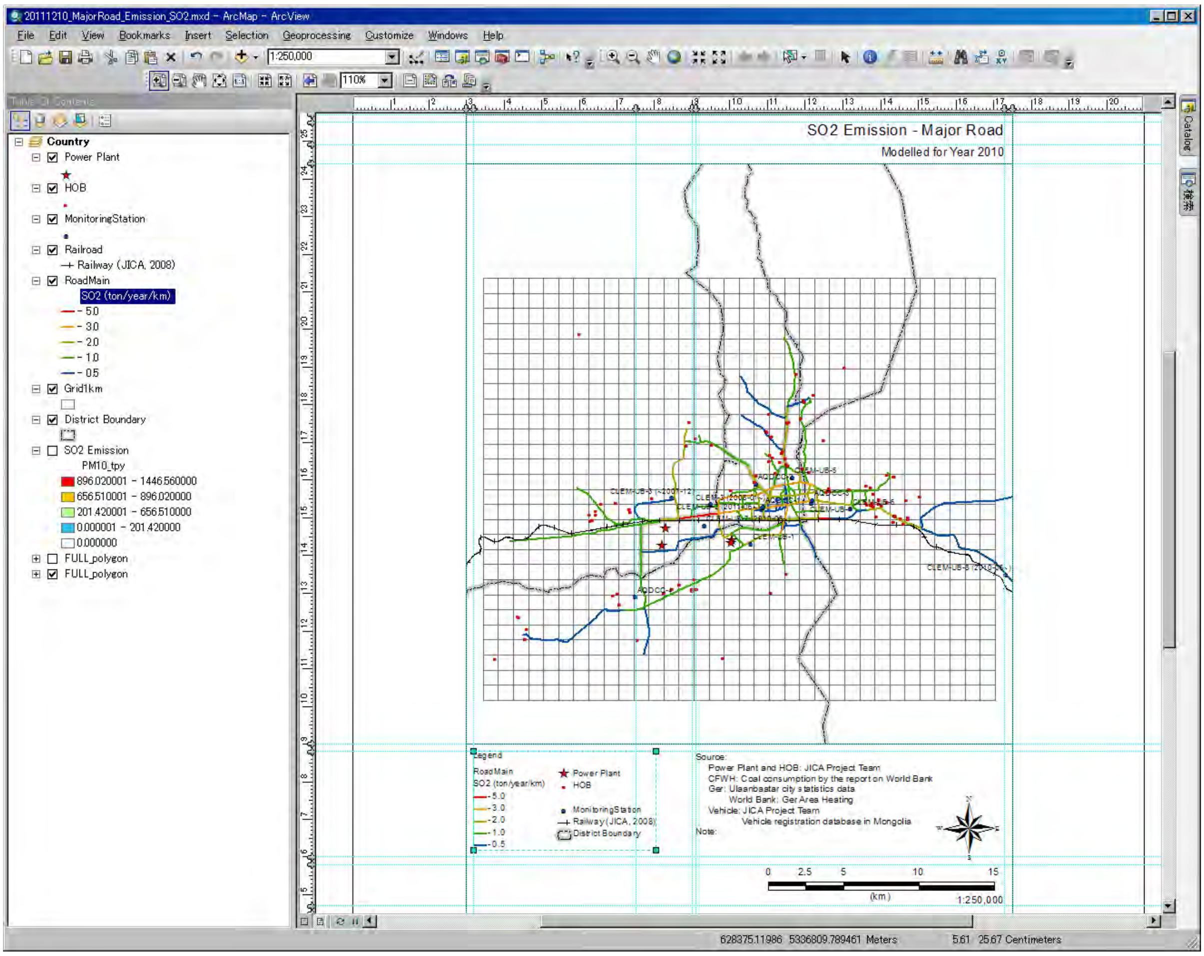
Select and right-click the legend and click [Properties].



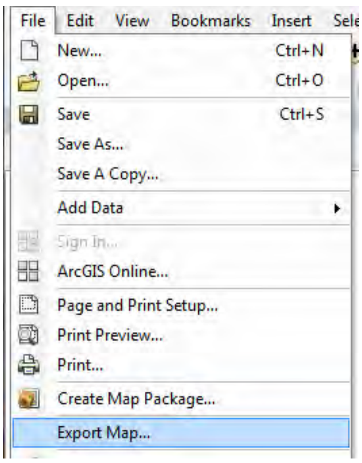
Select [RoadMain] at [Legend Items] of [Item] tab, move it to the top of [Legend Items] list by [↑] button, click [OK].



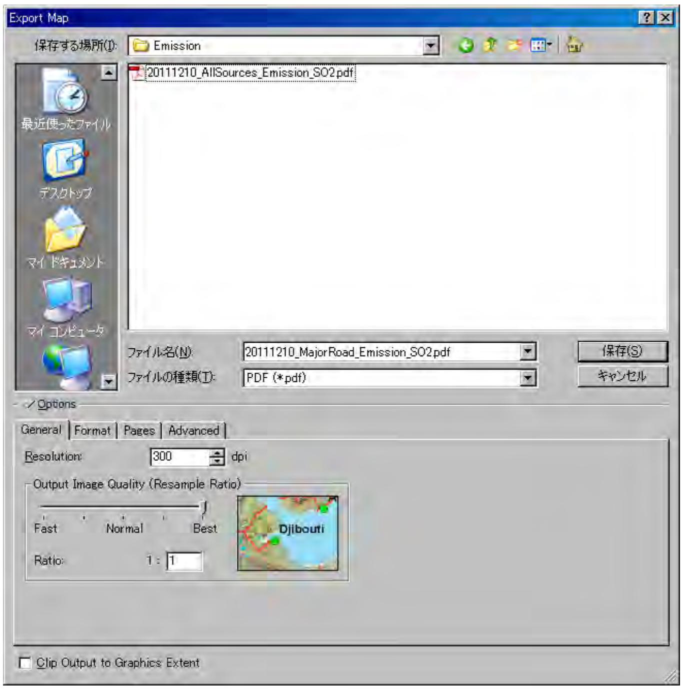
Complete drawing the map by ArcGIS.



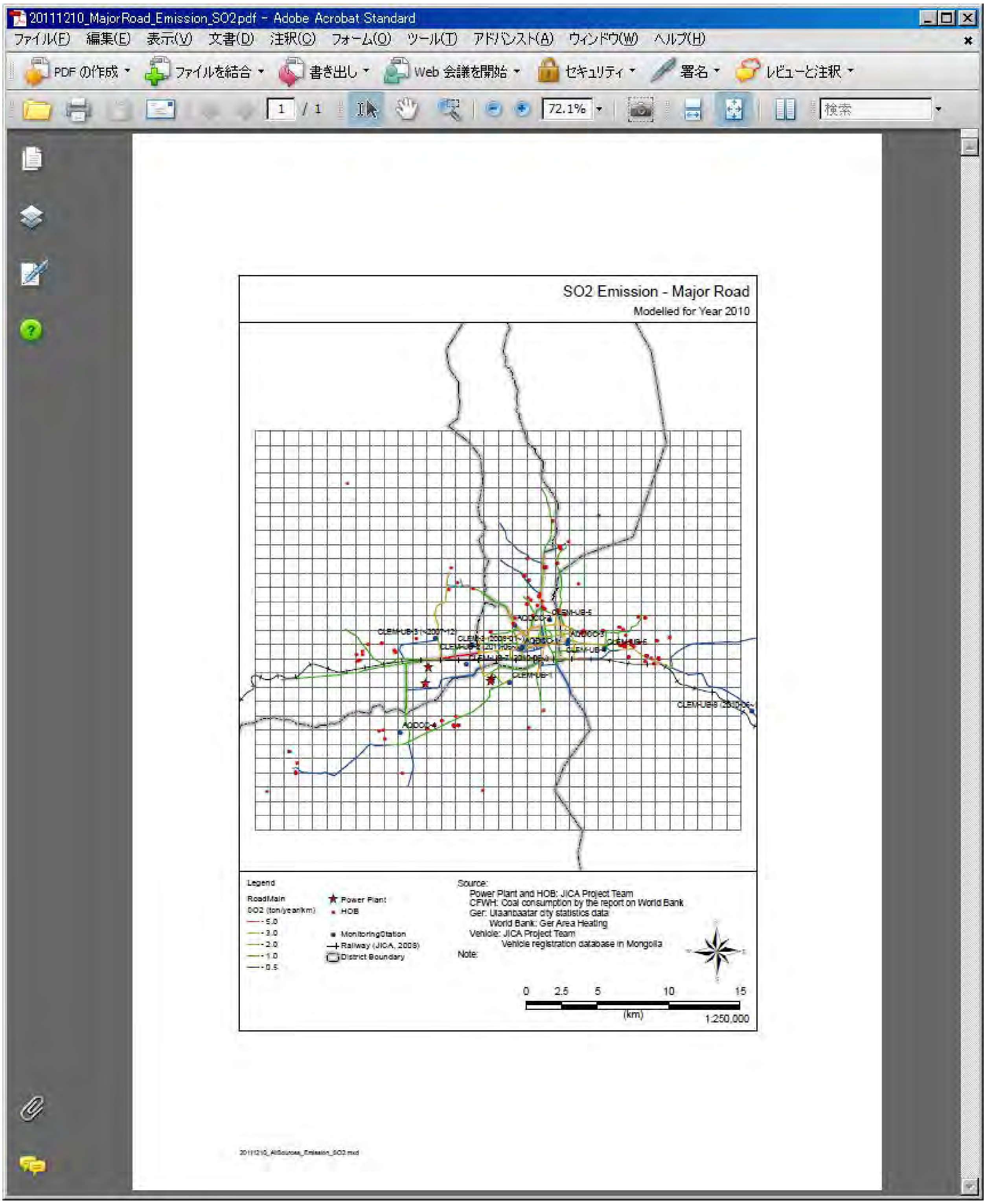
To export the distribution map to PDF file, click [File]-[Export Map].



Setting the destination and file name and click [Save].


Export Map
保存する場所(I):
Emission
20111210_AllSources_Emission_SO2.pdf
最近使ったファイル
デスクトップ
マイ ドキュメント
マイ コンピュータ
ファイル名(N):
20111210_MajorRoad_Emission_SO2.pdf
ファイルの種類(T):
PDF (*.pdf)
保存(S)
キャンセル
Options
General
Format
Pages
Advanced
Resolution:
300
dpi
Output Image Quality (Resample Ratio)
Fast
Normal
Best
Ratio:
1 :
1
Djibouti
Clip Output to Graphics Extent

Create the PDF file of distribution map.



7 Others Source Inventory (Fugitive Ash from Ash Pond of Power Plant)

7.1 Developing and Updating Method for Emission inventory

Other source targets fugitive ash from ash pond of power plant in this manual.Calculation flow diagram of the emission from fugitive ash from ash pond of power plant is shown in Figure 7-1. Emission is calculated by using the following formula. Regarding temporal change, monthly fugitive pattern by site is calculated by using monthly erosion depth by monitoring.

$$\mathrm{E}_i = \mathrm{AD}_i \times \mathrm{EF}_i$$

Ei: Emission from site i (ton/year)

ADi: Capable area of fugitve ash from site i (m2)

EFi: Emission factor of site i (g/m2)

ADi and EFi are respectively calculated by the following formula.

$$\mathrm{AD}_i = \mathrm{A}_i \times \mathrm{P}_i$$

$$\mathrm{EF}_i = \mathrm{D}_i \times \mathrm{d}$$

Ai: Area of site i (m2)

Pi: Capable ratio of fugitive ash in site i (%)

Di: Erosion depth of site i (cm)

d: Dry density of ash (=1.041 g/cm3)

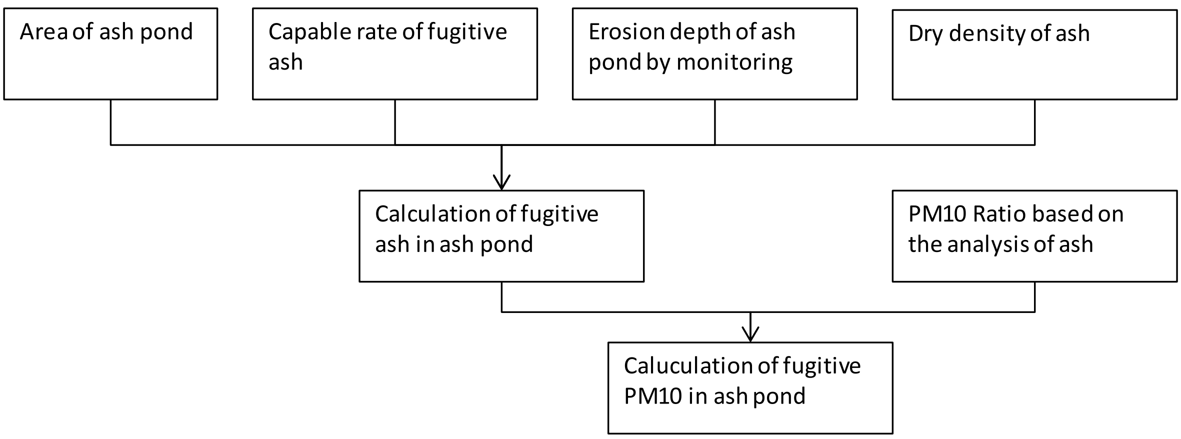


Figure 7-1 Calculation Flow Diagram of the Emission from Fugitive Ash from Ash Pond of Power Plant

7.1.1 Collecting and Organizing Information on Activity Data

Activity data of this source is the area by ash pond by power plant and the monthly scatterable ratio.

Monthly scatterable ratio is the ratio of the area other than the area where it does not scatter due to covering soil and containing moisture in ash pond.

Inquire the person in charge of management of ash pond at each power station or the person in charge of monitoring, and check the usage condition of the ash pond including the above information. At that time, discuss and estimate the monthly scattering rate using satellite images such as Google Earth.

Therefore, activity data is calculated by the following formula.

Scatterable area (m^2) = the area of ash pond x scatterable ratio (%) / 100

7.1.2 Collecting Information on Emission Factor

Data from which the emission factor at this source is based is the dry density of the ash (ρ g/cm^3), the average erosion depth of the ash pond (D cm), and the content of PM10 and PM2.5 in ash (R_{PM10} and $R_{PM2.5}$). Emission factors are calculated by the following formula.

$EF_{Ash} = \rho \times D \times 10^{-2}$

$EF_{PM10} = EF_{Ash} \times R_{PM10}$

$EF_{PM2.5} = EF_{Ash} \times R_{PM2.5}$

EF_{Ash} EF_{PM10} $EF_{PM2.5}$: Emission factor of fugitive ash, and PM10 and PM2.5 in ash (ton/m^2)

In the non-winter season, monitoring of the average erosion depth of ash pond for each site of power plant and month is conducted at least once a month, so collect the file that the monitoring staff has been organized.

It is preferable to measure dry density of ash by taking a sample for each ash pond, but it is difficult to ensure measurement accuracy. For this reason, collect analysis results on the dry density of fly ash and bottom ash both in Mongolia and overseas, and set the dry density for each power plant taking account of the ash condition at ash pond.

Since ash may leak due to rain during the summer, if there is any doubt about the data, inquire to the monitoring staff and decide whether or not to apply it to the emission factor after discussing whether it is used for calculating the emission factor.

Take a sample from the ash pond and asked to analyze the content of PM10 and PM2.5 in the ash. Since the particle size distribution of ash differs depending on power plant, you should collect and analyze a sample for each power plant. The institute name and contacts for conducting the analysis are as follows.

Institute name	Responsible person	Contacts
Soil laboratory, Institute Geography, Mongolian Academy of Sciences	Head of Soil laboratory: Dr. Ochirbat Batkhishig	99712339 batkhishig@gmail.com

7.1.3 Developing and Updating Emission Inventory

Use “FugitiveAsh_AshPond.xls” for developing and updating emission inventory of fugitive ash from ash pond of power plant.

Emission is automatically calculated by using fuel consumption and emission factor.

Power Plant 4 (PP4)

		middle			west			east			Fugitive ash amount				
	dry density	Area	Suspension Source Area Ratio	Average Erosion Thickness	Area	Suspension Source Area Ratio	Average Erosion Thickness	Area	Suspension Source Area Ratio	Average Erosion Thickness	Ash pond of PP4				Gross of fugitive ash amount
Month	(g/cm3)	(m^2)	(%)	(cm/month)	(m^2)	(%)	(cm/month)	(m^2)	(%)	(cm/month)	Middle	West	East	Total	
	Condition	Used	Estimation	Estimation	Covered bush	Estimation	Estimation	capability of dispersion	Estimation	Measurement	Used	Covered bush	capability of dispersion		
1	1.00	250,000	0%	0	160,000	0%	0	180,000	0%	0	0	0	0	0	0
2	1.00	250,000	0%	0	160,000	0%	0	180,000	0%	0	0	0	0	0	0
3	1.00	250,000	0%	0	160,000	0%	0	180,000	40%	0	0	0	0	0	0
4	1.00	250,000	0%	0	160,000	0%	0	180,000	80%	0.45	0	0	648	648	648
5	1.00	250,000	0%	0	160,000	0%	0	180,000	80%	0.04375	0	0	63	63	63
6	1.00	250,000	0%	0	160,000	0%	0	180,000	80%	0.125	0	0	180	180	180
7	1.00	250,000	0%	0	160,000	0%	0	180,000	60%	0	0	0	0	0	0
8	1.00	250,000	0%	0	160,000	0%	0	180,000	40%	0	0	0	0	0	0
9	1.00	250,000	0%	0	160,000	0%	0	180,000	40%	0	0	0	0	0	0
10	1.00	250,000	0%	0	160,000	0%	0	180,000	40%	0	0	0	0	0	0
11	1.00	250,000	0%	0	160,000	0%	0	180,000	0%	0	0	0	0	0	0
12	1.00	250,000	0%	0	160,000	0%	0	180,000	0%	0	0	0	0	0	0
Total											0	0	891	891	891

Calculate the fugitive amount of PM10 and PM2.5 by multiplying the above fugitive ash amount by the ratio of PM10 and PM2.5.

PP4
Fugitive PM10 amount

Month	Middle	West	East	Total	Pattern
1	0	0	0	0	0.0000
2	0	0	0	0	0.0000
3	0	0	0	0	0.0000
4	0	0	248.31	248.31	8.7273
5	0	0	24.14	24.14	0.8485
6	0	0	68.98	68.98	2.4242
7	0	0	0	0	0.0000
8	0	0	0	0	0.0000
9	0	0	0	0	0.0000
10	0	0	0	0	0.0000
11	0	0	0	0	0.0000
12	0	0	0	0	0.0000
Total	0	0	341.43	341.43	

PP4
Fugitive PM2.5 amount

Month	Middle	West	East	Total
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	110.42	110.42
5	0	0	10.74	10.74
6	0	0	30.67	30.67
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0
11	0	0	0	0
12	0	0	0	0
Total	0	0	151.83	151.83

Soil laboratory, Institute Geography, Mongolian Academy of Sciences

Soil analaysys

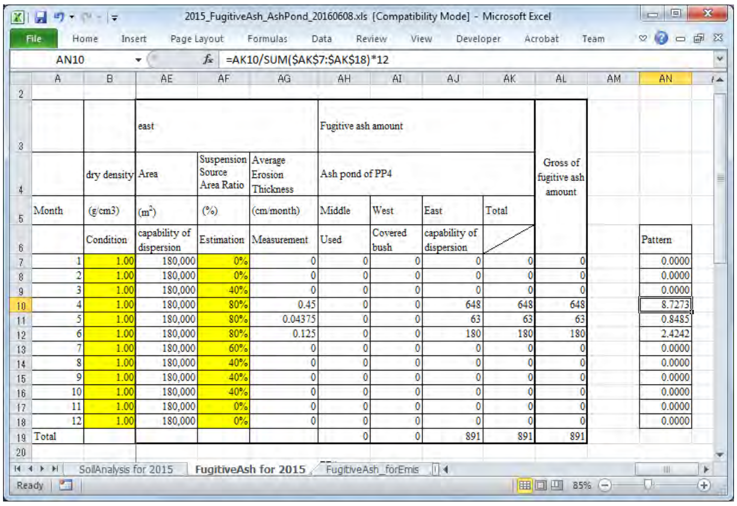
Analysys	Methods
Sample preparation	Air dry, 2 mm sieve
Stone	Gravimetric, > 2 mm
PM10, PM2.5	pippete

2015.04.30

Partuculate matter content, PM10 and PM 2.5

Sample #	Stone, % (> 2 mm)	PM 10, %	PM 2.5, %	PM 10, %	PM 2.5, %
		In the fine material (< 2 mm)		Total (including stone)	
CHP4-East Ash Pond	0.0	38.32	17.04	38.32	17.04
CHP4	15.7	26.24	14.32	22.68	12.38
CHP2-Ash	16.1	14.24	12.44	12.26	10.71
CHP3-Ash Pond	36.2	29.44	19.32	21.61	14.18

Estimated the fugitive pattern from ash pond using the hourly fugitive amount by ash pond



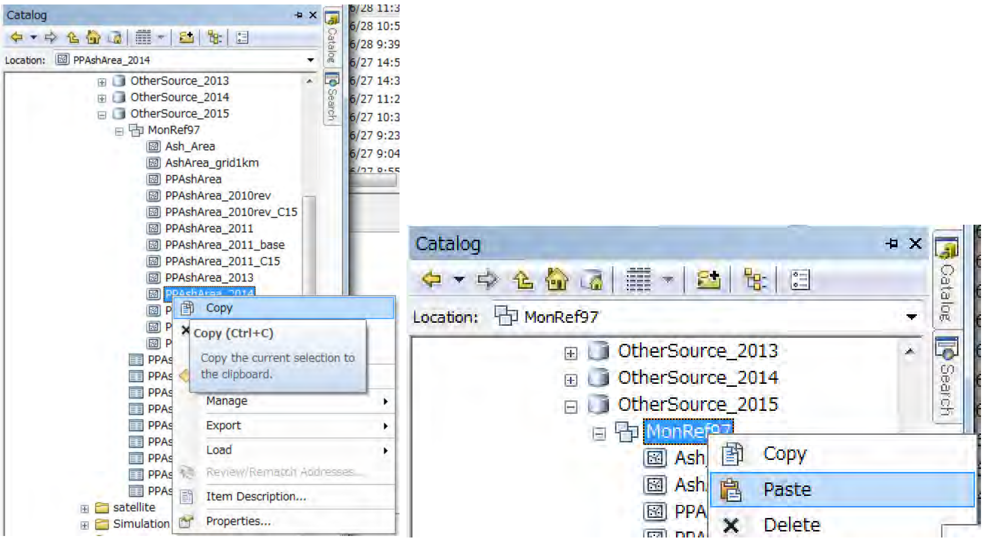
		east			Fugitive ash amount				Gross of fugitive ash amount	
	dry density	Area	Suspension Source Area Ratio	Average Erosion Thickness	Ash pond of PP4					
Month	(g/cm3)	(m²)	(%)	(cm/month)	Middle	West	East	Total		
	Condition	capability of dispersion	Estimation	Measurement	Used	Covered bush	capability of dispersion			Pattern
1	1.00	180,000	0%	0	0	0	0	0	0	0.0000
2	1.00	180,000	0%	0	0	0	0	0	0	0.0000
3	1.00	180,000	40%	0	0	0	0	0	0	0.0000
4	1.00	180,000	80%	0.45	0	0	648	648	648	8.7273
5	1.00	180,000	80%	0.04375	0	0	63	63	63	0.8485
6	1.00	180,000	80%	0.125	0	0	180	180	180	2.4242
7	1.00	180,000	60%	0	0	0	0	0	0	0.0000
8	1.00	180,000	40%	0	0	0	0	0	0	0.0000
9	1.00	180,000	40%	0	0	0	0	0	0	0.0000
10	1.00	180,000	40%	0	0	0	0	0	0	0.0000
11	1.00	180,000	0%	0	0	0	0	0	0	0.0000
12	1.00	180,000	0%	0	0	0	0	0	0	0.0000
Total					0	0	891	891	891	

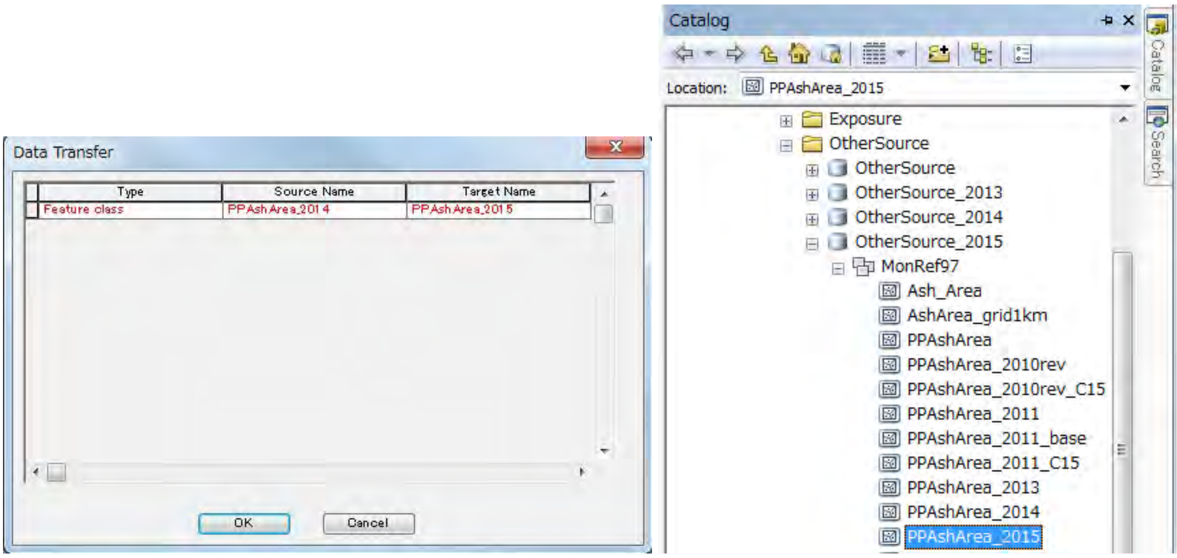
7.2 Import Inventory File into Access

Data on other source inventory is generated in “OtherSources.mdb”. This explains the method to import the inventory developing in 7.1.3 to “OtherSources.mdb”.

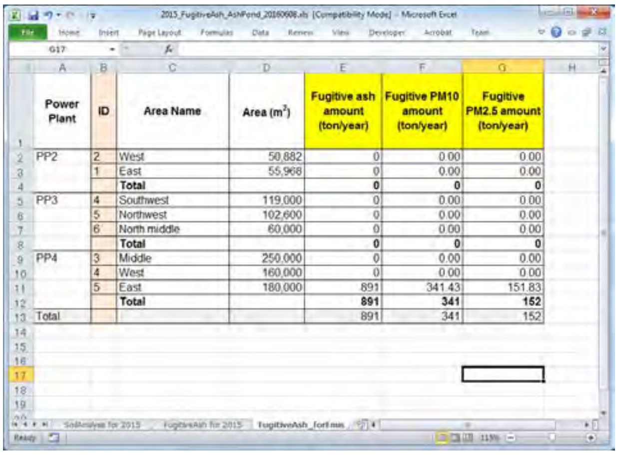
Open ArcGIS, copy [PPAsh_Area_20xx] featureclass in previous year, and create [PPAsh_Area_20yy] featureclass in target year

Here, copy the featureclass of 2014 and create the one of 2015.

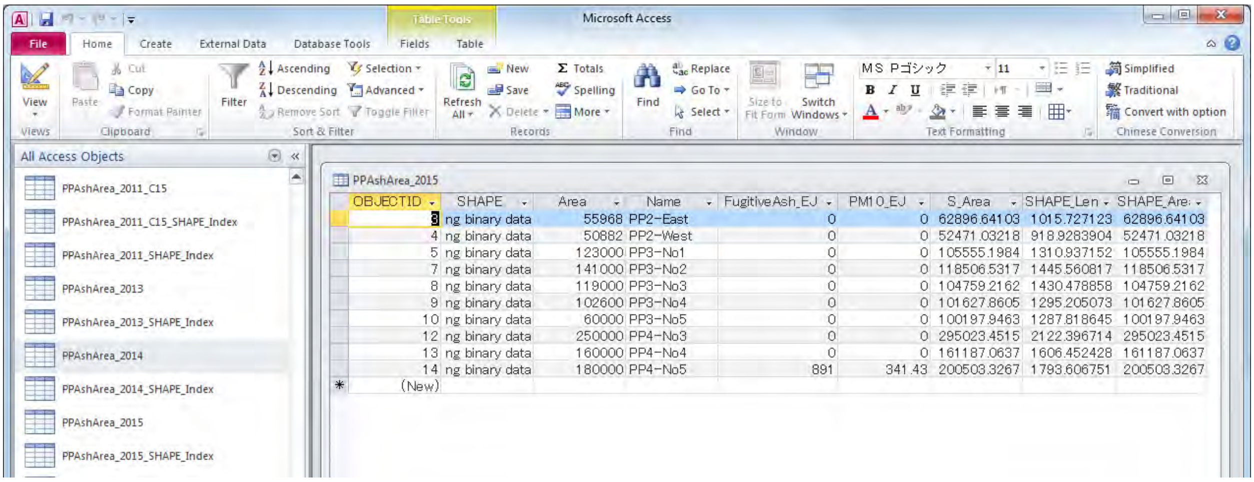




Open “PPAshArea_2015” table in “OtherSources.mdb” and input [Fugitive ash amount] and [Fugitive PM10 amount], that is fugitive ash amount by ash pond in [FugitiveAsh_forEmis] sheet of “FugitiveAsh_AshPond.xls” to [FugitiveAsh_EJ] and [PM10_EJ] respectively.



Power Plant	ID	Area Name	Area (m²)	Fugitive ash amount (ton/year)	Fugitive PM10 amount (ton/year)	Fugitive PM2.5 amount (ton/year)
PP2	2	West	50,882	0	0.00	0.00
	1	East	55,968	0	0.00	0.00
		Total		0	0	0
PP3	4	Southwest	119,000	0	0.00	0.00
	5	Northwest	102,600	0	0.00	0.00
	6	North middle	60,000	0	0.00	0.00
		Total		0	0	0
PP4	3	Middle	250,000	0	0.00	0.00
	4	West	160,000	0	0.00	0.00
	5	East	180,000	891	341.43	151.83
		Total		891	341	152
Total				891	341	152



PPAshArea_2015

OBJECTID	SHAPE	Area	Name	FugitiveAsh_EJ	PM10_EJ	S_Area	SHAPE_Len	SHAPE_Are
3	ng binary data	55968	PP2-East	0	0	62896.64103	1015.727123	62896.64103
4	ng binary data	50882	PP2-West	0	0	52471.03218	918.9283904	52471.03218
5	ng binary data	123000	PP3-No1	0	0	105555.1984	1310.937152	105555.1984
7	ng binary data	141000	PP3-No2	0	0	118506.5317	1445.560817	118506.5317
8	ng binary data	119000	PP3-No3	0	0	104759.2162	1430.478858	104759.2162
9	ng binary data	102600	PP3-No4	0	0	101627.8605	1295.205073	101627.8605
10	ng binary data	60000	PP3-No5	0	0	100197.9463	1287.818645	100197.9463
12	ng binary data	250000	PP4-No3	0	0	295023.4515	2122.396714	295023.4515
13	ng binary data	160000	PP4-No4	0	0	161187.0637	1606.452428	161187.0637
14	ng binary data	180000	PP4-No5	891	341.43	200503.3267	1793.606751	200503.3267
(New)								

7.3 Spatial Distribution to the Grid of Emission by Site

Since the amount of fugitive ash was calculated for each ash pond, when using the emission for simulation, the amount of fugitive ash was distributed for each grid.

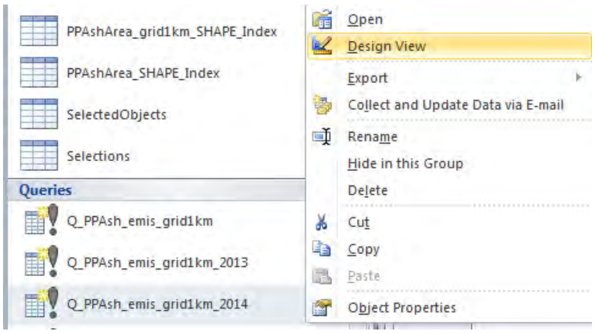
The amount of fugitive ash by grid in ash pond is calculated by the following formula.

Fugitive amount of ash pond by grid

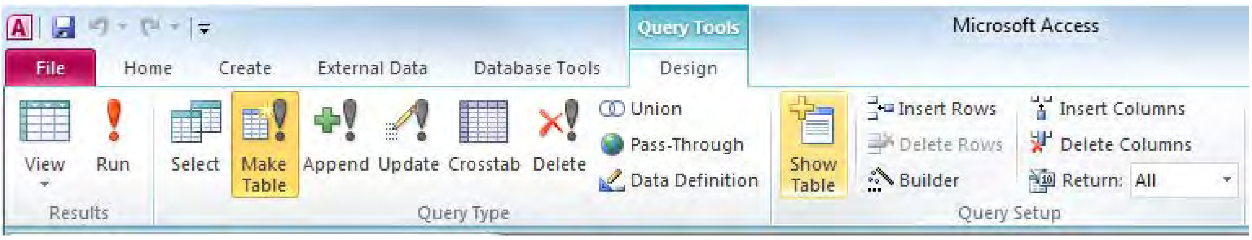
= Fugitive amount of ash pond x the area of ash pond in a grid / total area of ash pond

Right-click the query calculated emission by grid for previous year and click [Design View]. Change this query name to the one of target year and save as new file.

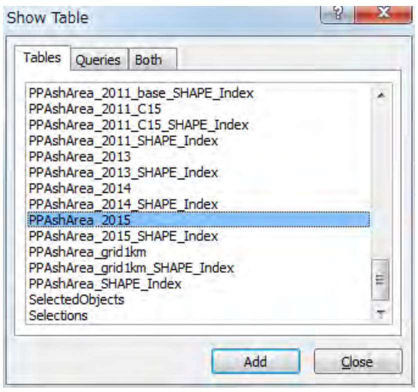
Here, open [Q_PPAsh_emis_grid1km_2014] query and save the query as [Q_PPAsh_emis_grid1km_2015].



Click [Show Table] in [Design] tab.

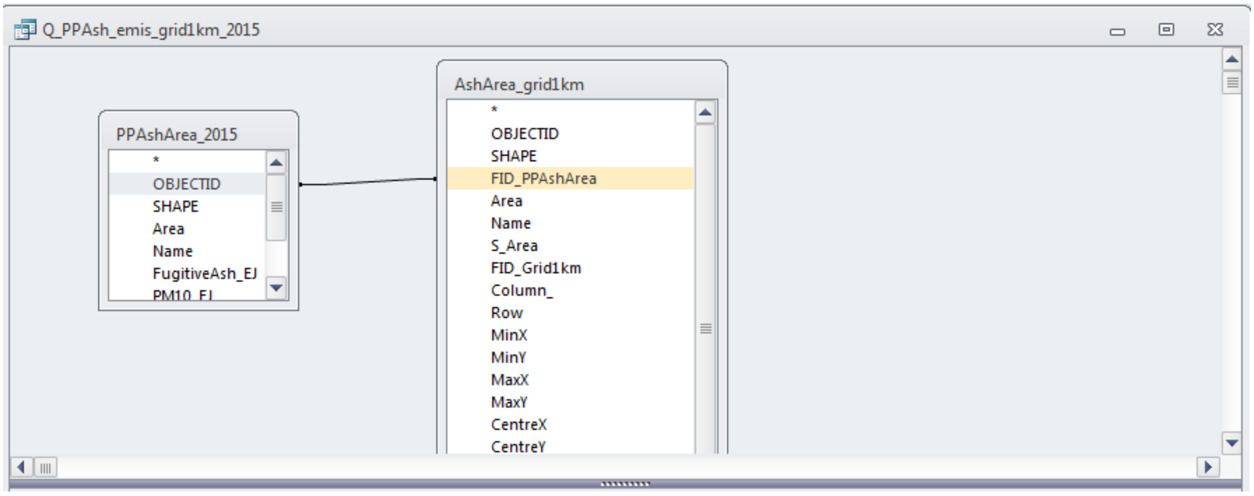


Select “PPAshArea_2015” table and click [Add].

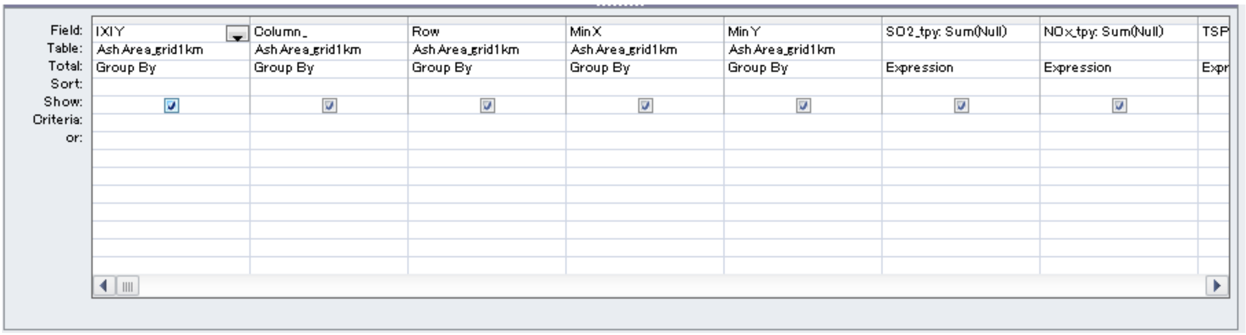


Join [ObjectID] column in “PPAshArea_2015” table to [FID_PPAshArea] column in [AshArea_grid1km].

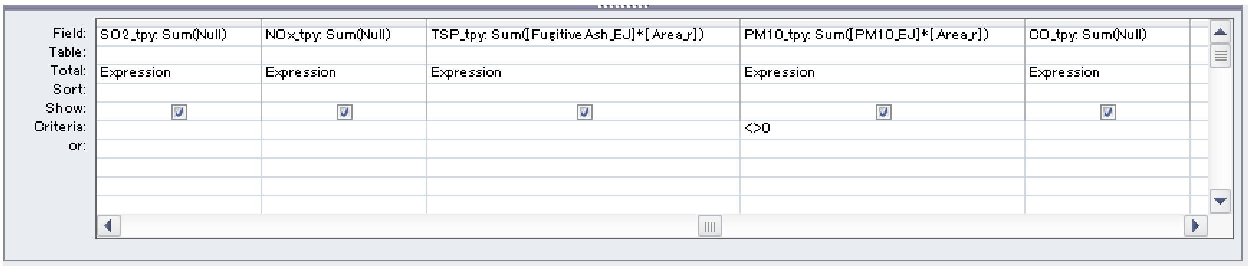
Select [ObjectID] column in “PPAshArea_2015” table, drag and drop to [FID_PPAshArea] column in “AshArea_grid1km” table, and then these columns are connected by black line.



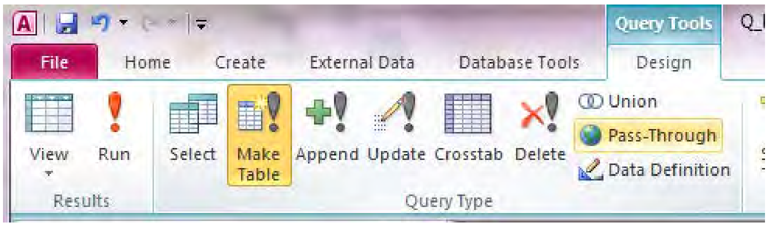
Set [table] of [IXIY], [Column_], [Row], [MinX], and [MinY] column as [AshArea_grid1km].



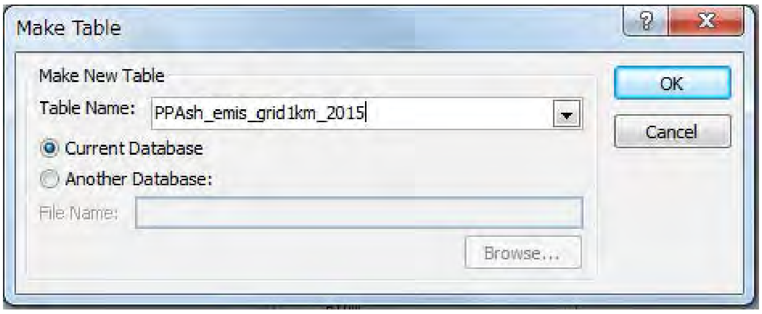
Regarding [FugitiveAsh_EJ_tpy] and [PM10_EJ_tpy] column, set as follows.



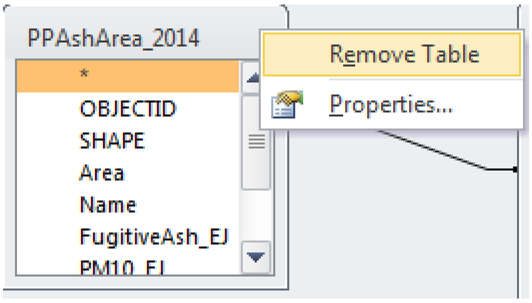
Click [Make Table] in [Design]



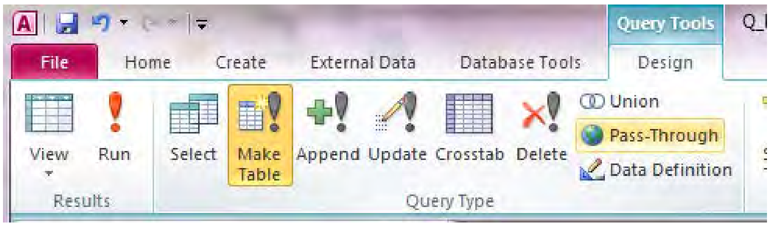
Set the table name (Here it is “PPAsh_emis_grid1km_2015”).



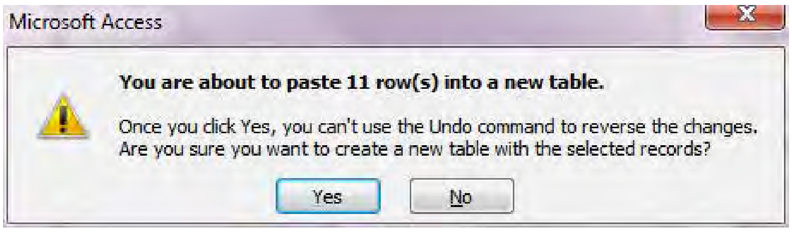
Right-click the old table and click [Remove Table] (Here it is “PPAshArea_2014” table).



Click [Run] in [Design] and create the new table.

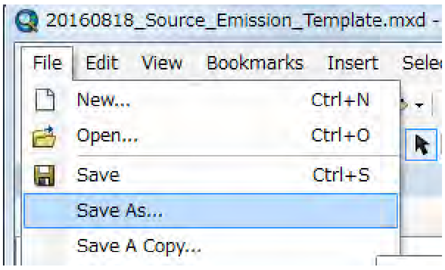


Click [Yes] and create the table of fugitive amount by grid.



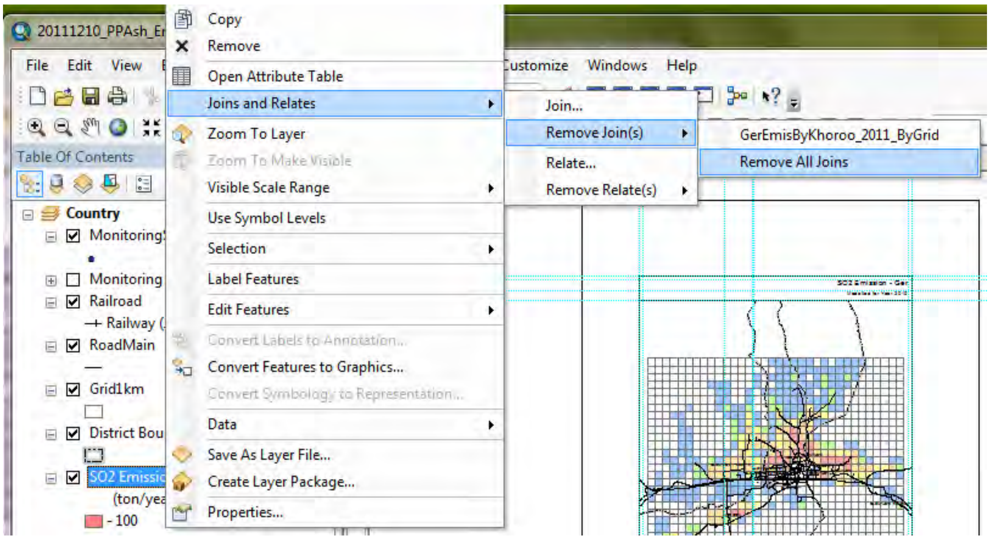
7.4 Drawing Emission Distribution Map

Open template file, click [File]-[Save As], and saved as other name.

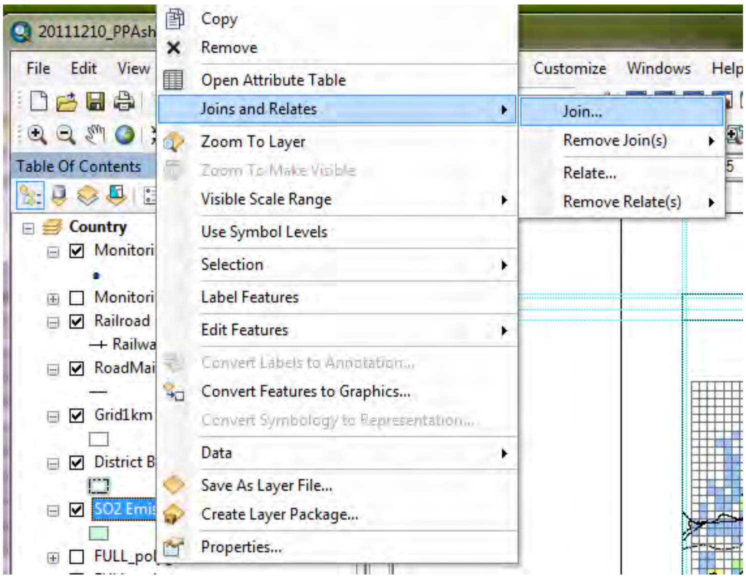


Join the table of emission by grid to “SO2 Emission” layer

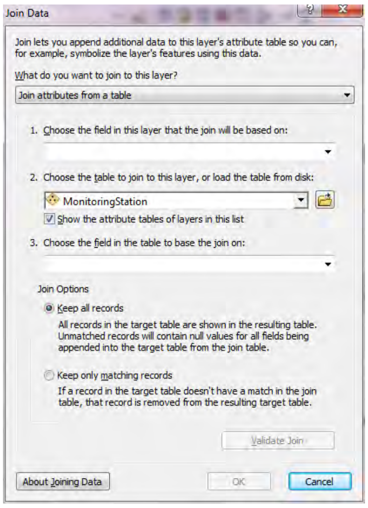
If the table is already a joined table, select [Joins and Relates]-[Remove Join(s)]-[Remove All].



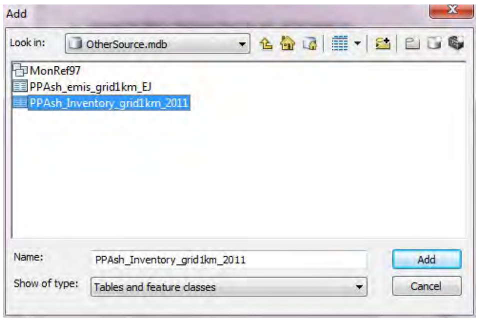
Right-click “SO2 Emission” layer and select [Joins and Relates]-[Join].



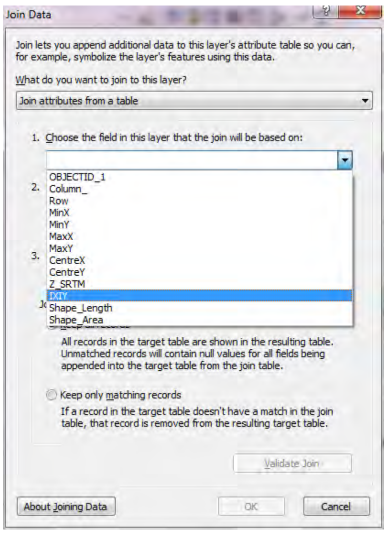
When showing the following dialog, click  button.



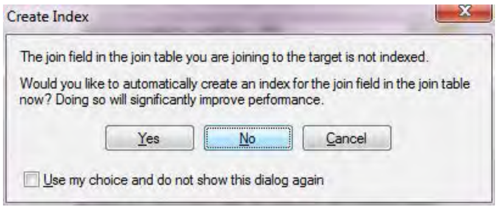
Select the table of emission by grid to join and click [Add] (Here it is “PPAsh_Inventory_grid1km_2011” table).



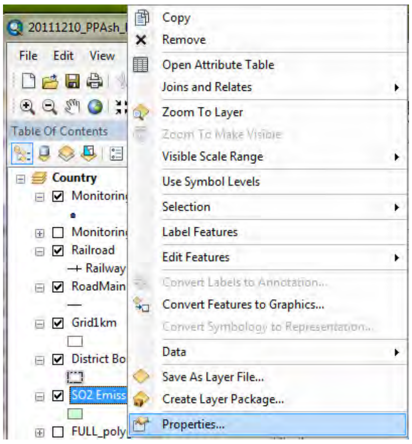
Show the selected table in the dropdown textbox of “2.”. When clicking the dropdown button of “1.” and selecting “IXIY”, show “IXIY” in “3.” automatically. After then, click [OK].



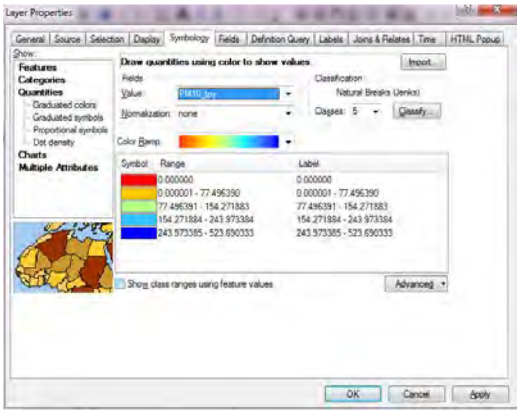
If the following dialog may be shown, click [No].



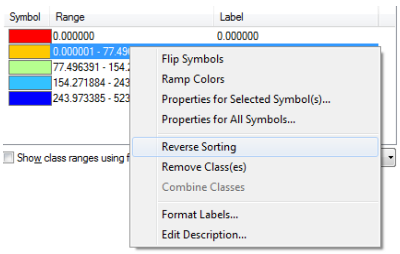
Right-click “SO2 Emission” layer and click [Properties].



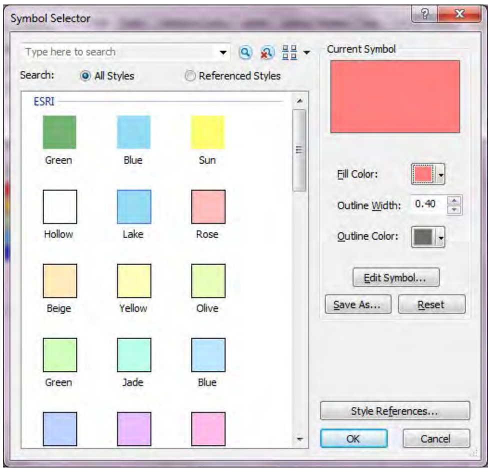
Click [Symbology] tab and select [Quantities]-[Graduated colors]. Click and select the target column name at the drop down button of [Value] (Here it is [PM10_tpy].).



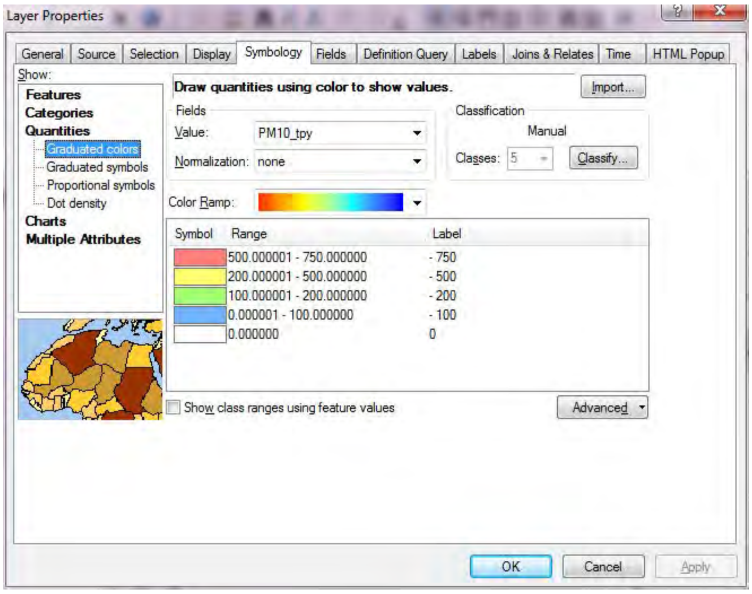
When click [Reverse Sorting] after you right-click on the [Range] column, the display order of rank changes. According to the order of symbol color, decide the display order of rank.



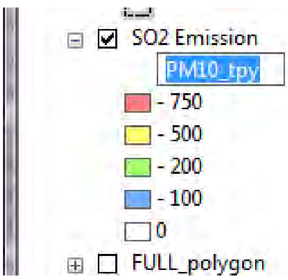
When double-clicking color in [Symbol] column, since the following dialog is shown, select color.



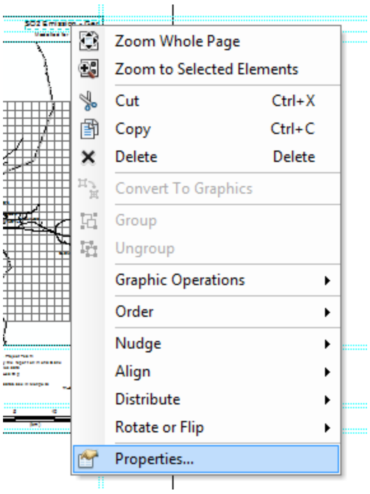
After selecting a rank, click the [Range] of the selected rank and input the maximum of the rank. However, if doing [Reverse Sorting], since the input order of rank is reversed, take care in the input order. When all setting completed, click [OK].



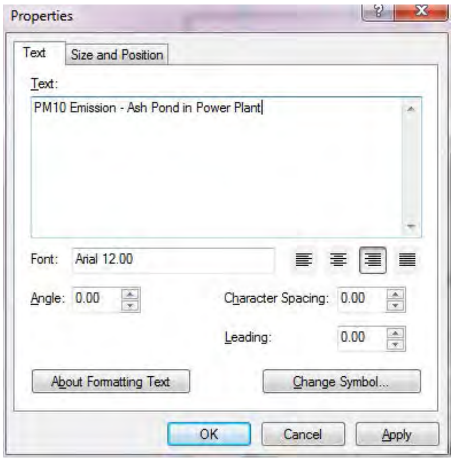
Click “SO2_tpy” of “PM10_tpy” layer and make it editable and change to “ton/year”.



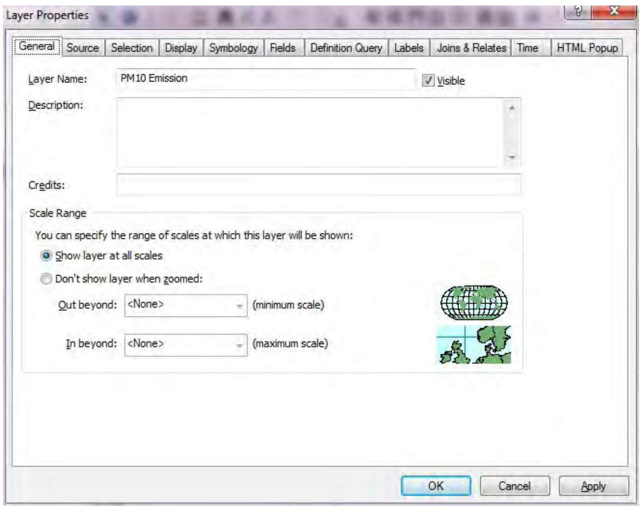
Change the title of this map. Move the cursor to the textbox of title, right-click it, and click [Properties].



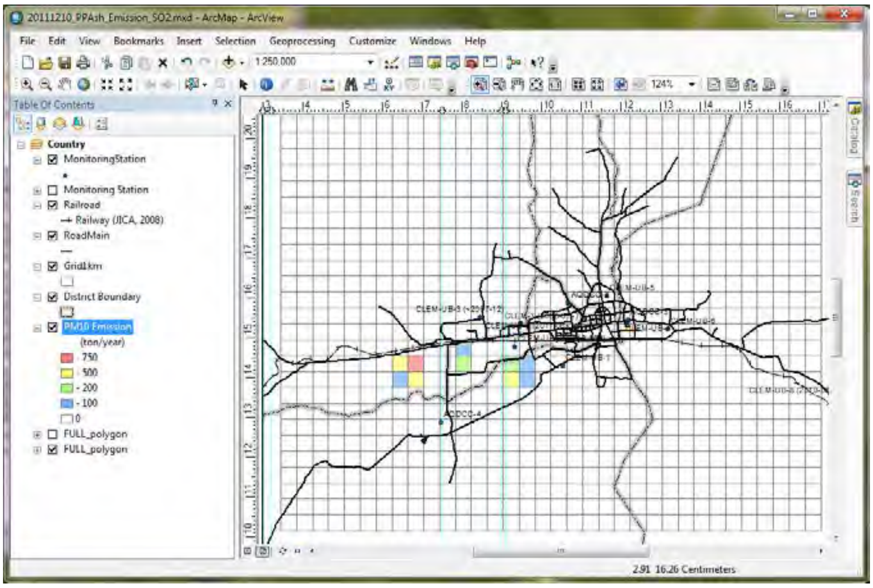
Input a title in [Text] (Here it is “SO2 Emission – Ash Pond in Power Plant”.).



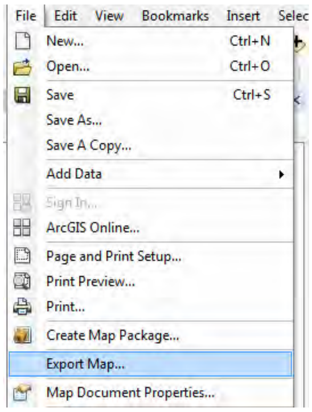
Update [Layer Name] of [Properties]-[General] tab to “PM10 Emission”.



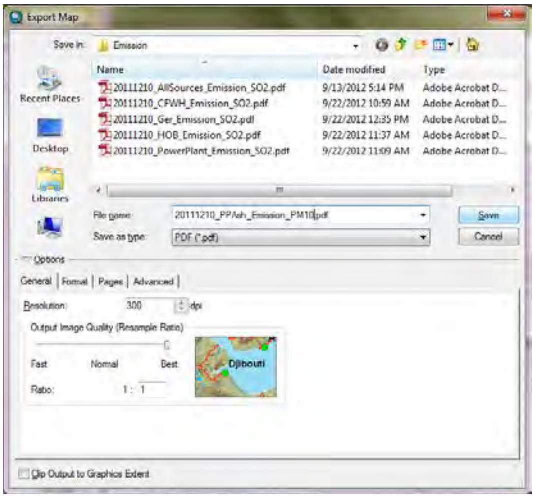
Complete drawing the map by ArcGIS.



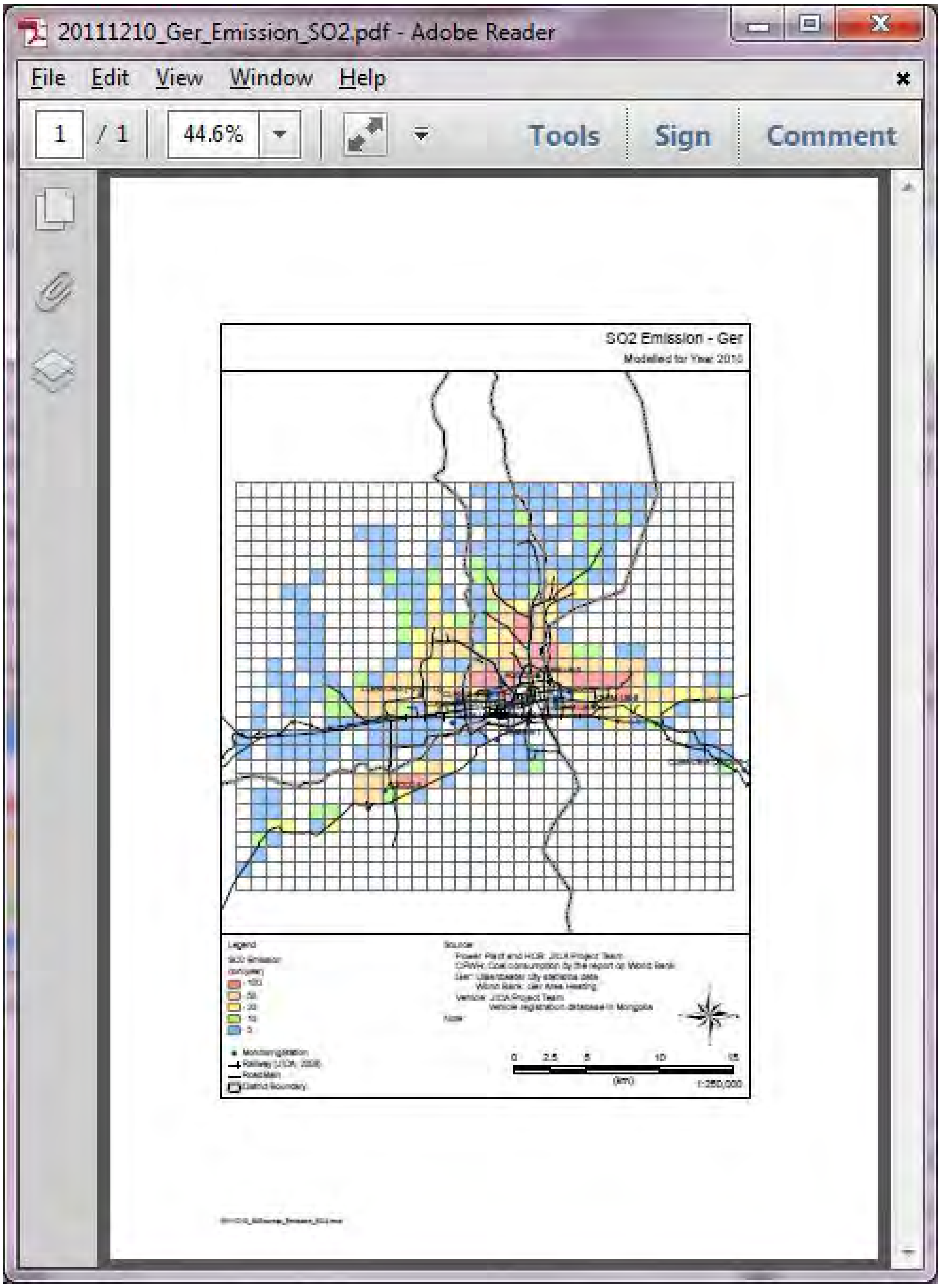
To export the distribution map to PDF file, click [File]-[Export Map].



Setting the destination and file name and click [Save].



Create the PDF file of distribution map.


20111210_Ger_Emission_SO2.pdf - Adobe Reader
File Edit View Window Help
1 / 1
44.6%
Tools
Sign
Comment
SO2 Emission - Ger
Modelled for Year 2010

Mongolia
Air Pollution Reducing Department of Capital City (APRD)

Capacity Development Project for Air Pollution Control in Ulaanbaatar City Phase 2 Mongolia

Technical Manual 08
Manual for Conducting and Updating of Dispersion Simulation

March 2017

Japan International Cooperation Agency (JICA)

SUURI-KEIKAKU CO., LTD.

Contents

1 Developing Dispersion Simulation Model

1.1 Dispersion Simulation Model Used in This Manual

When grasping the air pollution structure in UB city and the effect of concentration reduction measures, the selection conditions of dispersion simulation model are as follows.

1. This model is recommended in the world

   AERMOD and CALPUFF are specified as recommended models in USEPA. Therefore, one of these atmospheric dispersion simulation models is preferred to use. In addition, information such as user manual of these atmospheric dispersion simulation models etc. is available from websites.

2. This model is available at low price

   The budget for conducting the atmospheric dispersion simulation model is limited. Therefore, input data, such as meteorological data, terrain data, and the main tool of dispersion simulation model, is preferred to be available for free or at low cost.

3. This model has the linear relation between emission and concentration

   In order to calculate concentration by source, it is preferable to calculate and sum up for each source and to calculate only the target source when recalculating. In addition, the calculation time and the number of calculations are preferred to be small in order to verify various air pollution control measures.

As a result of selecting the atmospheric diffusion simulation model that meets these conditions, CALPUFF Ver 5.8.4 (USEPA recommended model) is used in this manual. Under the condition 2, CALPUFF's program and code is available for free from the website and related aerological data, elevation data, land use data also are available for free from the website. Under the condition 3, the pseudo-first-order chemical reaction model (MESOPUFF II) is used in CALPUFF, and the calculation time and the calculation frequency for verifying the control measures are reduced because of the assumption of the linear relation between emission and concentration.

1.2 Flow Diagram of Developing and Conducting Dispersion Simulation Model, CALPUFF

1.2.1 Outline of CALPUFF

Until now, JICA Experts have been utilizing ISC-ST3 model which is not able to consider generation process of secondary particles such as chemical transformation. In order to solve this matter, CALPUFF was decided for the utilization. CALPUFF was reconstructed as an air dispersion simulation model because CALPUFF is able to consider chemical transformation.

CALPUFF is a model developed by Scire, et al. in 1995 to correspond to advection and dispersion of the pollutant by non-steady-state change in an air current in a maritime area and complex geometry. In an air current field generated by three dimension air flow model, the advective dispersion calculation of pollutant is conducted by using the advective puff.

The model consists of 3 components: (1) CALMET which generates three dimension air flow model, (2) CALPUFF which conducts air quality dispersion model using puff model, and (3) CALPOST which outputs or analyzes the calculation result. In addition, this model consists of some sub-module, such as MAKEGEO.

The basic equation for CALPUFF is as follows.

$$C = \frac{Q}{2\pi\sigma_x\sigma_y} \cdot g \cdot exp\left[-{d_a}^2/(2{\sigma_x}^2)\right] \cdot \exp\left[-{d_c}^2/\left(2{\sigma_y}^2\right)\right] \cdots\cdots\cdots\cdots \text{(2-1)}$$

$$g = \frac{2}{(2\pi)(2\pi)^{1/2}\sigma_z} \cdot \sum_{n=-\infty}^{\infty} exp[-(H_e + 2nh)^2/(2\sigma_z{}^2)] \quad \text{(2-2)}$$

Where,

C: ground-level concentration (g/m3)

Q: pollutant mass contained in the puff (g)

σx: standard deviation of Gaussian distribution in the along-wind direction (m)

σy: standard deviation of Gaussian distribution in the cross-wind direction (m)

σz: standard deviation of Gaussian distribution in the vertical direction (m)

da: distance from the puff center to the receptor in the along-wind direction (m)

dc: distance from the puff center to the receptor in the cross-wind direction (m)

g: vertical term of the Gaussian equation (m)

He: effective height above the ground of the puff center

h: height of the mixed-layer (m)

The summation of the vertical term g expresses multiple reflections of the mixing layer and the ground surface. The term g converges to the uniformly mixed limit of 1/h for σz > 1.6 h. In general, puffs within the convective boundary layer meet this criterion after few hours from release.

For a horizontal symmetric puff with σx = σy, the equation (2-1) reduces to:

$$C = \frac{Q(s)}{2\pi\sigma_y{}^2(s)} \cdot g(s) \cdot exp\left[-R^2(s)/\left(2\sigma_y{}^2(s)\right)\right] \quad \text{(2-3)}$$

Where, R is the distance from the center of the puff to the receptor (m), and, s is the distance traveled by the puff (m). The distance dependent variables in Equation (2-3) are terms such as C(s) and σy(s).

1.2.2 Flow Diagram of Developing and Conducting Dispersion Simulation Model

Flow diagram of dispersion simulation with CALPUFF is shown in Figure 1.2-1.

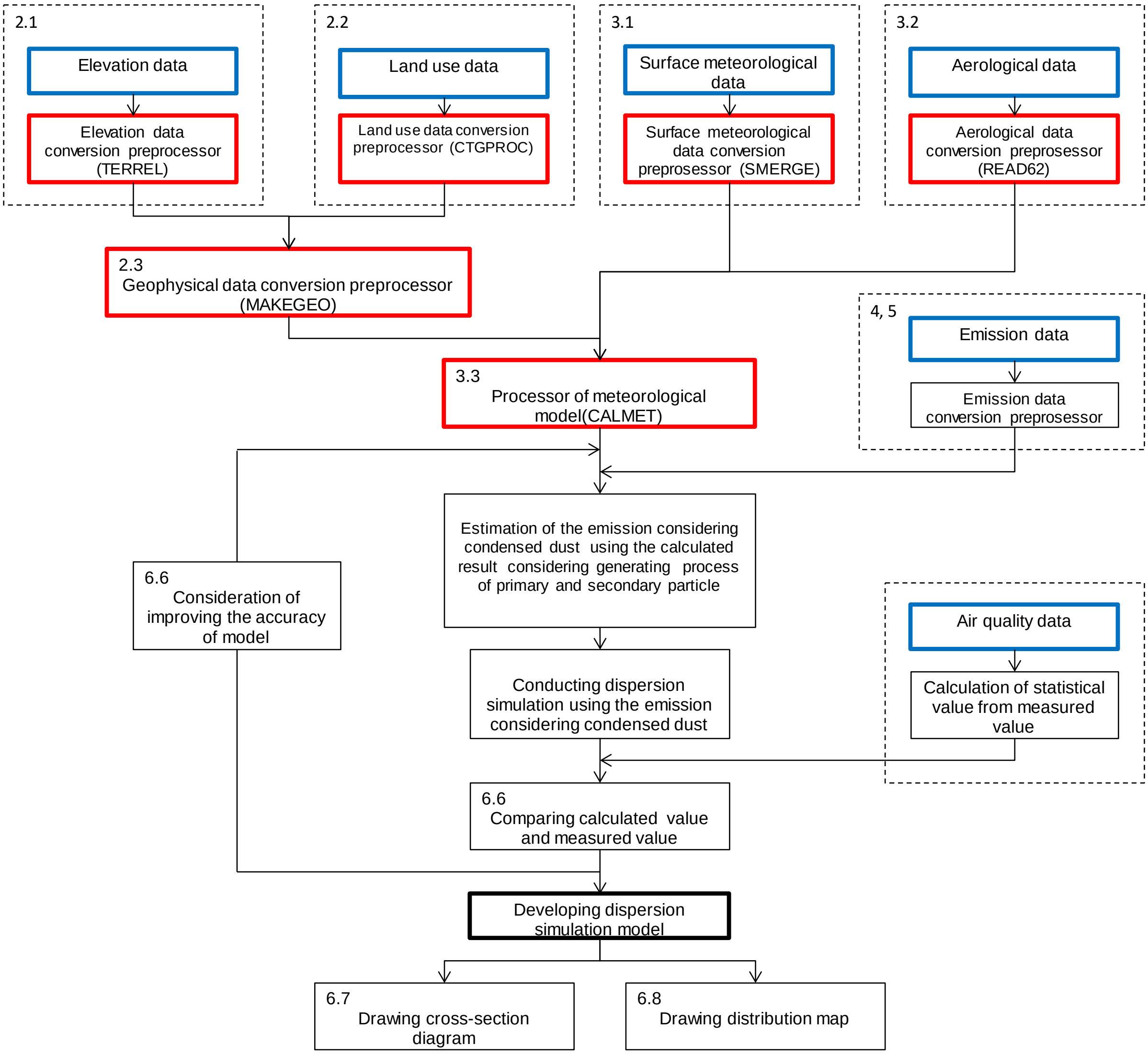


Figure 1.2-1 Flow Diagram of Dispersion Simulation with CALPUFF

2 Developing Geology Data

2.1 Collecting and Organizing Elevation Data

2.1.1 Outline

Download SRTM30/GTOPO30 Global Data (~900 m, 30 arc-sec) from USGS website[1] as elevation data.

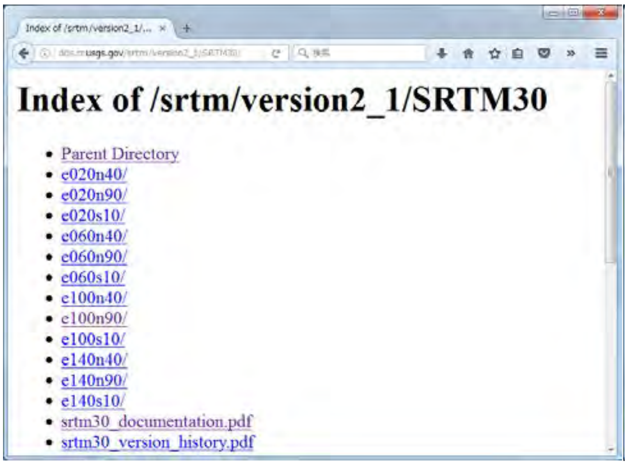
Decompress the downloaded file and use DEM file as input file.

CALPUFF includes TERREL as elevation data conversion processor.

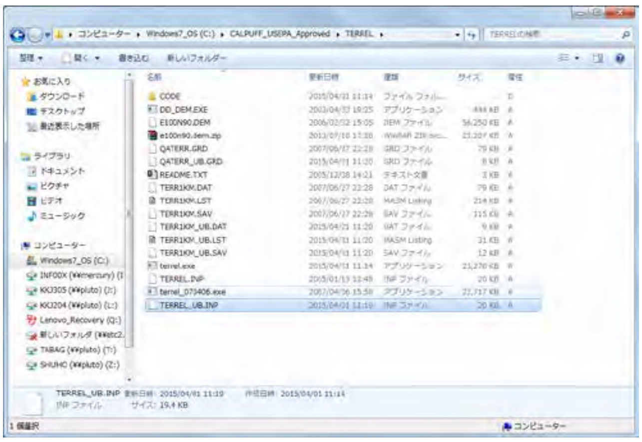
Set input file, output file, projection, datum, calculation range, and calculation resolution in TERREL. Output elevation data file is used in MAKEGEO processor.

2.1.2 Developing Method

Download SRTM30/GTOPO30 Global Data (~900 m, 30 arc-sec) from USGS website. In the case of UB city, open “e100n90” folder and save “e100n90.dem.zip” to “TERREL” folder.

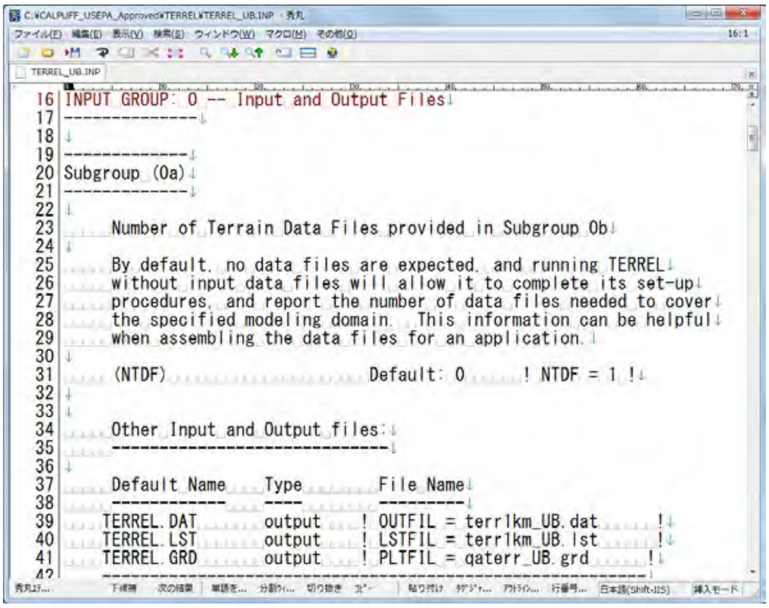


Decompress “e100n40.dem.zip” saved in “TERREL” folder. The file after decompressing is “E100N40.DEM”. Open INP file in the folder.



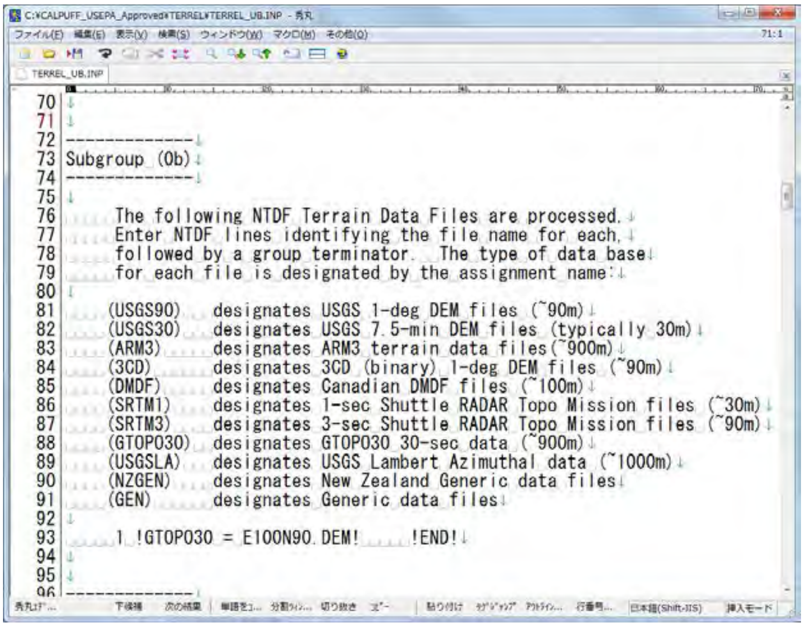
1 e100n40 and e100n90 in folder of http://dds.cr.usgs.gov/srtm/version2_1/SRTM30/

Set the number of input file as elevation data (NTDF) and output file name (OUTFIL, LSTFIL, PLTFIL).



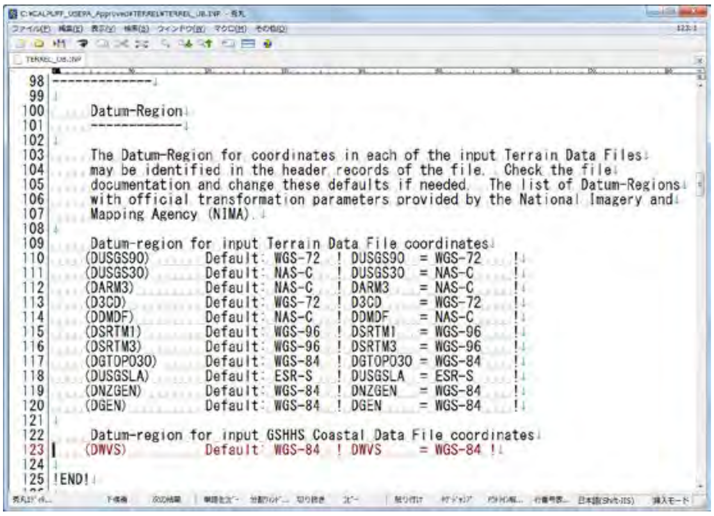
```
INPUT GROUP: 0 -- Input and Output Files
--------------

--------------
Subgroup (0a)
--------------

     Number of Terrain Data Files provided in Subgroup 0b

     By default, no data files are expected, and running TERREL
     without input data files will allow it to complete its set-up
     procedures, and report the number of data files needed to cover
     the specified modeling domain.  This information can be helpful
     when assembling the data files for an application.

     (NTDF)                       Default: 0      ! NTDF = 1 !


     Other Input and Output files:
     -----------------------------

     Default Name    Type       File Name
     ------------    ----       ---------
    TERREL.DAT       output    ! OUTFIL = terr1km_UB.dat     !
    TERREL.LST       output    ! LSTFIL = terr1km_UB.lst     !
    TERREL.GRD       output    ! PLTFIL = qaterr_UB.grd      !
```

Set input file name of elevation data. [GTOPO30] means the setting format of elevation data. When using the data except [GTOPO30], see the list in the figure. Set the input file name at the back of "=". Don't forget to input "!END!" because of mandatory word.



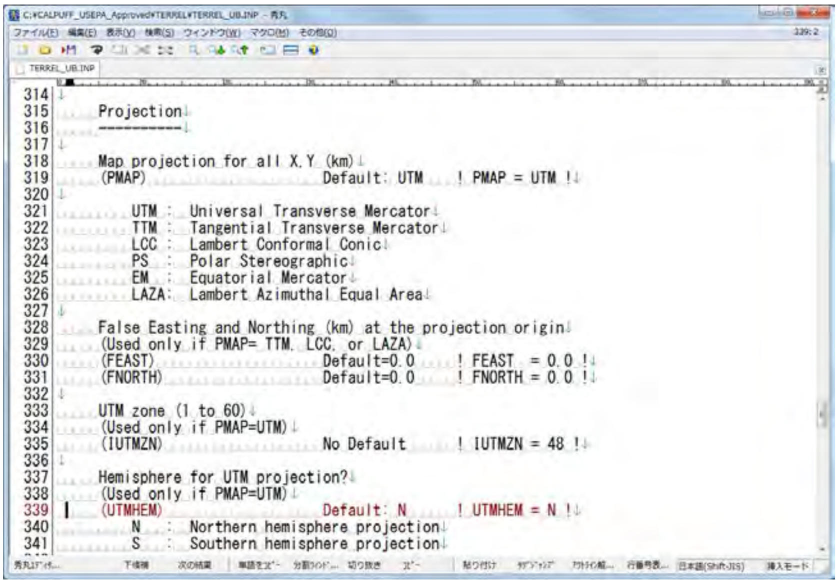
```


--------------
Subgroup (0b)
--------------

     The following NTDF Terrain Data Files are processed.
     Enter NTDF lines identifying the file name for each,
     followed by a group terminator.  The type of data base
     for each file is designated by the assignment name:

    (USGS90)   designates USGS 1-deg DEM files (~90m)
    (USGS30)   designates USGS 7.5-min DEM files (typically 30m)
    (ARM3)     designates ARM3 terrain data files(~900m)
    (3CD)      designates 3CD (binary) 1-deg DEM files (~90m)
    (DMDF)     designates Canadian DMDF files (~100m)
    (SRTM1)    designates 1-sec Shuttle RADAR Topo Mission files (~30m)
    (SRTM3)    designates 3-sec Shuttle RADAR Topo Mission files (~90m)
    (GTOPO30)  designates GTOPO30 30-sec data (~900m)
    (USGSLA)   designates USGS Lambert Azimuthal data (~1000m)
    (NZGEN)    designates New Zealand Generic data files
    (GEN)      designates Generic data files

     1 !GTOPO30 = E100N90.DEM!      !END!


--------------
```

Set the datum of elevation data. When input data is [GTOPO30], set "WGS-84". When using the other data, see the list in the following figure.



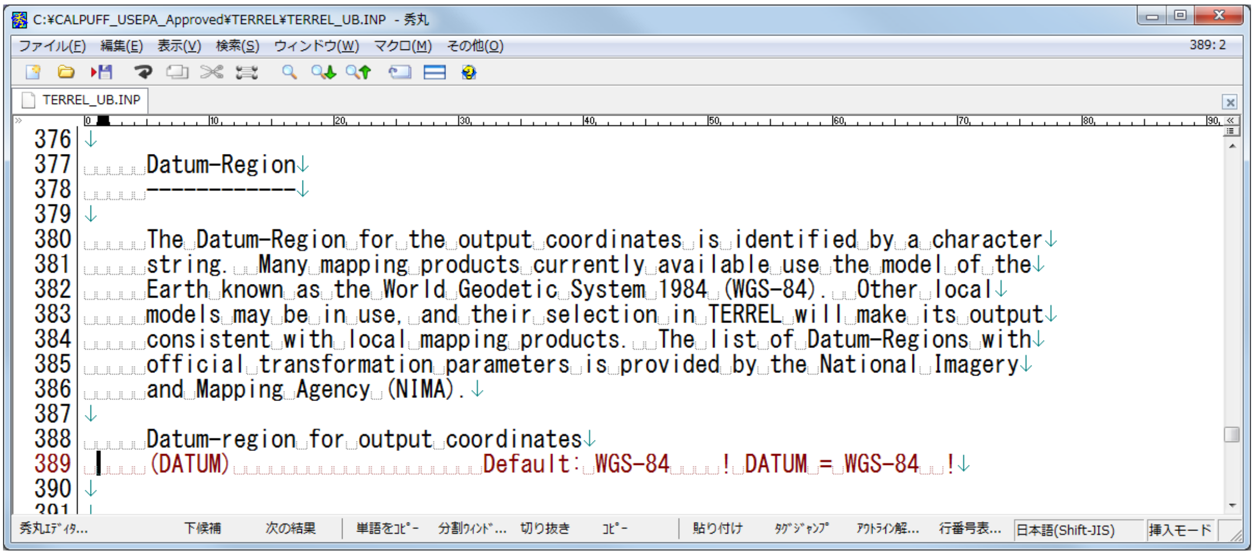
```
--------------

    Datum-Region
    ------------

    The Datum-Region for coordinates in each of the input Terrain Data Files
    may be identified in the header records of the file.  Check the file
    documentation and change these defaults if needed.  The list of Datum-Regions
    with official transformation parameters provided by the National Imagery and
    Mapping Agency (NIMA).

    Datum-region for input Terrain Data File coordinates
   (DUSGS90)        Default: WGS-72  ! DUSGS90  = WGS-72   !
   (DUSGS30)        Default: NAS-C   ! DUSGS30  = NAS-C    !
   (DARM3)          Default: NAS-C   ! DARM3    = NAS-C    !
   (D3CD)           Default: WGS-72  ! D3CD     = WGS-72   !
   (DDMDF)          Default: NAS-C   ! DDMDF    = NAS-C    !
   (DSRTM1)         Default: WGS-96  ! DSRTM1   = WGS-96   !
   (DSRTM3)         Default: WGS-96  ! DSRTM3   = WGS-96   !
   (DGTOPO30)       Default: WGS-84  ! DGTOPO30 = WGS-84   !
   (DUSGSLA)        Default: ESR-S   ! DUSGSLA  = ESR-S    !
   (DNZGEN)         Default: WGS-84  ! DNZGEN   = WGS-84   !
   (DGEN)           Default: WGS-84  ! DGEN     = WGS-84   !

    Datum-region for input GSHHS Coastal Data File coordinates
   (DWVS)           Default: WGS-84  ! DWVS     = WGS-84 !

!END!
```

Set the projection of output data (PMAP). “UTM” is set in this case. UTM is the projection that earth is divided into 60 zones every longitude 6 degrees. Therefore, set the zone that target city located (IUTMZN). UTM zone in UB city is “48”.

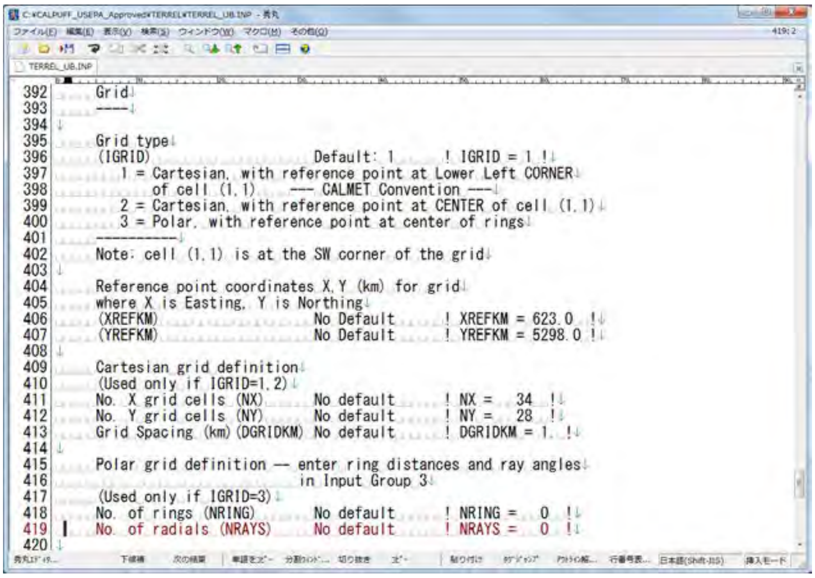


```
    Projection
    ----------

    Map projection for all X,Y (km)
    (PMAP)                         Default: UTM    ! PMAP = UTM !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
         PS  :  Polar Stereographic
         EM  :  Equatorial Mercator
         LAZA:  Lambert Azimuthal Equal Area

    False Easting and Northing (km) at the projection origin
    (Used only if PMAP= TTM, LCC, or LAZA)
    (FEAST)                        Default=0.0     ! FEAST  = 0.0 !
    (FNORTH)                       Default=0.0     ! FNORTH = 0.0 !

    UTM zone (1 to 60)
    (Used only if PMAP=UTM)
    (IUTMZN)                       No Default      ! IUTMZN = 48 !

    Hemisphere for UTM projection?
    (Used only if PMAP=UTM)
    (UTMHEM)                       Default: N      ! UTMHEM = N !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection
```

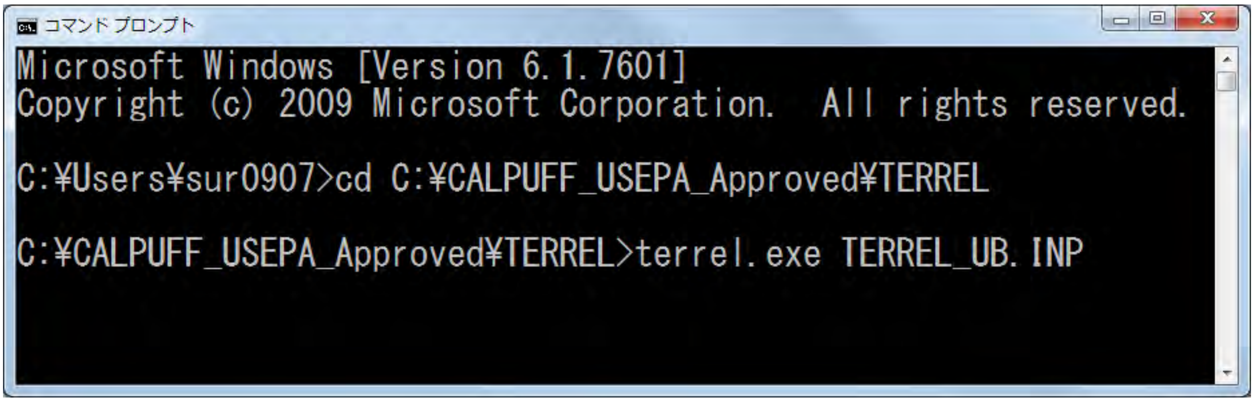
Set the datum of output data (DATUM). “WGS-84” is set in this case.



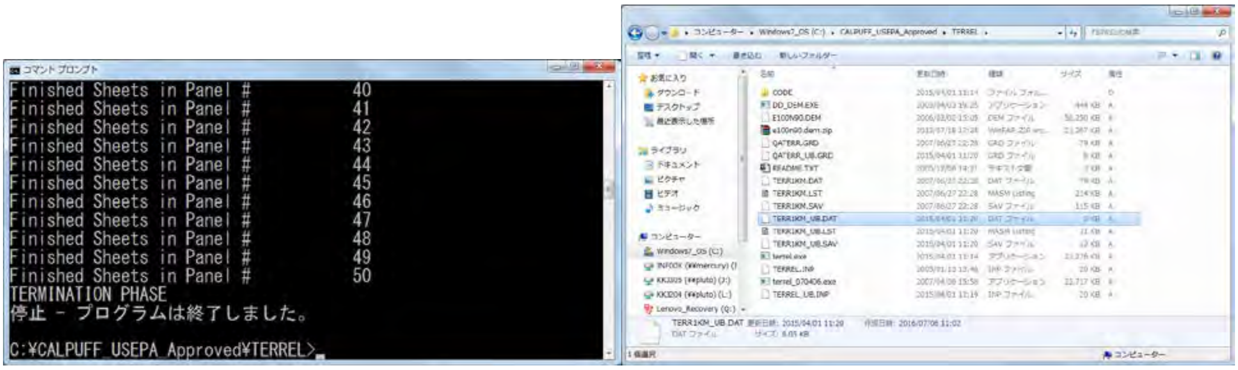
Set the grid type of output (IGRID), reference point coordinates for grid of output at lower left corner (XREFKM, YREFKM), the number of grid (NX, NY), and grid spacing (DGRIDKM).



Move the “TERREL” folder in command prompt, input “terrel.exe <input file name>.INP”, and press [Enter] (Here it is “TERREL_UB.INP”).



When showing “TERMINATION PHASE” message and completing calculation, you check to make output files. Output file is ”TERR1KM_UB.DAT” in this case.



2.2 Collecting and Organizing Land Use Data

2.2.1 Outline

Download USGS Land Use/Land Cover Scheme of “Lambert Azimuthal Equal Area Projection (Optimized for Asia)” from USGS website[2] as land use data.

Decompress the downloaded file and use IMG file as input file.

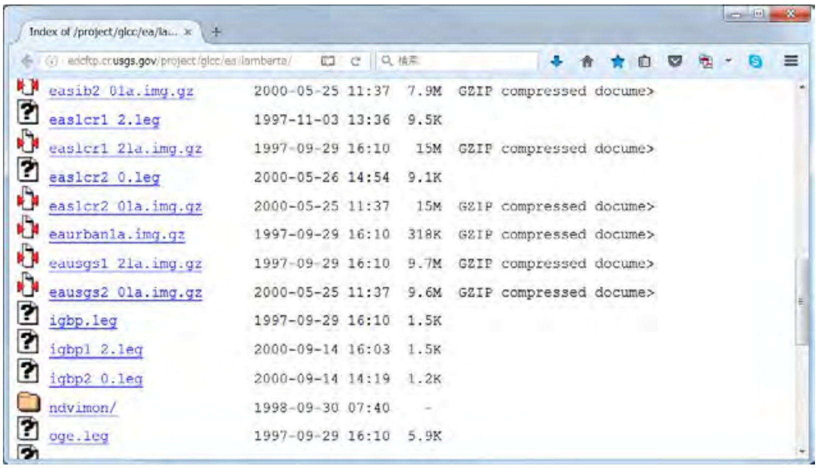
CALPUFF includes CTGPROC as land use data conversion processor.

Set input file, output file, projection, datum, calculation range, and calculation resolution in CTGPROC. Output land use data file is used in MAKEGEO processor.

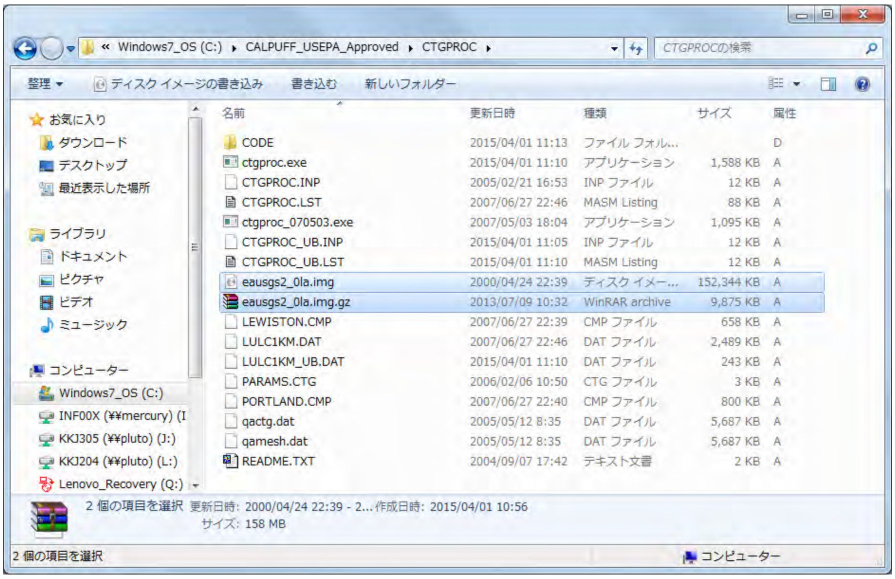
2.2.2 Developing Method

Download ”eausgs2_0la.img.gz” from USGS website.

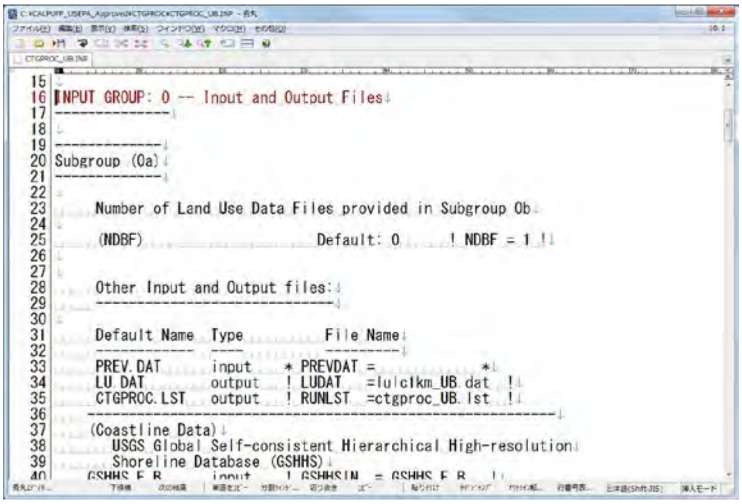
[2] Eurasia Land Cover Characteristics Data Base Version 2.0
http://edcftp.cr.usgs.gov/project/glcc/ea/lamberta/



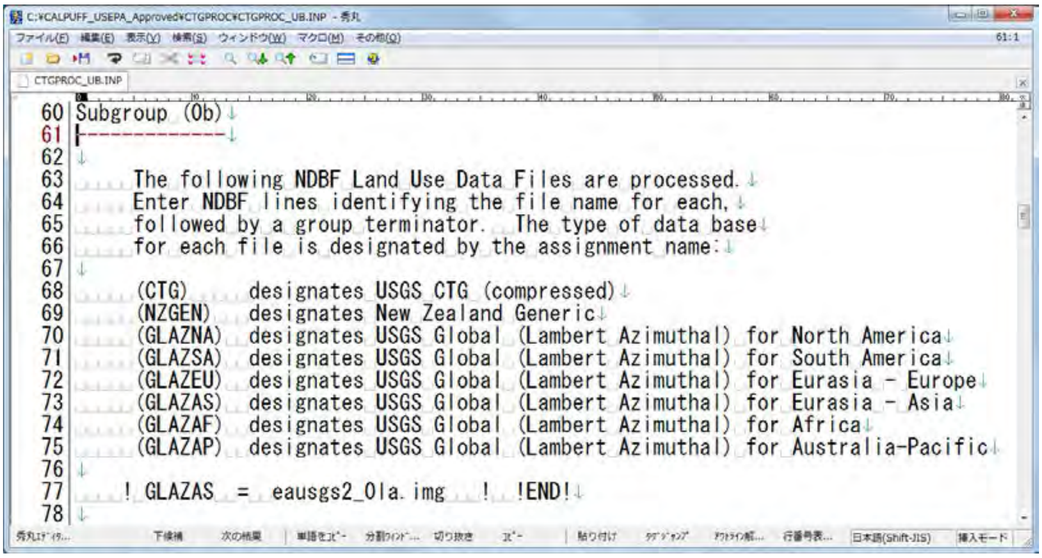
Decompress compressed file saved in “CTGPROC” folder. Open INP file in the folder.



Set the number of input file as land use data (NDBF) and output file name (LUDAT、RUNLST).

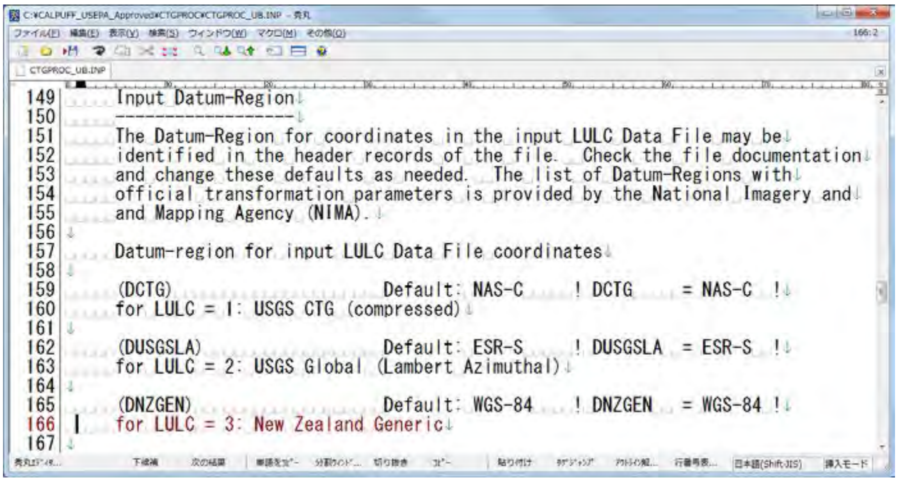


Set input file name of land use data. [GLAZAS] means the setting format of land use data. When using the data except [GLAZAS], see the list in the figure.



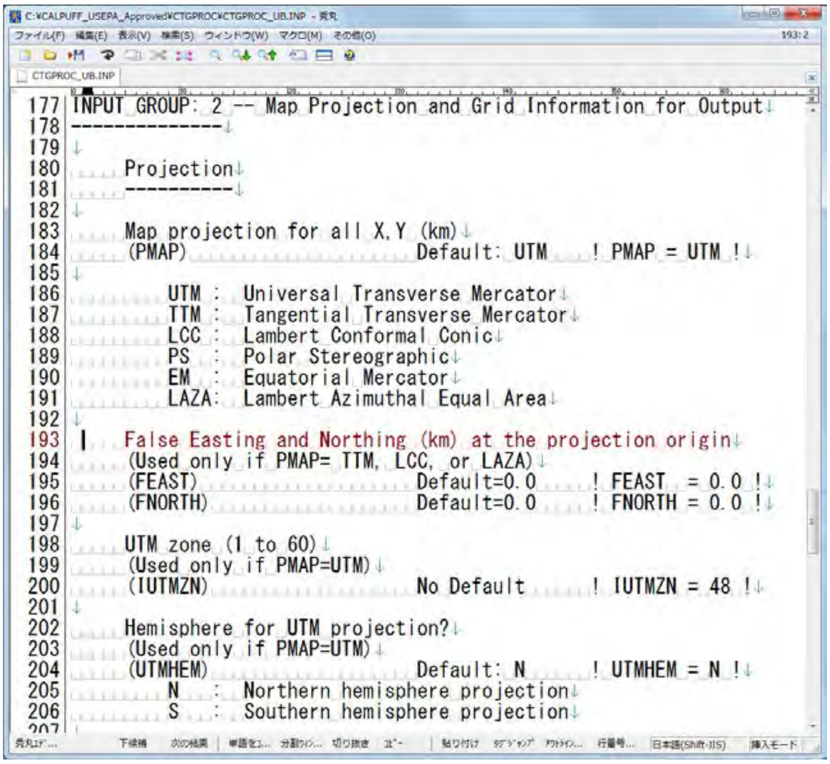
```
Subgroup (0b)
-------------

   The following NDBF Land Use Data Files are processed.
   Enter NDBF lines identifying the file name for each,
   followed by a group terminator.  The type of data base
   for each file is designated by the assignment name:

   (CTG)     designates USGS CTG (compressed)
   (NZGEN)   designates New Zealand Generic
   (GLAZNA)  designates USGS Global (Lambert Azimuthal) for North America
   (GLAZSA)  designates USGS Global (Lambert Azimuthal) for South America
   (GLAZEU)  designates USGS Global (Lambert Azimuthal) for Eurasia - Europe
   (GLAZAS)  designates USGS Global (Lambert Azimuthal) for Eurasia - Asia
   (GLAZAF)  designates USGS Global (Lambert Azimuthal) for Africa
   (GLAZAP)  designates USGS Global (Lambert Azimuthal) for Australia-Pacific

  ! GLAZAS  =  eausgs2_0la.img  !  !END!
```

Set the datum of input data. Since input data is ”USGS Global (Lambert Azimuthal) for Eurasia – Asia” in this case, check whether [DUSGSLA] is ”ESR-S”.



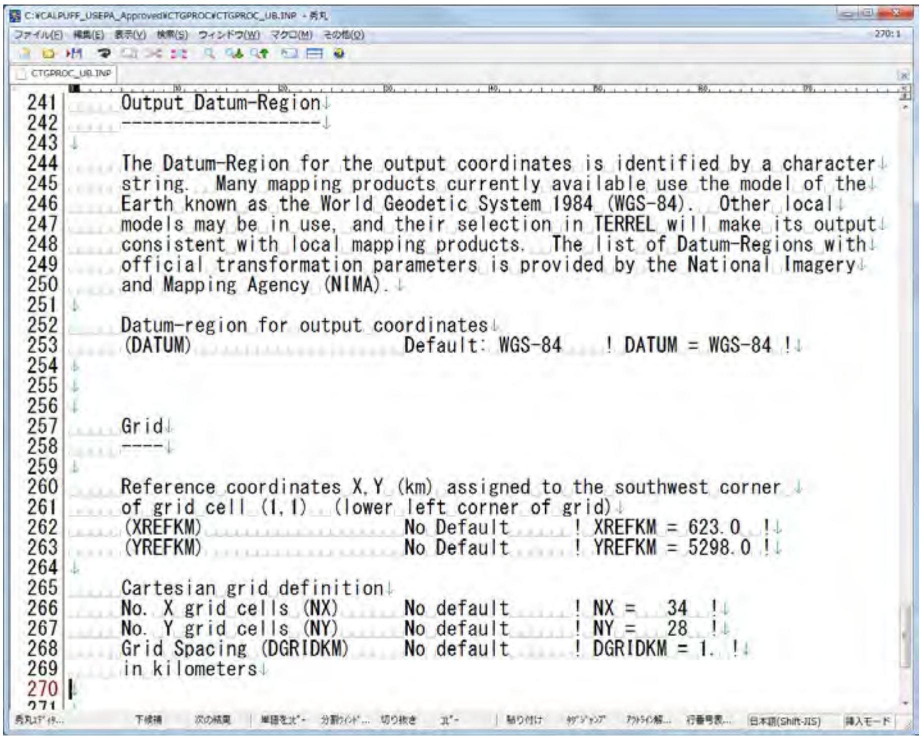
```
    Input Datum-Region
    ------------------
    The Datum-Region for coordinates in the input LULC Data File may be
    identified in the header records of the file.  Check the file documentation
    and change these defaults as needed.  The list of Datum-Regions with
    official transformation parameters is provided by the National Imagery and
    and Mapping Agency (NIMA).

    Datum-region for input LULC Data File coordinates

    (DCTG)                  Default: NAS-C    ! DCTG    = NAS-C  !
    for LULC = 1: USGS CTG (compressed)

    (DUSGSLA)               Default: ESR-S    ! DUSGSLA  = ESR-S  !
    for LULC = 2: USGS Global (Lambert Azimuthal)

    (DNZGEN)                Default: WGS-84   ! DNZGEN  = WGS-84 !
    for LULC = 3: New Zealand Generic
```

Set the same projection of output data as “TERREL” (PMAP etc.).



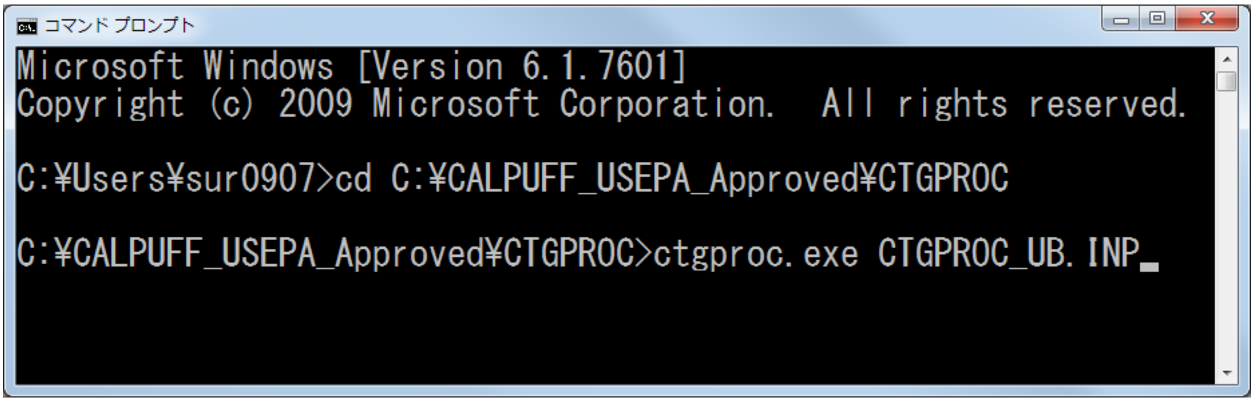
```
INPUT GROUP: 2 -- Map Projection and Grid Information for Output
--------------

    Projection
    ----------

    Map projection for all X,Y (km)
    (PMAP)                     Default: UTM    ! PMAP = UTM !

          UTM :  Universal Transverse Mercator
          TTM :  Tangential Transverse Mercator
          LCC :  Lambert Conformal Conic
          PS  :  Polar Stereographic
          EM  :  Equatorial Mercator
          LAZA:  Lambert Azimuthal Equal Area

    False Easting and Northing (km) at the projection origin
    (Used only if PMAP= TTM, LCC, or LAZA)
    (FEAST)                    Default=0.0     ! FEAST  = 0.0 !
    (FNORTH)                   Default=0.0     ! FNORTH = 0.0 !

    UTM zone (1 to 60)
    (Used only if PMAP=UTM)
    (IUTMZN)                   No Default      ! IUTMZN = 48 !

    Hemisphere for UTM projection?
    (Used only if PMAP=UTM)
    (UTMHEM)                   Default: N      ! UTMHEM = N !
          N   :  Northern hemisphere projection
          S   :  Southern hemisphere projection
```

Set the datum of output (DATUM), the grid type of output (IGRID), reference point coordinates for grid of output at lower left corner (XREFKM, YREFKM), the number of grid (NX, NY), and grid spacing (DGRIDKM). These items have to be the same setting as “TERREL”

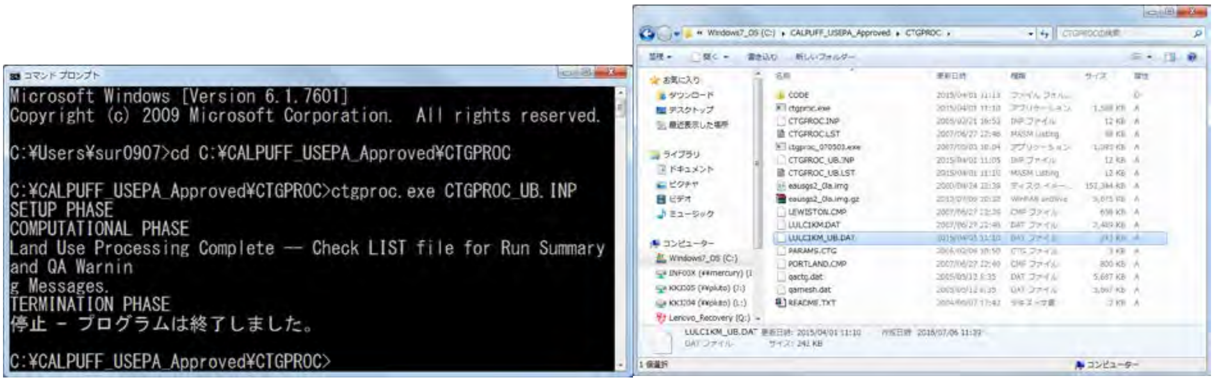


```
    Output Datum-Region
    -------------------

    The Datum-Region for the output coordinates is identified by a character
    string.  Many mapping products currently available use the model of the
    Earth known as the World Geodetic System 1984 (WGS-84).  Other local
    models may be in use, and their selection in TERREL will make its output
    consistent with local mapping products.  The list of Datum-Regions with
    official transformation parameters is provided by the National Imagery
    and Mapping Agency (NIMA).

    Datum-region for output coordinates
    (DATUM)                    Default: WGS-84    ! DATUM = WGS-84 !



    Grid
    ----

    Reference coordinates X,Y (km) assigned to the southwest corner
    of grid cell (1,1)  (lower left corner of grid)
    (XREFKM)                   No Default      ! XREFKM = 623.0  !
    (YREFKM)                   No Default      ! YREFKM = 5298.0 !

    Cartesian grid definition
    No. X grid cells (NX)      No default      ! NX =    34  !
    No. Y grid cells (NY)      No default      ! NY =    28  !
    Grid Spacing (DGRIDKM)     No default      ! DGRIDKM = 1.  !
    in kilometers
```

Move the “CTGPROC” folder in command prompt, input “CTGPROC.exe <input file name>.INP”, and press [Enter] (Here it is “CTGPROC_UB.INP”).



When showing "TERMINATION PHASE" message and completing calculation, you check to make output files. Output file is "LULC1KM_UB.DAT" in this case.



2.3 Developing Geological Data

2.3.1 Outline

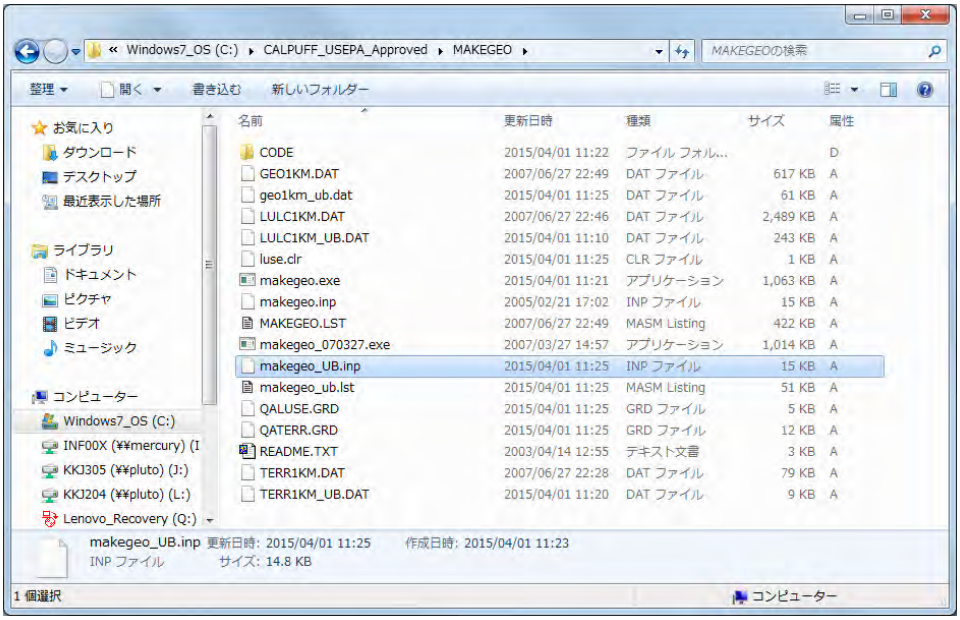
Geological data is made by using elevation data made in "TERREL" and land use data made in "CTGPROC".

CALPUFF includes MAKEGEO as processor to combine elevation data and land use data.

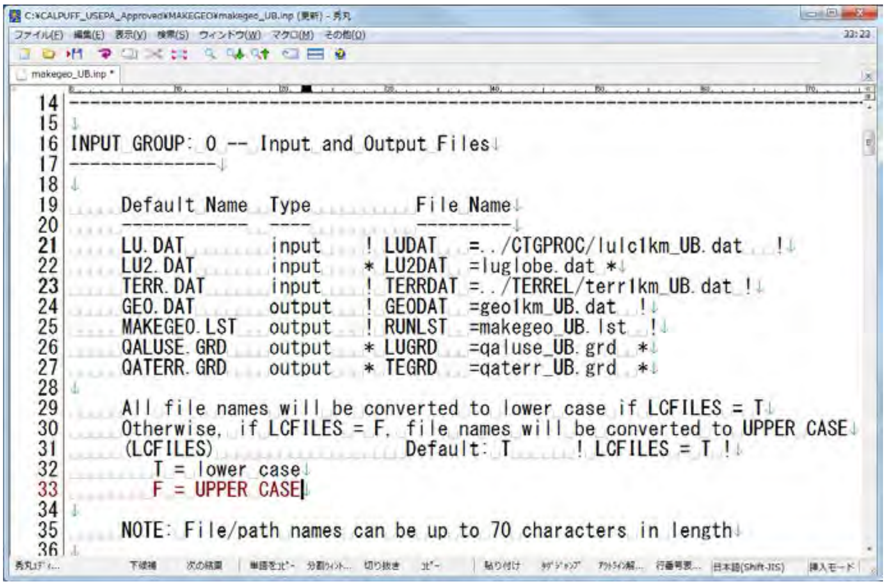
Set input file, output file, projection, datum, calculation range, and calculation resolution in TERREL. Output geological data file is used in CALMET processor.

2.3.2 Developing Method

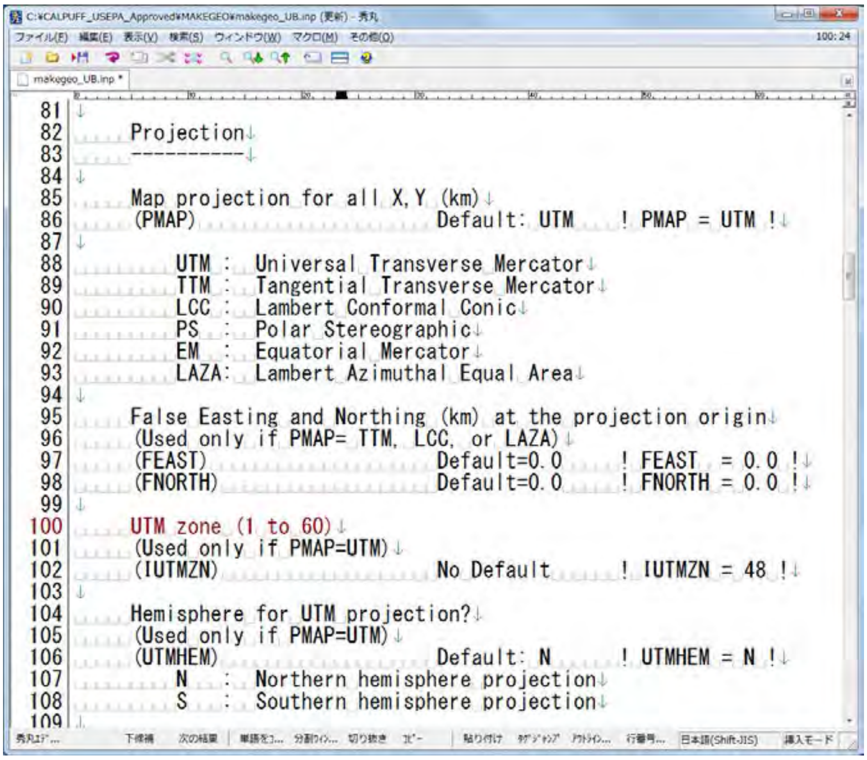
Open INP file in "MAKEGEO" folder.



Set input file (LUDAT, TERRDAT) and output file name (GEODAT, RUNLST).

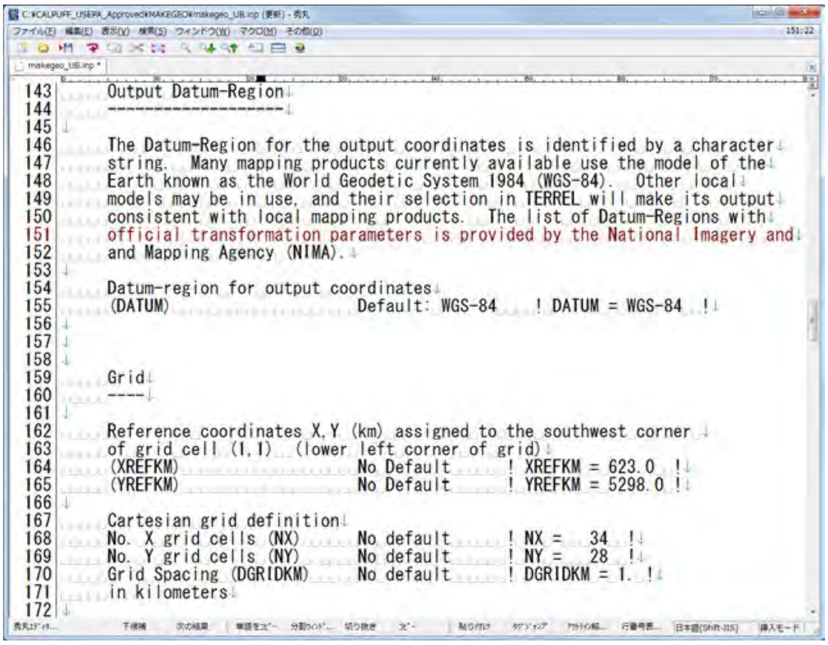


Set the same projection as “TERREL” etc. (PMAP etc.).



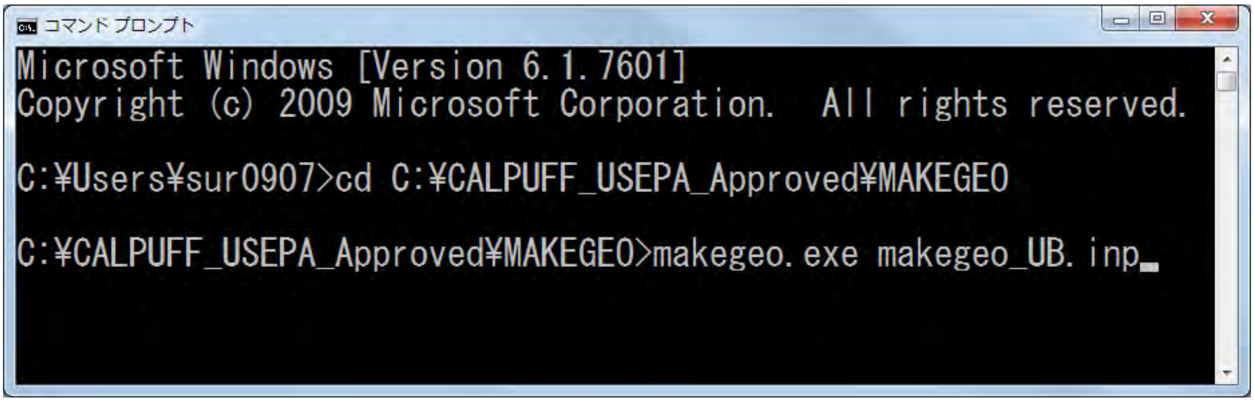
```
    Projection
    ----------

    Map projection for all X,Y (km)
    (PMAP)                     Default: UTM    ! PMAP = UTM !

          UTM :  Universal Transverse Mercator
          TTM :  Tangential Transverse Mercator
          LCC :  Lambert Conformal Conic
          PS  :  Polar Stereographic
          EM  :  Equatorial Mercator
          LAZA:  Lambert Azimuthal Equal Area

    False Easting and Northing (km) at the projection origin
    (Used only if PMAP= TTM, LCC, or LAZA)
    (FEAST)                    Default=0.0     ! FEAST  = 0.0 !
    (FNORTH)                   Default=0.0     ! FNORTH = 0.0 !

    UTM zone (1 to 60)
    (Used only if PMAP=UTM)
    (IUTMZN)                   No Default      ! IUTMZN = 48 !

    Hemisphere for UTM projection?
    (Used only if PMAP=UTM)
    (UTMHEM)                   Default: N      ! UTMHEM = N !
          N   :  Northern hemisphere projection
          S   :  Southern hemisphere projection
```

Set the datum of output (DATUM), the grid type of output (IGRID), reference point coordinates for grid of output at lower left corner (XREFKM, YREFKM), the number of grid (NX, NY), and grid spacing (DGRIDKM). These items have to be the same setting as “TERREL”.

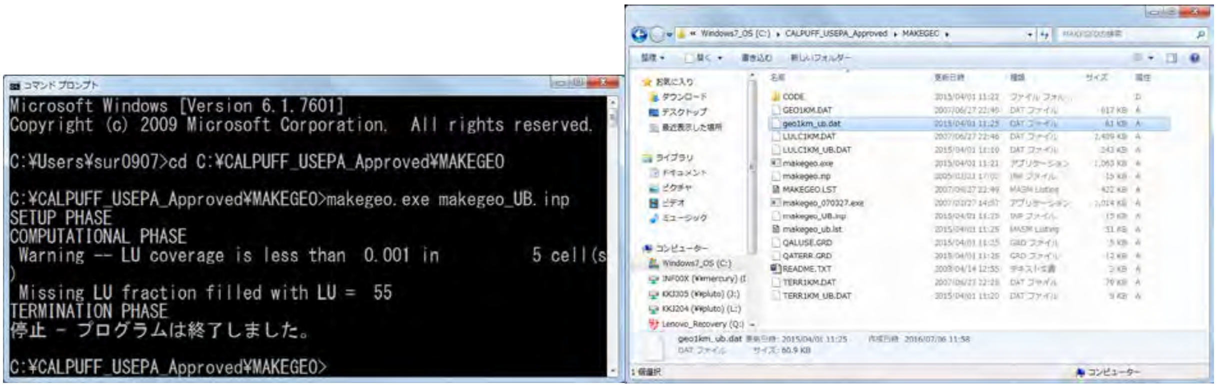


```
    Output Datum-Region
    -------------------

    The Datum-Region for the output coordinates is identified by a character
    string.  Many mapping products currently available use the model of the
    Earth known as the World Geodetic System 1984 (WGS-84).  Other local
    models may be in use, and their selection in TERREL will make its output
    consistent with local mapping products.  The list of Datum-Regions with
    official transformation parameters is provided by the National Imagery and
    and Mapping Agency (NIMA).

    Datum-region for output coordinates
    (DATUM)                    Default: WGS-84    ! DATUM = WGS-84  !



    Grid
    ----

    Reference coordinates X,Y (km) assigned to the southwest corner
    of grid cell (1,1)  (lower left corner of grid)
    (XREFKM)                   No Default      ! XREFKM = 623.0  !
    (YREFKM)                   No Default      ! YREFKM = 5298.0 !

    Cartesian grid definition
    No. X grid cells (NX)      No default      ! NX =    34  !
    No. Y grid cells (NY)      No default      ! NY =    28  !
    Grid Spacing (DGRIDKM)     No default      ! DGRIDKM = 1.  !
     in kilometers
```

Move the “MAKEGEO” folder in command prompt, input “makegeo.exe <input file name>.INP”, and press [Enter] (Here it is “makegeo_UB.INP”).



When showing “TERMINATION PHASE” message and completing calculation, you check to make output files. Output file is ”geo1km_ub.dat” in this case.



3 Converting Meteorological Data

3.1 Converting Surface Meteorological Data

3.1.1 Outline

CALPUFF includes SMERGE as surface meteorological data conversion processor.

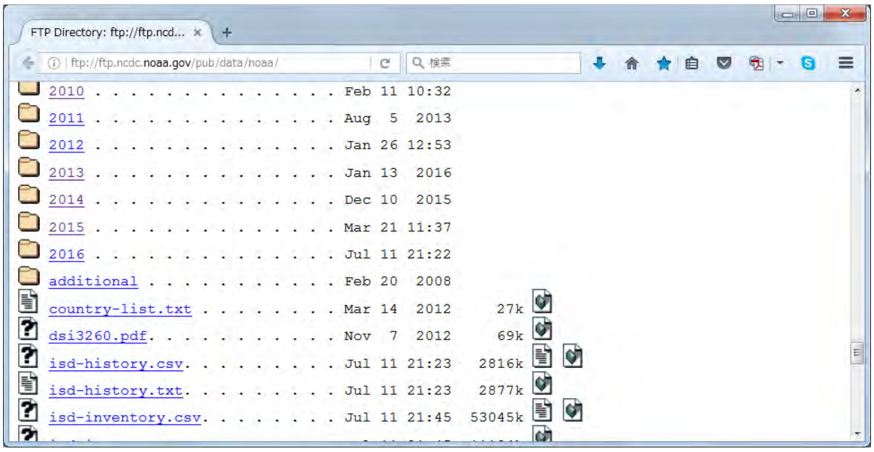
Preparing surface meteorological data is converted into the format of input data in SMERGE

SMERGE format is limited to 6 types such as CD144, NCDC SAMSON, NCDC HUSWO, ISHWO, TD3505, and TD9956 and these are the format of NCDC[3]. Among them, surface meteorological data created in the format of TD 3505 is available from NOAA's website. However, if there is missing in the data, it is necessary to make assumptions based on the data before and after.

Set input file, output file, calculation period, and input file format (TD3505) in SMERGE. The output surface meteorological data file is used by the CALMET processor.

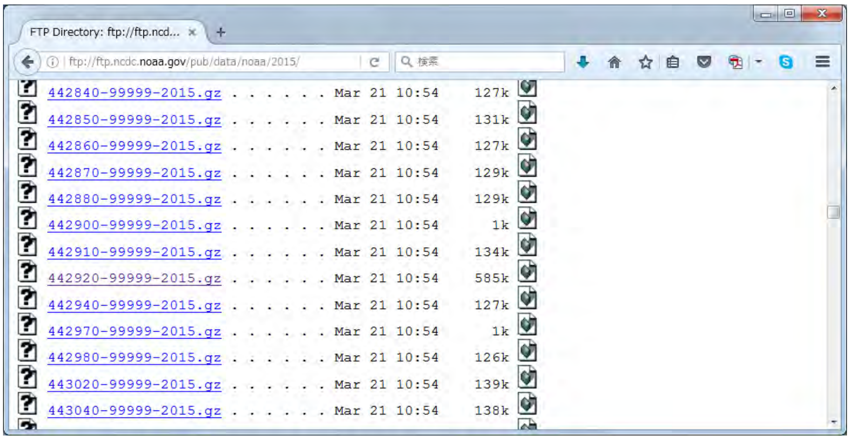
3.1.2 Obtaining Surface Meteorology Data

Obtain surface meteorological data formatted by TD3505 after accessing NOAA's website[4] and selecting the target year's folder. The detailed format of the data is described in "isd-lite-format.pdf".

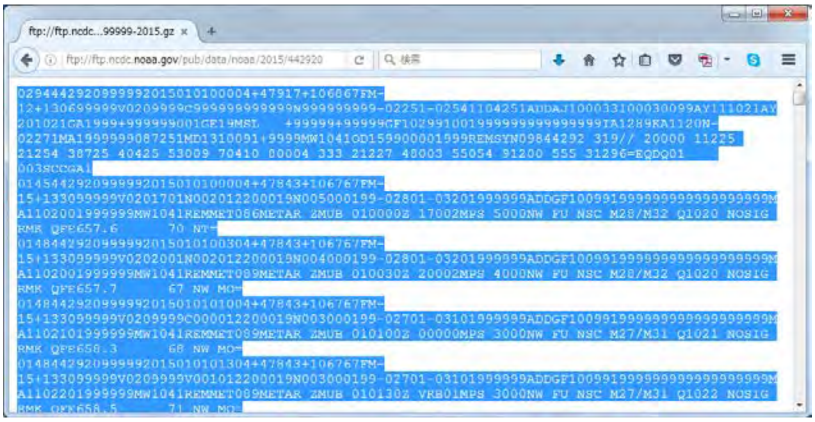


Obtain the surface meteorological data of target city. Code is specified by city[5] and code of UB city is "442920".

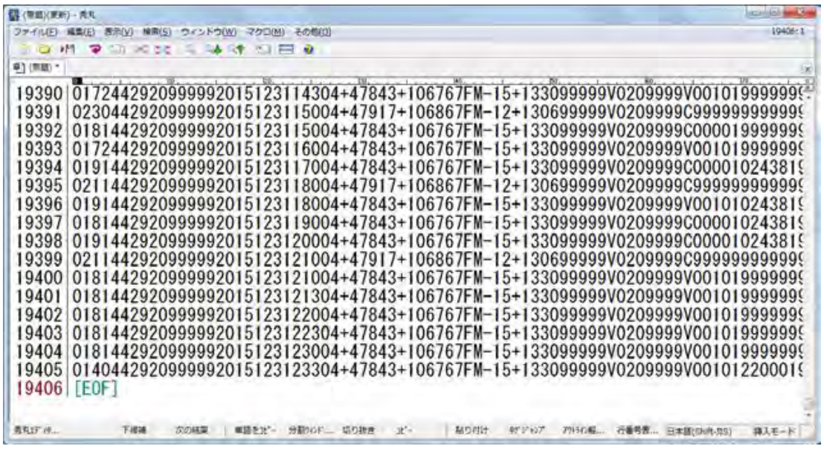
[3] the U.S. National Climatic Data Center
[4] ftp://ftp.ncdc.noaa.gov/pub/data/noaa/isd-lite
[5] http://rda.ucar.edu/datasets/ds353.4/inventories/station-list.html



Copy all data after opening “442920-99999-2015.gz”.

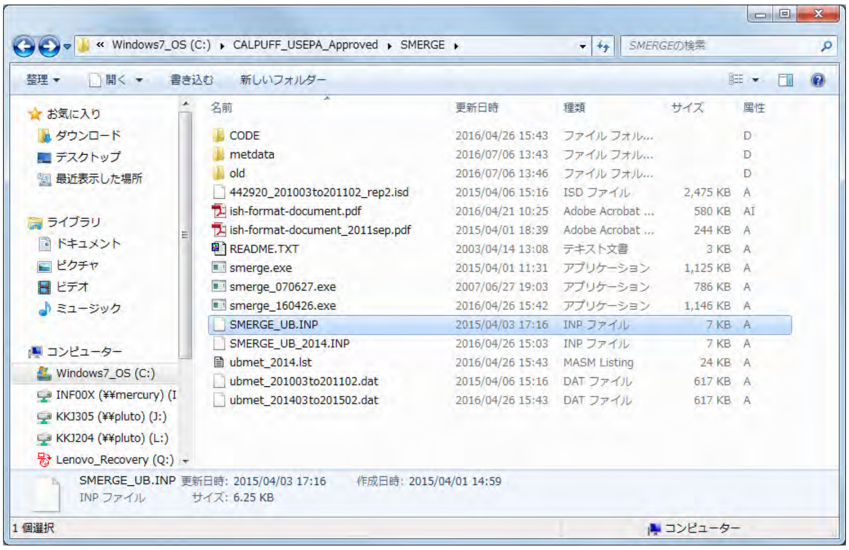


Paste to editor and save as the new name. Interpolate the mission data using the before and after data.

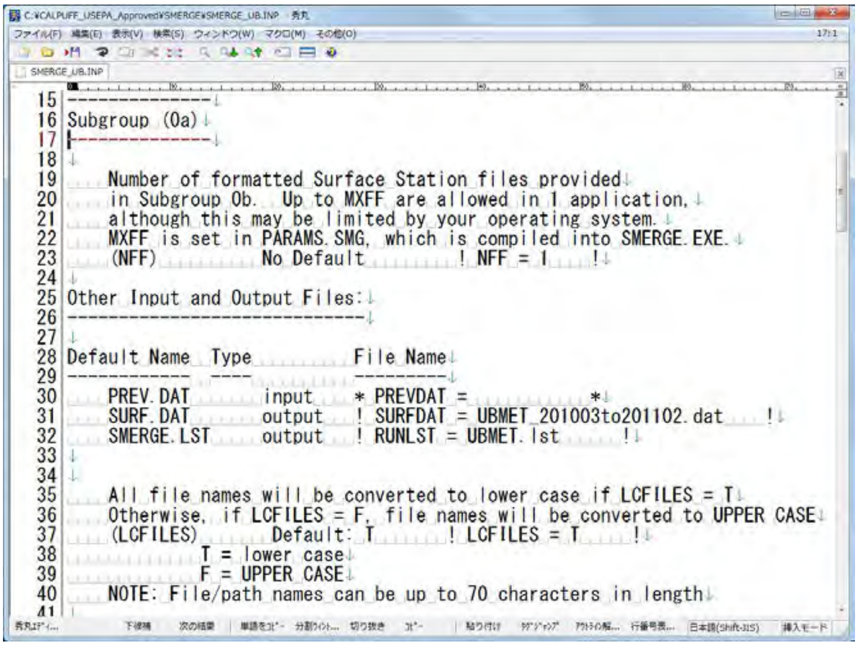


3.1.3 Developing Method

Open INP file in “SMERGE” folder.

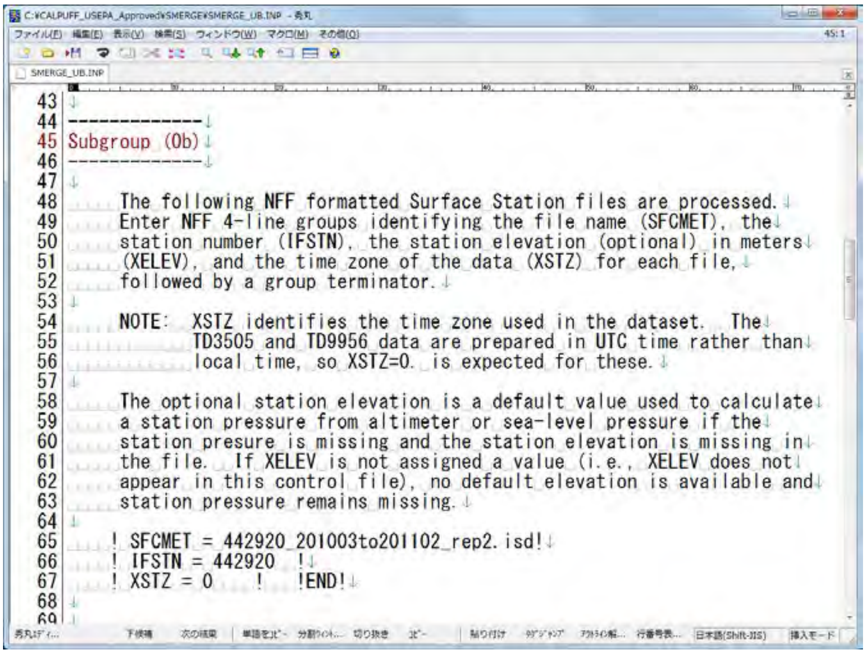


Set the number of input file as surface meteorological data (NFF) and output file name (SURFDAT, RUNLST).



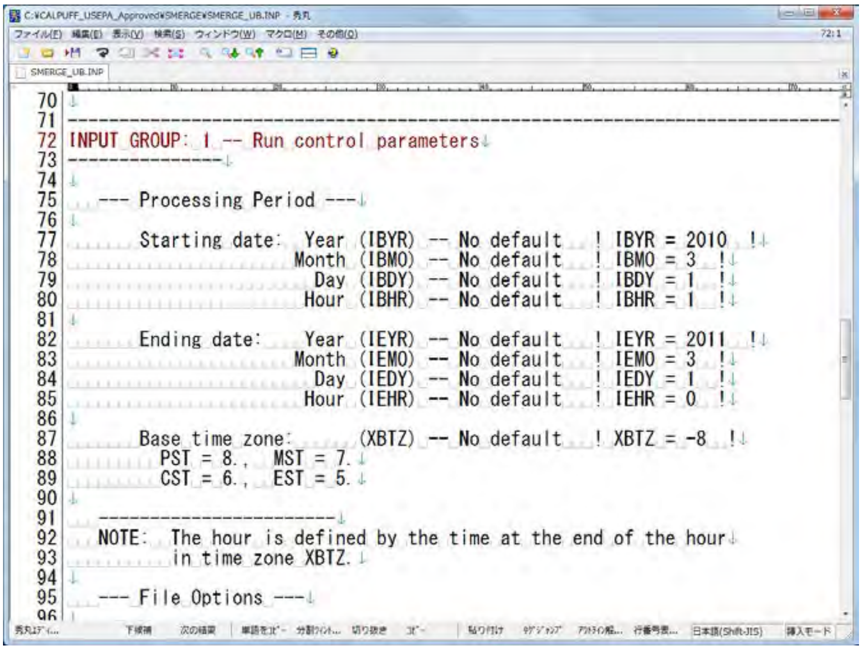
```
--------------
Subgroup (0a)
--------------

   Number of formatted Surface Station files provided
   in Subgroup 0b.  Up to MXFF are allowed in 1 application,
   although this may be limited by your operating system.
   MXFF is set in PARAMS.SMG, which is compiled into SMERGE.EXE.
   (NFF)           No Default       ! NFF = 1    !

Other Input and Output Files:
-----------------------------

Default Name  Type          File Name
------------  ----          ---------
   PREV.DAT       input     * PREVDAT =              *
   SURF.DAT       output    ! SURFDAT = UBMET_201003to201102.dat   !
   SMERGE.LST     output    ! RUNLST = UBMET.lst     !


   All file names will be converted to lower case if LCFILES = T
   Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
   (LCFILES)        Default: T        ! LCFILES = T    !
                 T = lower case
                 F = UPPER CASE
   NOTE: File/path names can be up to 70 characters in length
```

Set input file name of surface meteorological data (SFCMET), monitoring station number (IFSTN), and time zone (XSTZ). When using the surface meteorological data in the format of TD3505 or TD9956, since the time of them use UTC, time zone is set as “0”.



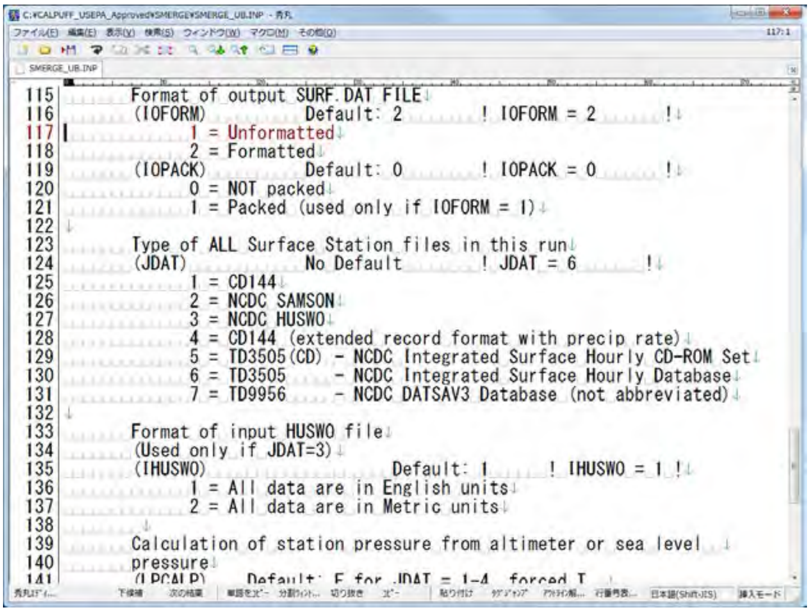
```
C:¥CALPUFF_USEPA_Approved¥SMERGE¥SMERGE_UB.INP

--------------
Subgroup (0b)
--------------

    The following NFF formatted Surface Station files are processed.
    Enter NFF 4-line groups identifying the file name (SFCMET), the
    station number (IFSTN), the station elevation (optional) in meters
    (XELEV), and the time zone of the data (XSTZ) for each file,
    followed by a group terminator.

    NOTE:  XSTZ identifies the time zone used in the dataset.  The
           TD3505 and TD9956 data are prepared in UTC time rather than
           local time, so XSTZ=0. is expected for these.

    The optional station elevation is a default value used to calculate
    a station pressure from altimeter or sea-level pressure if the
    station presure is missing and the station elevation is missing in
    the file.  If XELEV is not assigned a value (i.e., XELEV does not
    appear in this control file), no default elevation is available and
    station pressure remains missing.

   ! SFCMET = 442920_201003to201102_rep2.isd!
   ! IFSTN = 442920  !
   ! XSTZ = 0    !   !END!
```

Set the start date and time and the end date and time (IBYR, IBMO, IBDY, IBHR, IEYR, IEMO, IEDY, and IEHR) and time zone (XBTZ). When setting time zone, when going to the west, this value is positive and when going to the east, this value is negative. Therefore, set “-8” in Mongolia.

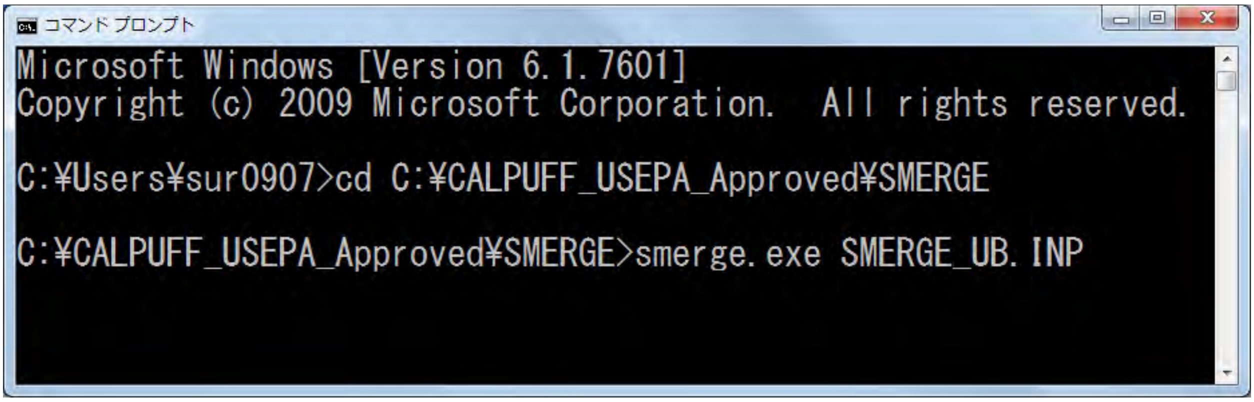


```
C:¥CALPUFF_USEPA_Approved¥SMERGE¥SMERGE_UB.INP

-------------------------------------------------------------------------------
INPUT GROUP: 1 -- Run control parameters
---------------

  --- Processing Period ---

      Starting date:  Year  (IBYR) -- No default   ! IBYR = 2010  !
                     Month  (IBMO) -- No default   ! IBMO = 3  !
                       Day  (IBDY) -- No default   ! IBDY = 1  !
                      Hour  (IBHR) -- No default   ! IBHR = 1  !

      Ending date:    Year  (IEYR) -- No default   ! IEYR = 2011  !
                     Month  (IEMO) -- No default   ! IEMO = 3  !
                       Day  (IEDY) -- No default   ! IEDY = 1  !
                      Hour  (IEHR) -- No default   ! IEHR = 0  !

      Base time zone:       (XBTZ) -- No default   ! XBTZ = -8  !
        PST = 8.,  MST = 7.
        CST = 6.,  EST = 5.

  ------------------------
  NOTE:  The hour is defined by the time at the end of the hour
         in time zone XBTZ.

  --- File Options ---
```

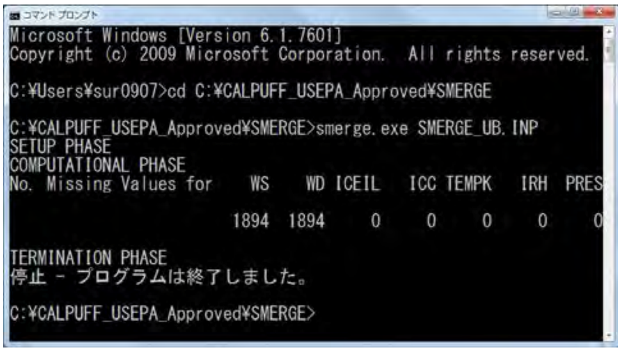
Set the file format of surface meteorological data.

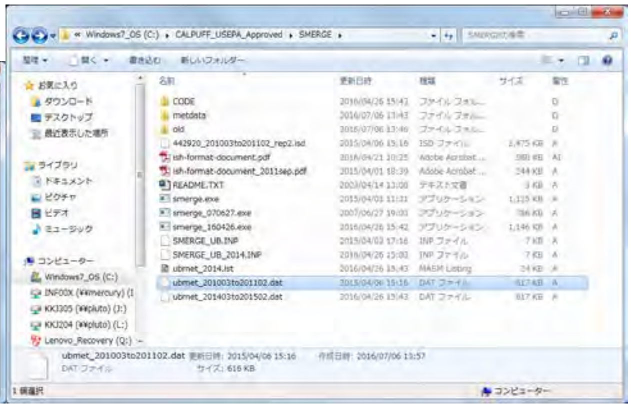


Move the “SMERGE” folder in command prompt, input “smerge.exe <input file name>.INP”, and press [Enter] (Here it is “SMERGE_UB.INP”).



When showing “TERMINATION PHASE” message and completing calculation, you check to make output files. Output file is ” ubmet_201003to201102.dat” in this case.





3.2 Converting Aerological Data

3.2.1 Outline

Aerological data is available from "NOAA/ESRL Radiosonde Database" [6].

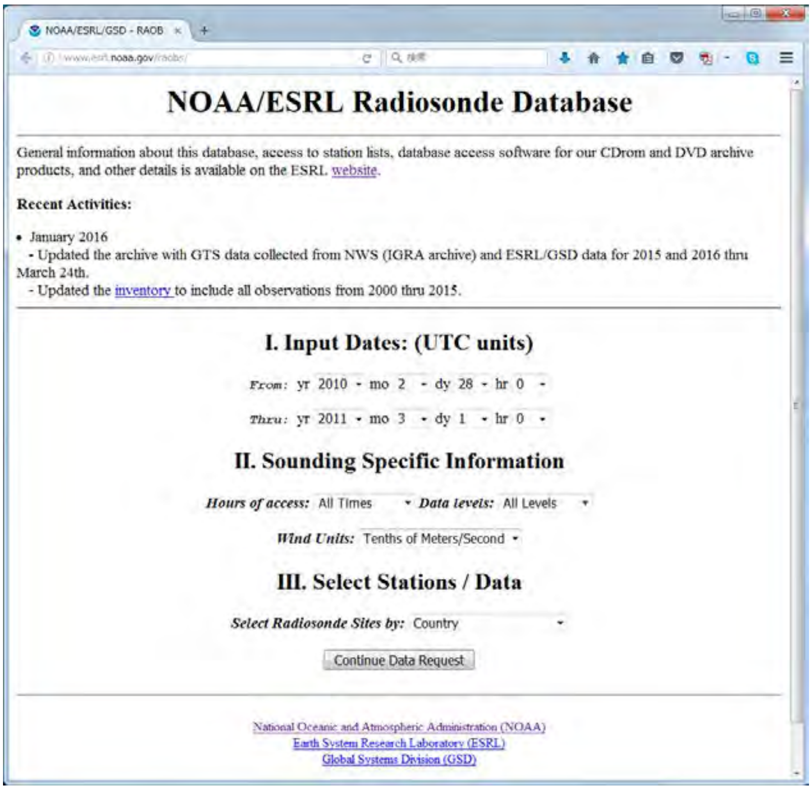
When setting target term, the unit of wind speed, monitoring station, and output format, show the data according to this setting. Set target term in UTC (Coordinated Universal Time). UTC is the value by subtracting eight hour from Mongolian time. After copying all displayed data, paste them to the text editor such as Notepad, and save as new file. This extension sets ".fsl".

CALPUFF includes READ62 as aerological data conversion processor.

Set input file, output file, calculation term, and input file format in READ62. Output aerological data file is used in CALMET processor.

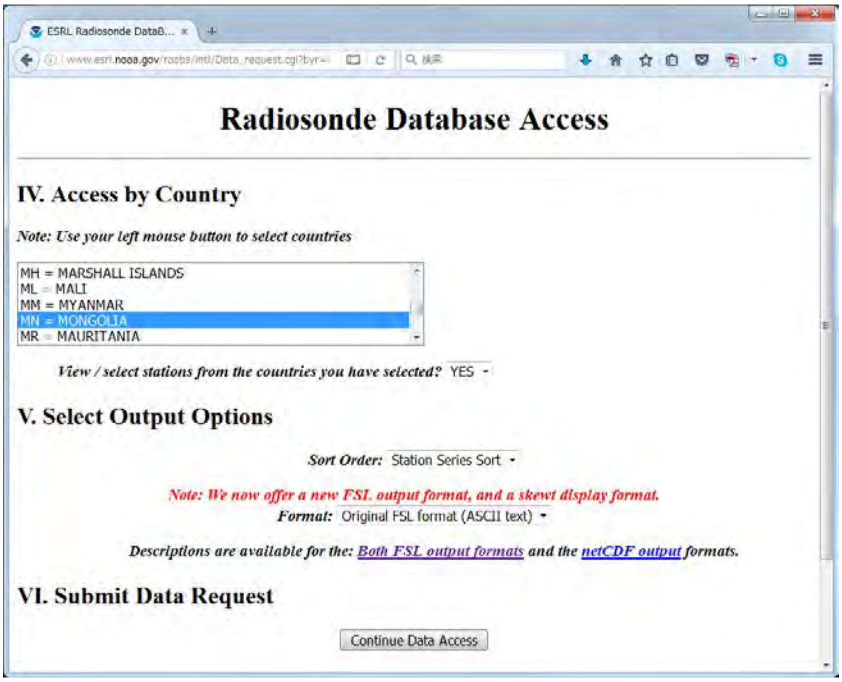
3.2.2 Obtaining Aerological Data

Visit "NOAA/ESRL Radiosonde Database" website and set target term. Date and time of aerological data is UTC, so considering the time-zone difference, set target term so that it covers the target term specified by SMERGE. Set the unit of wind speed to "Tenth of Meters/Second"

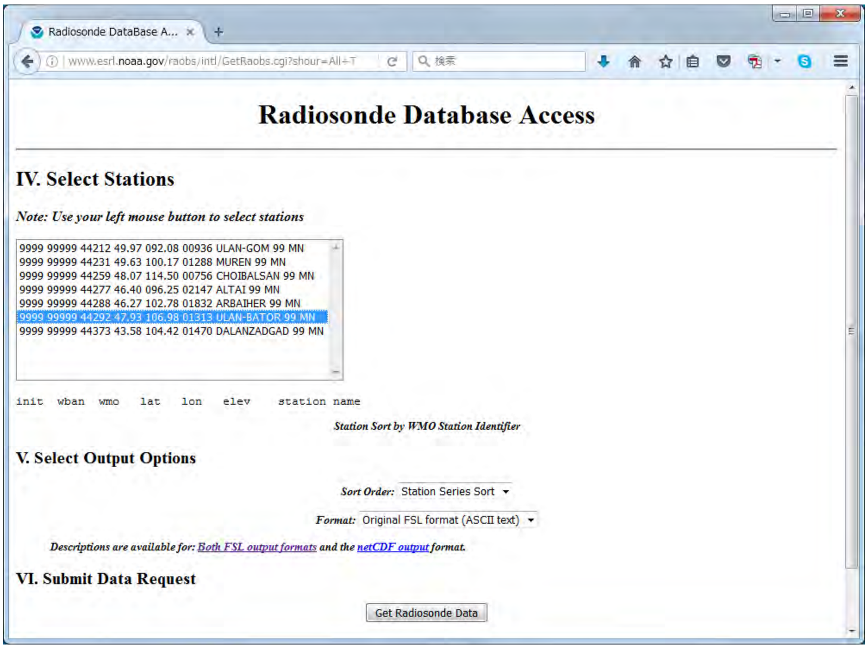


Set country (MN=Mongolia) and file format (Original FSL Format).

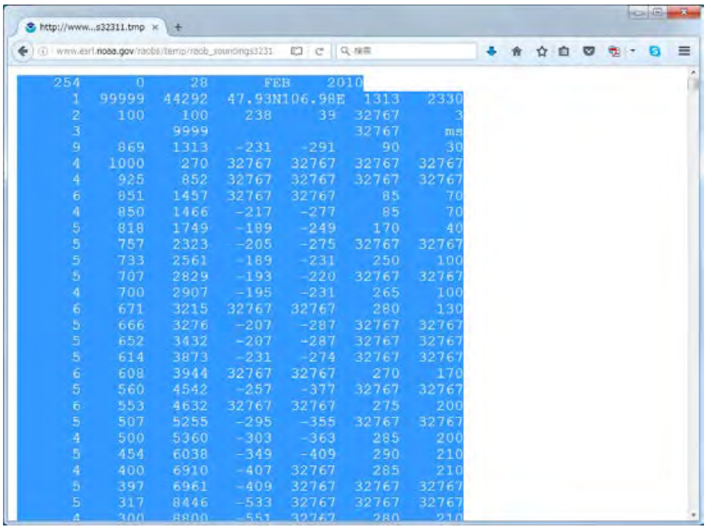
[6] http://www.esrl.noaa.gov/raobs/



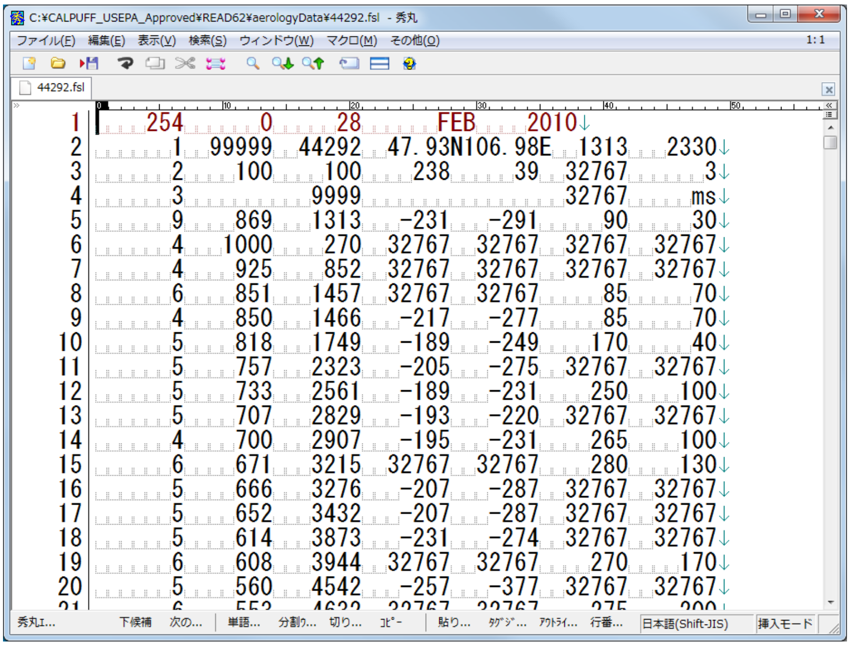
Select target monitoring station and click [Get Radiosonde Data]



Aerological data in target term is displayed. Select all data by pressing Ctrl+A and press Ctrl+C or select "copy" after right-clicking.

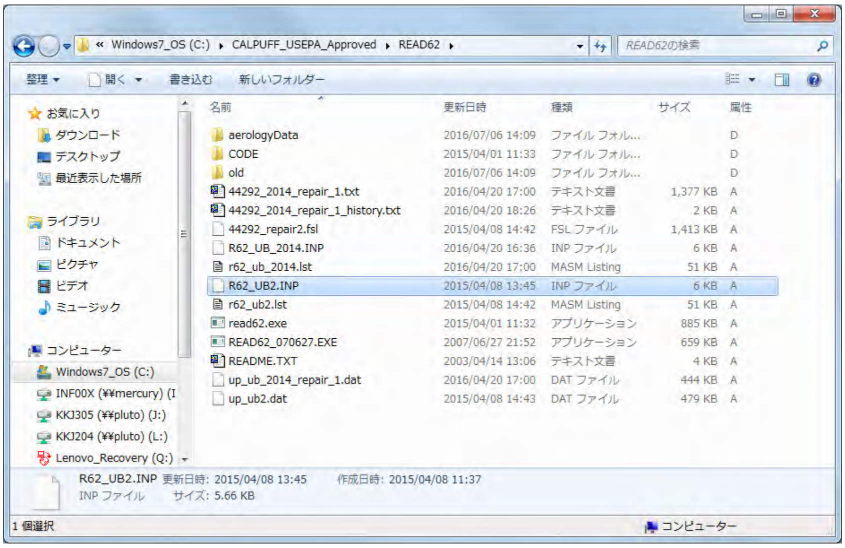


Paste the copied data to Notepad or text editor and save as this file as new file in “READ62” folder.

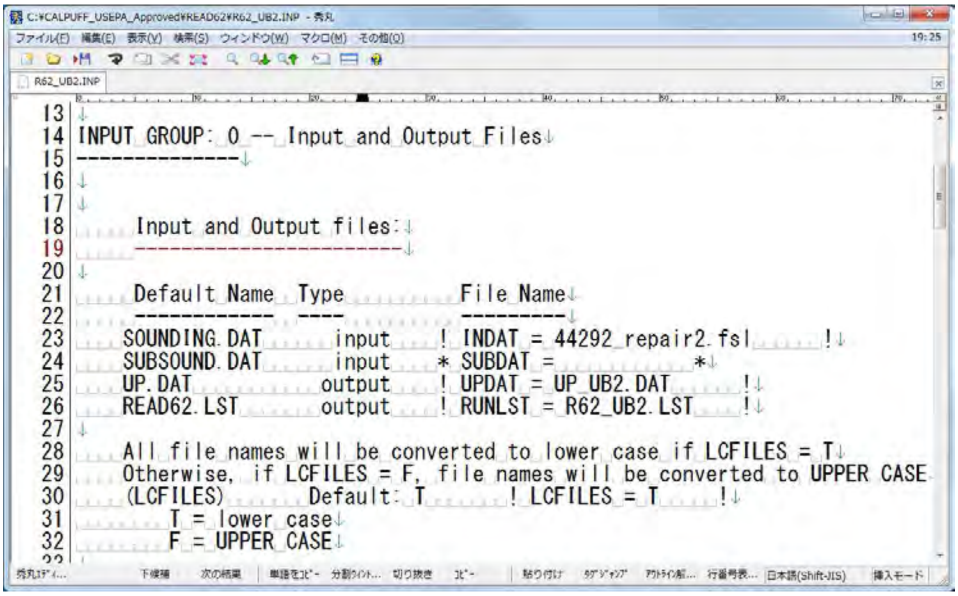


3.2.3 Developing Method

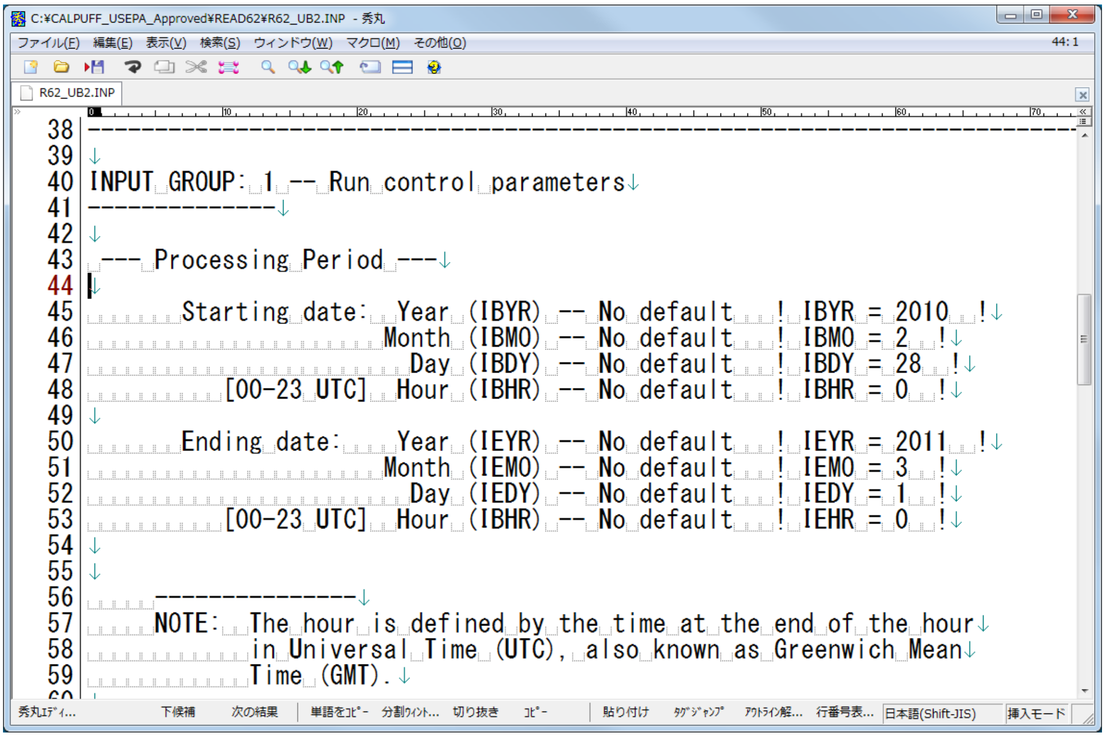
Open INP file in “READ62”.



Set input file (INDAT) and output file name (UPDAT, RUNLST).

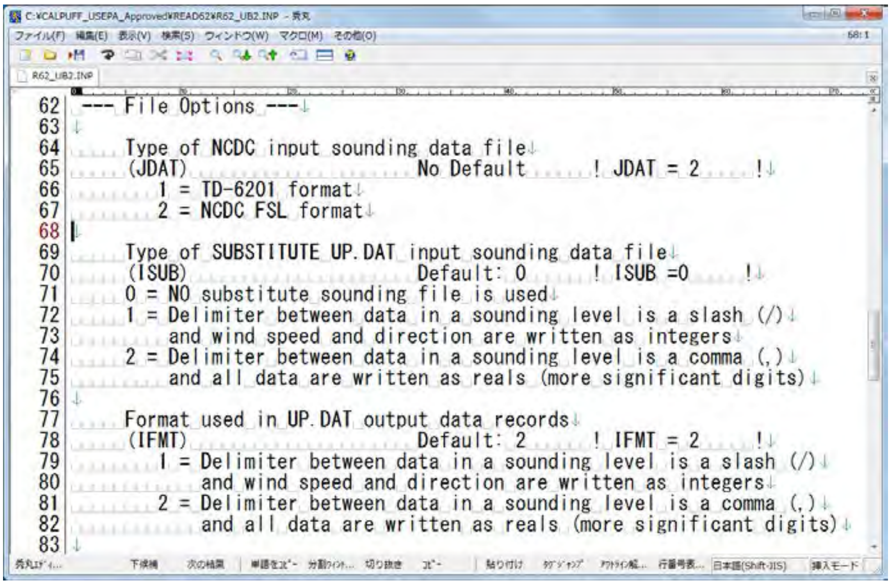


Set the start date and time and the end date and time (IBYR, IBMO, IBDY, IBHR, IEYR, IEMO, IEDY, and IEHR). Date and time of aerological data is UTC, so considering the time-zone difference, set target term so that it covers the target term specified by SMERGE.



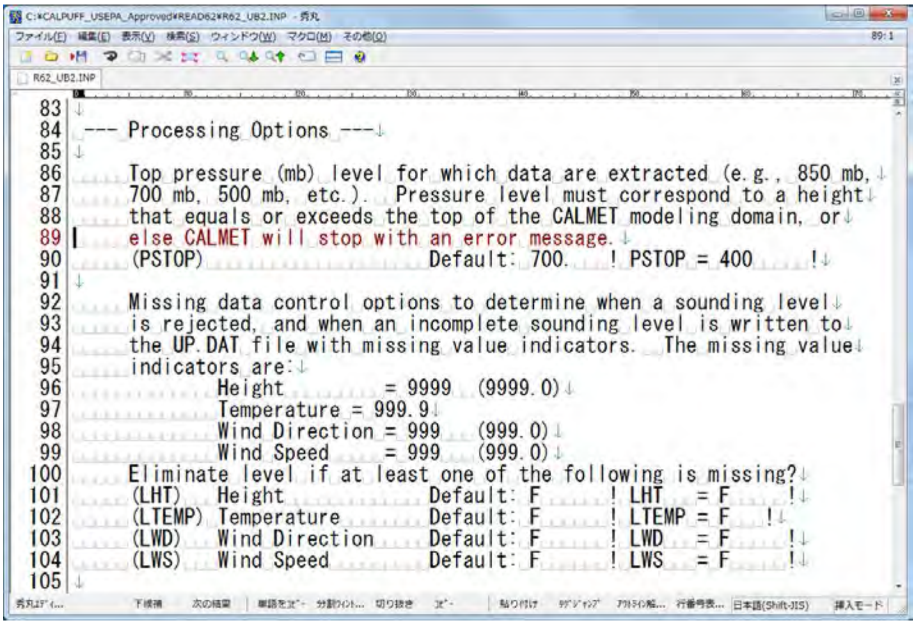

```
--------------------------------------------------------------------------------

INPUT GROUP: 1 -- Run control parameters
--------------

 --- Processing Period ---

       Starting date:   Year (IBYR) -- No default   ! IBYR = 2010  !
                       Month (IBMO) -- No default   ! IBMO = 2  !
                         Day (IBDY) -- No default   ! IBDY = 28  !
           [00-23 UTC]  Hour (IBHR) -- No default   ! IBHR = 0  !

       Ending date:     Year (IEYR) -- No default   ! IEYR = 2011  !
                       Month (IEMO) -- No default   ! IEMO = 3  !
                         Day (IEDY) -- No default   ! IEDY = 1  !
           [00-23 UTC]  Hour (IBHR) -- No default   ! IEHR = 0  !


     ---------------
     NOTE:  The hour is defined by the time at the end of the hour
            in Universal Time (UTC), also known as Greenwich Mean
            Time (GMT).
```

Set the format of aerological data (JDAT).



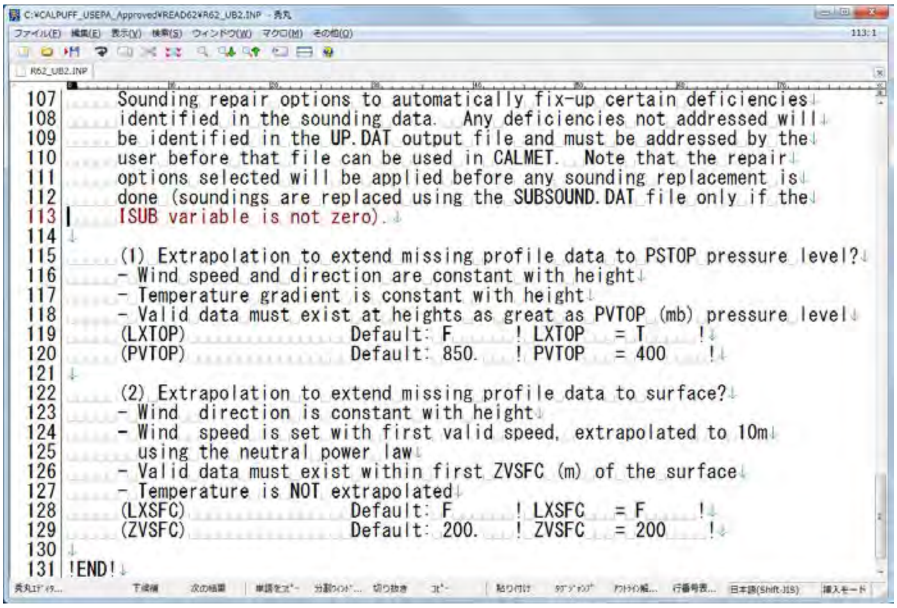

```
 --- File Options ---

     Type of NCDC input sounding data file
     (JDAT)                       No Default      ! JDAT = 2     !
         1 = TD-6201 format
         2 = NCDC FSL format

     Type of SUBSTITUTE UP.DAT input sounding data file
     (ISUB)                       Default: 0      ! ISUB =0      !
     0 = NO substitute sounding file is used
     1 = Delimiter between data in a sounding level is a slash (/)
         and wind speed and direction are written as integers
     2 = Delimiter between data in a sounding level is a comma (,)
         and all data are written as reals (more significant digits)

     Format used in UP.DAT output data records
     (IFMT)                       Default: 2      ! IFMT = 2     !
         1 = Delimiter between data in a sounding level is a slash (/)
             and wind speed and direction are written as integers
         2 = Delimiter between data in a sounding level is a comma (,)
             and all data are written as reals (more significant digits)
```

Set the top pressure of output aerological data (PSTOP).



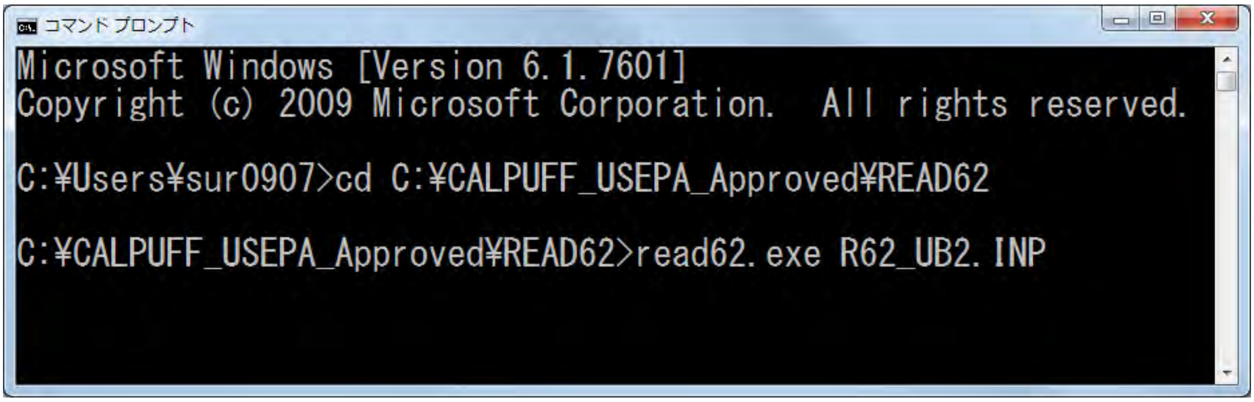
```

--- Processing Options ---

    Top pressure (mb) level for which data are extracted (e.g., 850 mb,
    700 mb, 500 mb, etc.).  Pressure level must correspond to a height
    that equals or exceeds the top of the CALMET modeling domain, or
    else CALMET will stop with an error message.
    (PSTOP)                     Default: 700.   ! PSTOP = 400      !

    Missing data control options to determine when a sounding level
    is rejected, and when an incomplete sounding level is written to
    the UP.DAT file with missing value indicators.  The missing value
    indicators are:
                 Height           = 9999   (9999.0)
                 Temperature = 999.9
                 Wind Direction = 999   (999.0)
                 Wind Speed       = 999   (999.0)
    Eliminate level if at least one of the following is missing?
    (LHT)    Height             Default: F       ! LHT   = F     !
    (LTEMP)  Temperature        Default: F       ! LTEMP = F   !
    (LWD)    Wind Direction     Default: F       ! LWD   = F     !
    (LWS)    Wind Speed         Default: F       ! LWS   = F     !

```

When extrapolating missing data with preceding and succeeding data, set the flag of extrapolation (LXTOP) to "T" and set the top value for extrapolation.

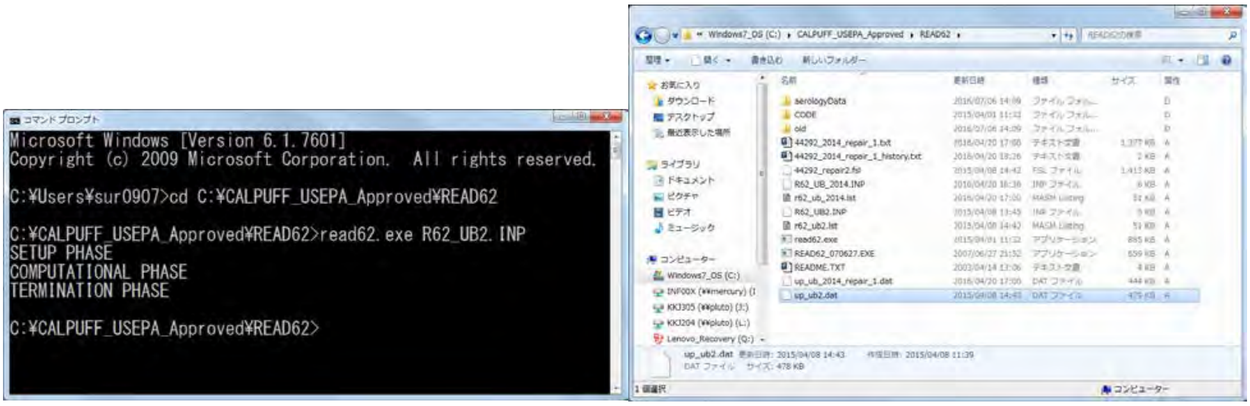


```
    Sounding repair options to automatically fix-up certain deficiencies
    identified in the sounding data.  Any deficiencies not addressed will
    be identified in the UP.DAT output file and must be addressed by the
    user before that file can be used in CALMET.  Note that the repair
    options selected will be applied before any sounding replacement is
    done (soundings are replaced using the SUBSOUND.DAT file only if the
    ISUB variable is not zero).

    (1) Extrapolation to extend missing profile data to PSTOP pressure level?
    - Wind speed and direction are constant with height
    - Temperature gradient is constant with height
    - Valid data must exist at heights as great as PVTOP (mb) pressure level
    (LXTOP)                  Default: F       ! LXTOP   = T      !
    (PVTOP)                  Default: 850.    ! PVTOP   = 400    !

    (2) Extrapolation to extend missing profile data to surface?
    - Wind  direction is constant with height
    - Wind  speed is set with first valid speed, extrapolated to 10m
      using the neutral power law
    - Valid data must exist within first ZVSFC (m) of the surface
    - Temperature is NOT extrapolated
    (LXSFC)                  Default: F       ! LXSFC   = F      !
    (ZVSFC)                  Default: 200.    ! ZVSFC   = 200    !

!END!
```

Move the "READ62" folder in command prompt, input "READ62.EXE <input file name>.INP", and press [Enter] (Here it is "R62_UB2.INP").



When showing “TERMINATION PHASE” message and completing calculation, you check to make output files. Output file is ”up_ub2.dat” in this case.



3.3 Developing Meteorological Model

3.3.1 Outline

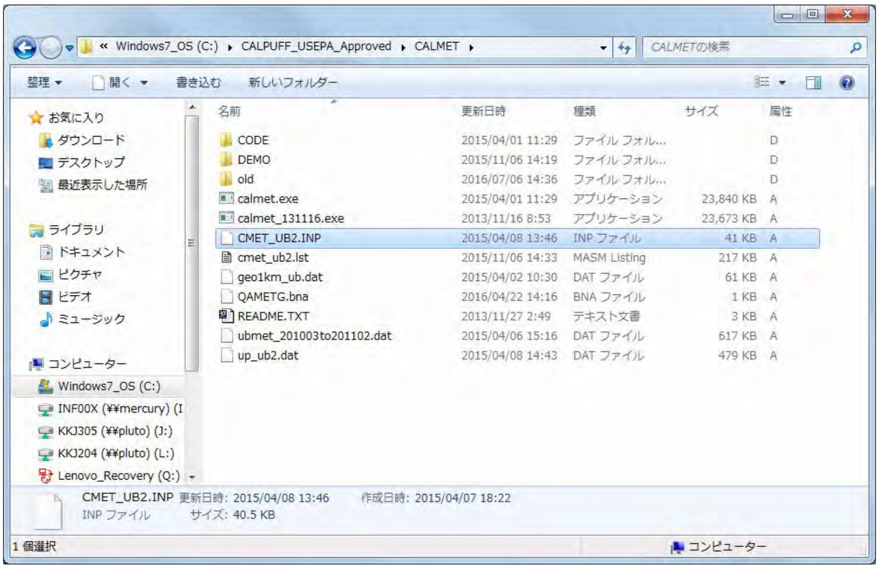
Meteorological model file is made by using geological data made in “MAKEGEO”, surface meteorological data made in “SMERGE”, and aerological data made in “READ62”.

CALPUFF includes CALMET as processor to make meteorological model file.

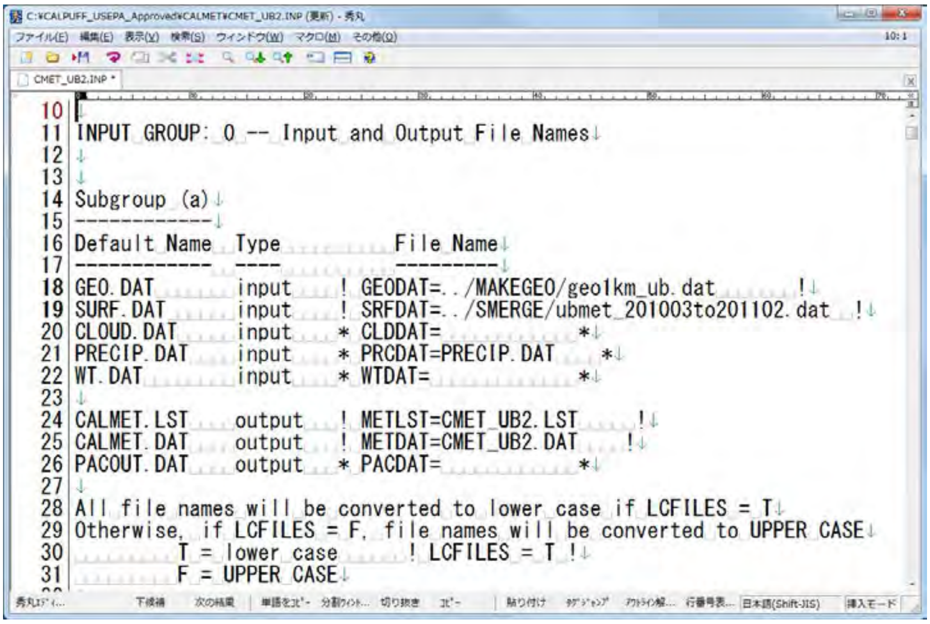
Set input file, output file, calculation term, projection, datum, calculation range, and calculation resolution in CALMET. These settings have to be the same setting as “MAKEGEO”, “SMERGE”, and “READ62”. Output meteorological model file is used in CALPUFF processor.

3.3.2 Developing Method

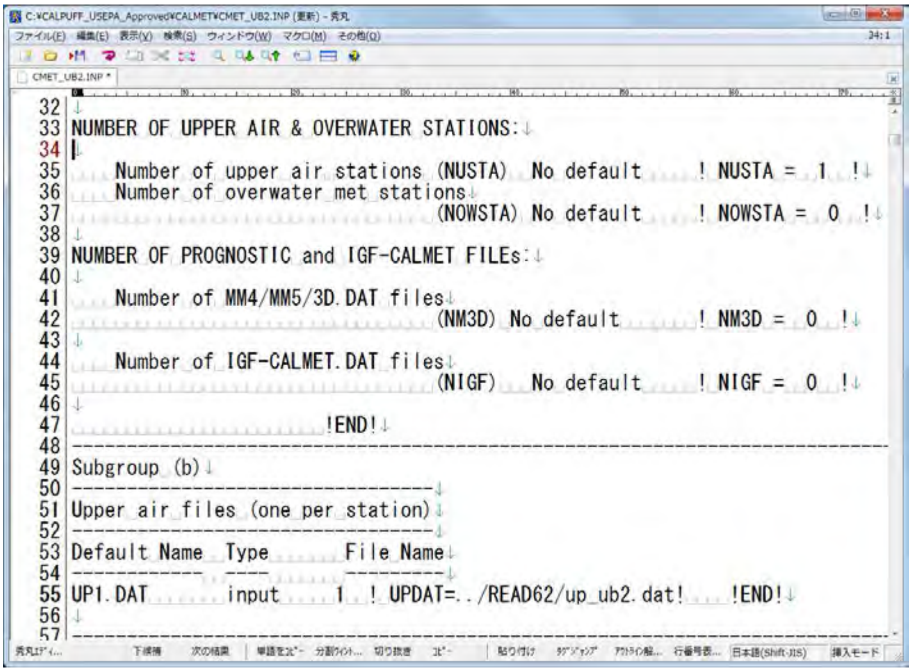
Open INP file in “CALMET” folder.



Set input file other than aerological data (GEODAT, SRFDAT), output file name (METLST, METDAT), and the number of aerological data file (NUSTA).

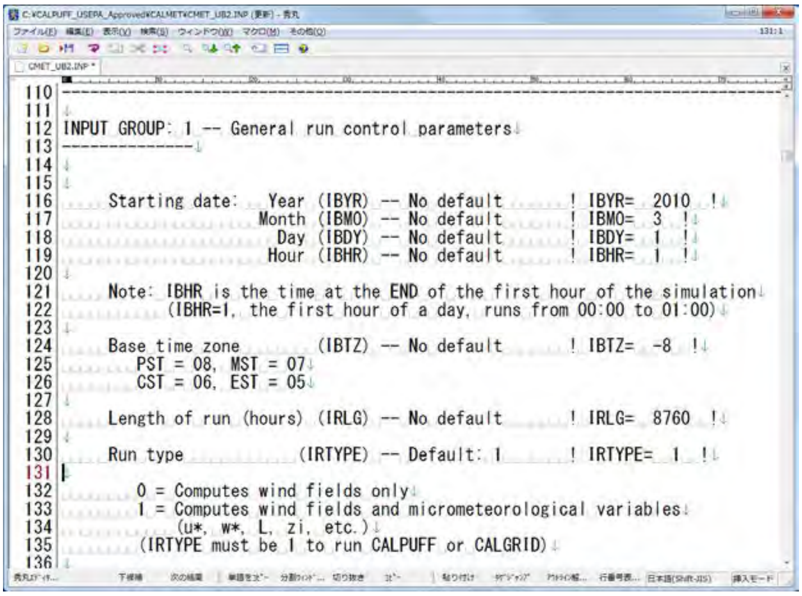


Set input file name of aerological data (UPDAT).



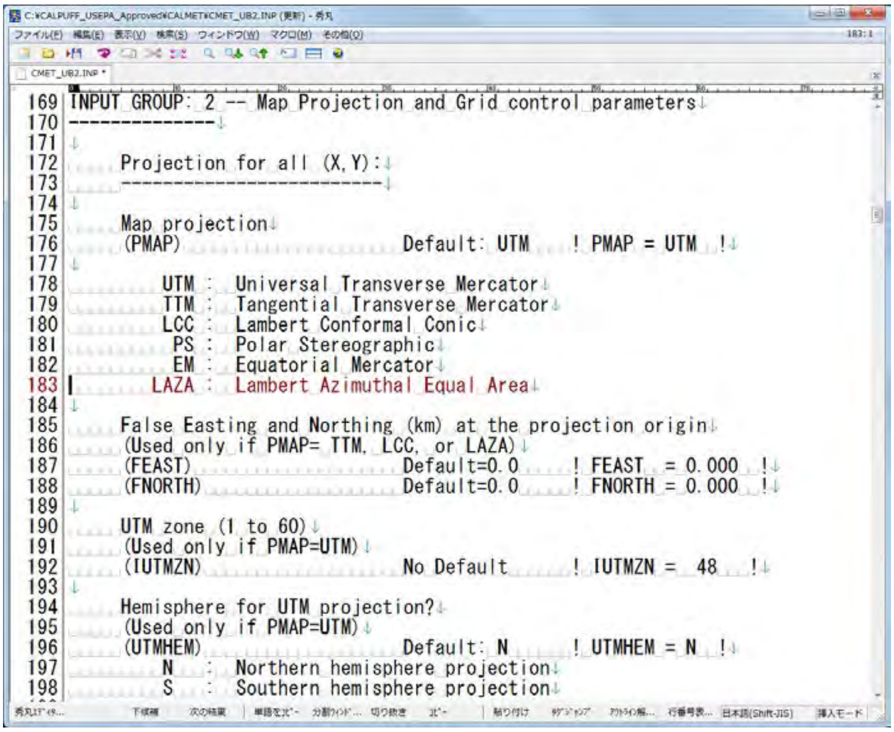
```

NUMBER OF UPPER AIR & OVERWATER STATIONS:

    Number of upper air stations (NUSTA)  No default     ! NUSTA =  1  !
    Number of overwater met stations
                                (NOWSTA) No default     ! NOWSTA =  0  !

NUMBER OF PROGNOSTIC and IGF-CALMET FILEs:

    Number of MM4/MM5/3D.DAT files
                                (NM3D)  No default     ! NM3D =  0  !

    Number of IGF-CALMET.DAT files
                                (NIGF)   No default     ! NIGF =  0  !

                        !END!
-------------------------------------------------------------------------------
Subgroup (b)
---------------------------------
Upper air files (one per station)
---------------------------------
Default Name  Type       File Name
------------  ----       ---------
UP1.DAT       input    1  ! UPDAT=../READ62/up_ub2.dat!    !END!

-------------------------------------------------------------------------------
```

Set the start date and time a (IBYR, IBMO, IBDY, and IBHR), time zone (IBTZ), and length of run (IRLG).



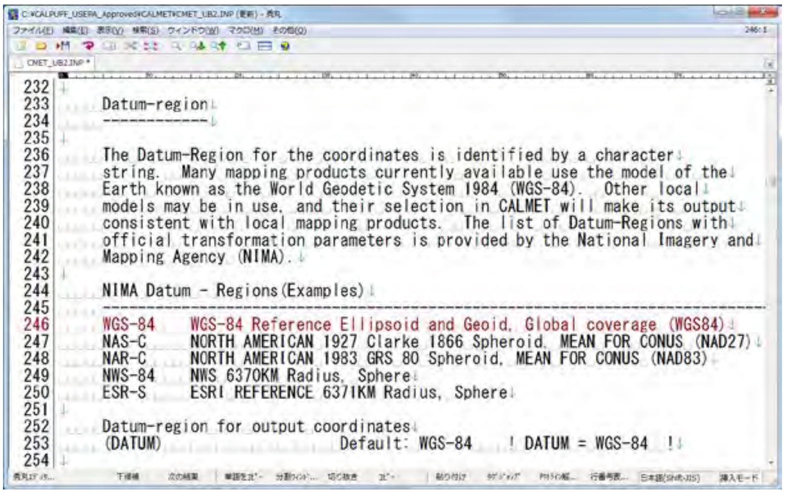
```
-------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------


     Starting date:    Year (IBYR) -- No default       ! IBYR=  2010  !
                      Month (IBMO) -- No default       ! IBMO=  3  !
                        Day (IBDY) -- No default       ! IBDY=  1  !
                       Hour (IBHR) -- No default       ! IBHR=  1  !

     Note: IBHR is the time at the END of the first hour of the simulation
           (IBHR=1, the first hour of a day, runs from 00:00 to 01:00)

     Base time zone          (IBTZ) -- No default       ! IBTZ=  -8  !
        PST = 08, MST = 07
        CST = 06, EST = 05

     Length of run (hours)  (IRLG) -- No default       ! IRLG=  8760  !

     Run type               (IRTYPE) -- Default: 1      ! IRTYPE=  1  !

        0 = Computes wind fields only
        1 = Computes wind fields and micrometeorological variables
            (u*, w*, L, zi, etc.)
        (IRTYPE must be 1 to run CALPUFF or CALGRID)

```

Set the projection of output data (PMAP etc.).



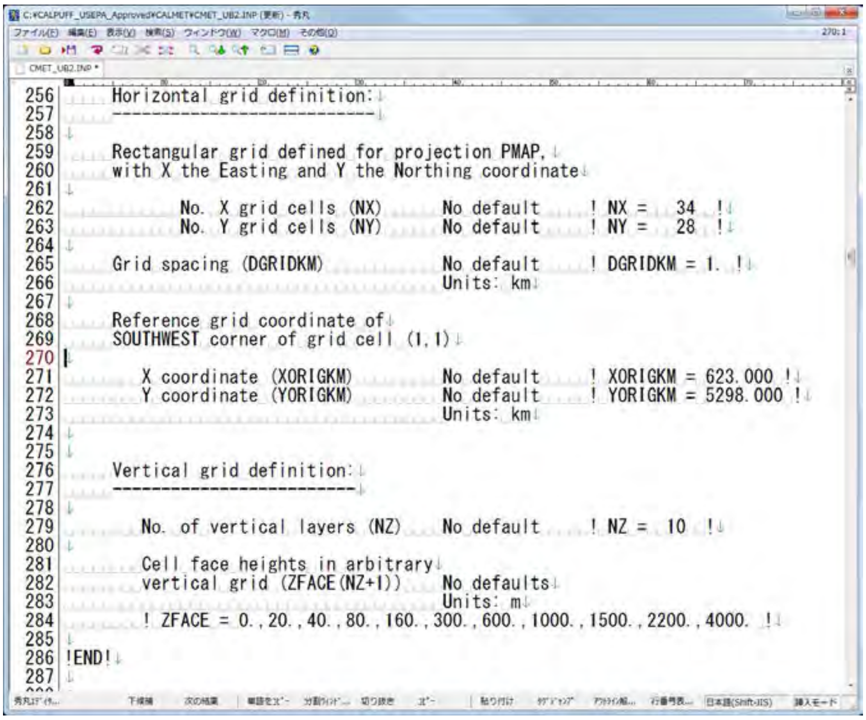
```
INPUT GROUP: 2 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM     ! PMAP = UTM  !

          UTM :  Universal Transverse Mercator
          TTM :  Tangential Transverse Mercator
          LCC :  Lambert Conformal Conic
           PS :  Polar Stereographic
           EM :  Equatorial Mercator
         LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                    Default=0.0      ! FEAST  = 0.000  !
     (FNORTH)                   Default=0.0      ! FNORTH = 0.000  !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                   No Default       ! IUTMZN =  48   !

     Hemisphere for UTM projection?
     (Used only if PMAP=UTM)
     (UTMHEM)                   Default: N       ! UTMHEM = N  !
          N   :  Northern hemisphere projection
          S   :  Southern hemisphere projection
```

Set the datum of output data (DATUM).

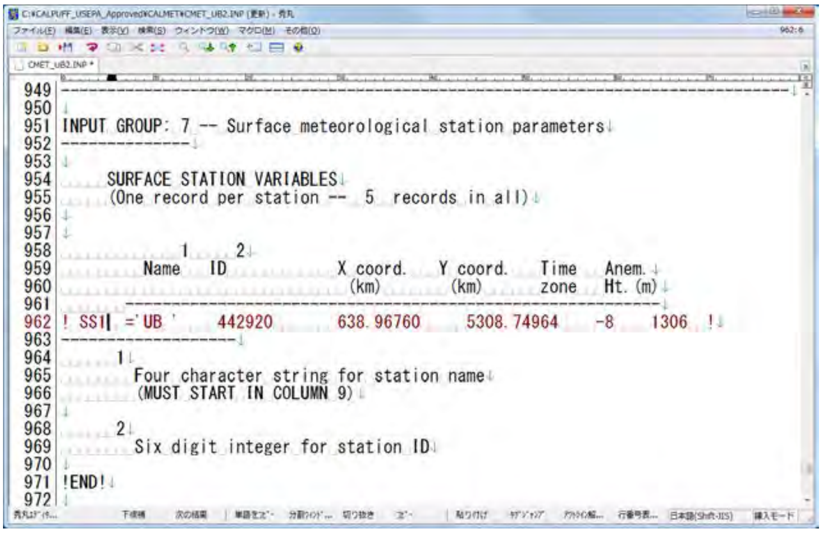


```
     Datum-region
     ------------

     The Datum-Region for the coordinates is identified by a character
     string.  Many mapping products currently available use the model of the
     Earth known as the World Geodetic System 1984 (WGS-84).  Other local
     models may be in use, and their selection in CALMET will make its output
     consistent with local mapping products.  The list of Datum-Regions with
     official transformation parameters is provided by the National Imagery and
     Mapping Agency (NIMA).

     NIMA Datum - Regions(Examples)
     ------------------------------------------------------------------------------
     WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
     NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
     NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
     NWS-84    NWS 6370KM Radius, Sphere
     ESR-S     ESRI REFERENCE 6371KM Radius, Sphere

     Datum-region for output coordinates
     (DATUM)                    Default: WGS-84    ! DATUM = WGS-84  !
```

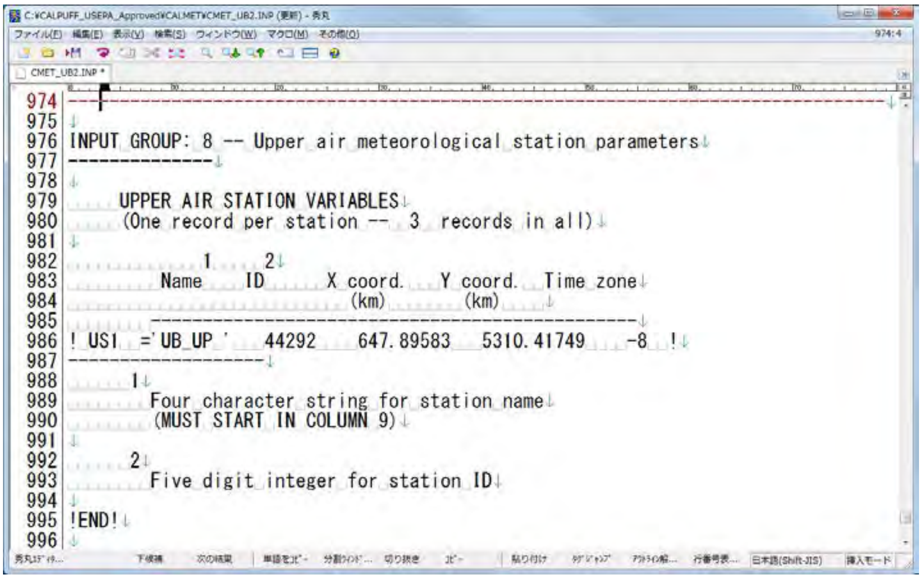
Set reference point coordinates at lower left corner of grid (XREFKM, YREFKM), the number of grid (NX, NY), and grid spacing (DGRIDKM). In addition, set the number of vertical grid and the height to divide the grid (ZFACE).



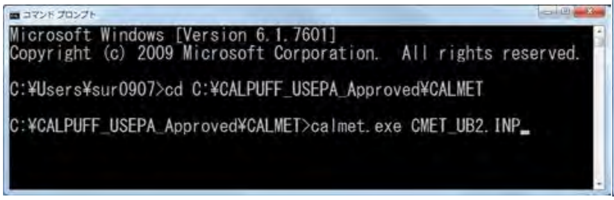
Set the name of surface meteorological data (NAME), monitoring station ID (ID), the location of monitoring station (X coord., Y coord.), time zone (Time zone), and elevation (Anem. Ht.).

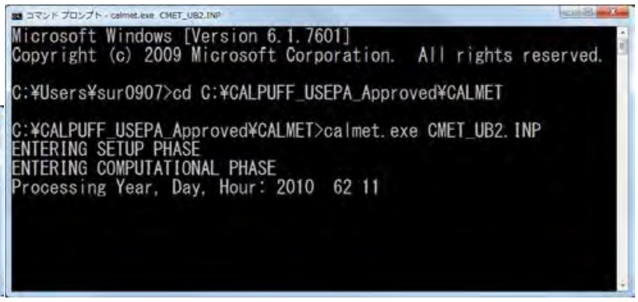


Set the name of aerological data (NAME), monitoring station ID (ID), the location of monitoring station (X coord., Y coord.), and time zone (Time zone).

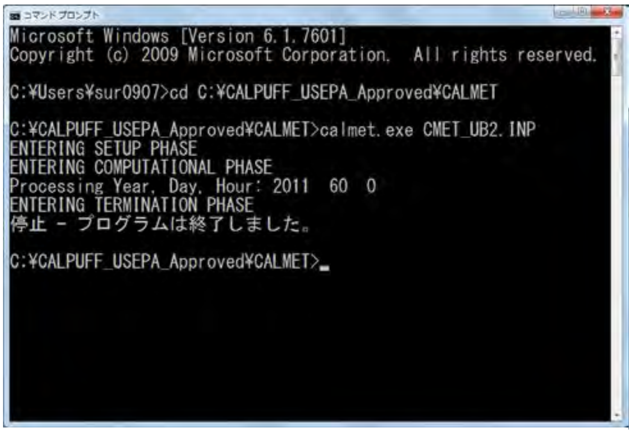


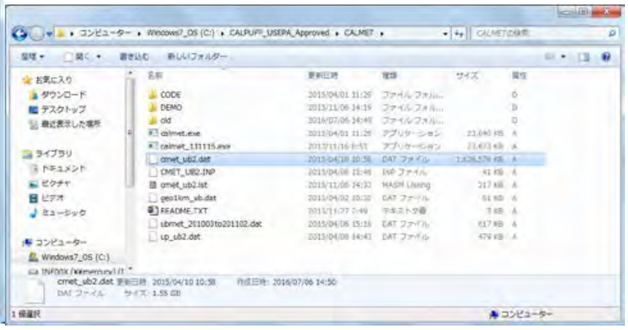
Move the "CALMET" folder in command prompt, input "CALMET.exe <input file name>.INP", and press [Enter] (Here it is "CMET_UB2.INP"). After starting the calculation, "Processing Year, Day, Hour: <Year> <Month> <Hour>" is displayed and you can check the progress.





When showing "TERMINATION PHASE" message and completing calculation, you check to make output files. Output file is "cmet_ub2.dat" in this case.



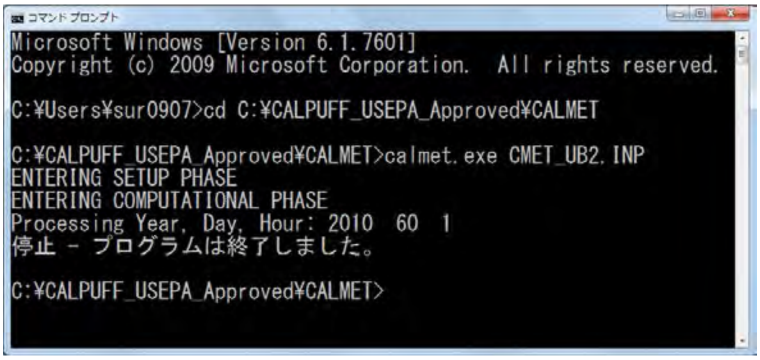


3.3.3 Treatment in Error Message

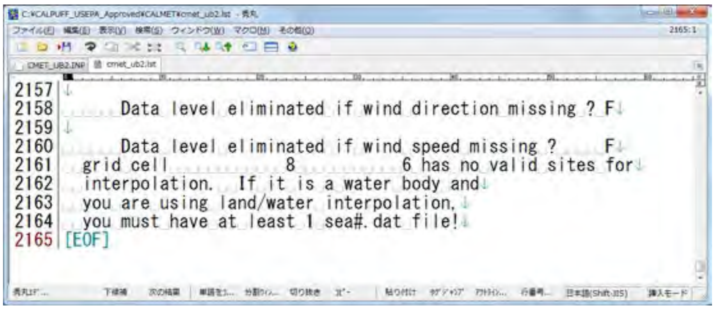
When CALMET is executed, the following situation may occur. In that case, the data created so far may have error, so it is necessary to go back to the former processor and modify the data.

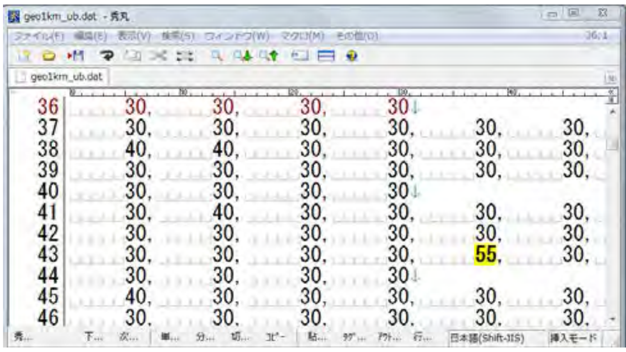
In the case that execution ends without "TERMINATION PHASE" message.

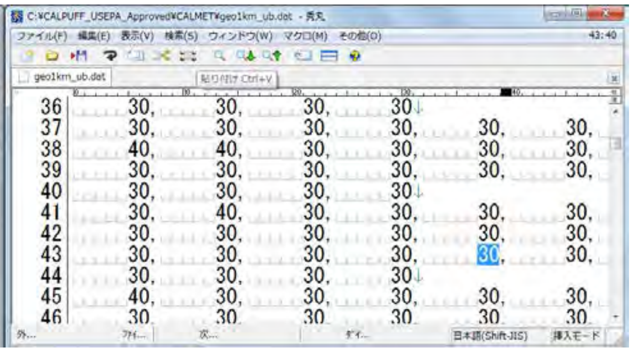
Error information may be written in the LST file that is created when it is executed. Therefore, open LST file and look for the description part of error.



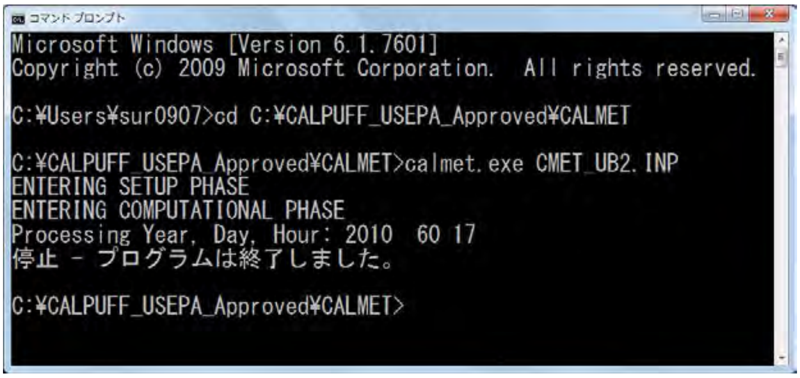
In the following cases, there is a grid of water in the land use grid file and it is a message that at least sea surface meteorological data is necessary. However, since Mongolia does not have sea and sea surface meteorological data, interpolate grid of water with the surrounding land use data to eliminate the error.



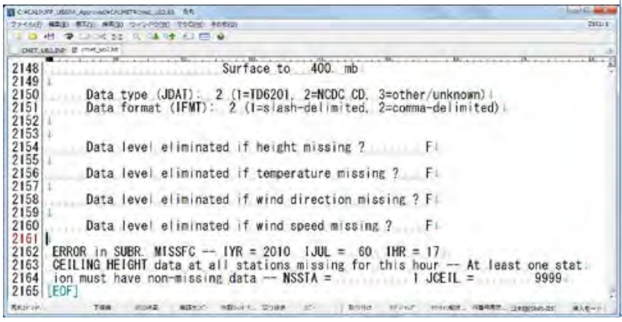


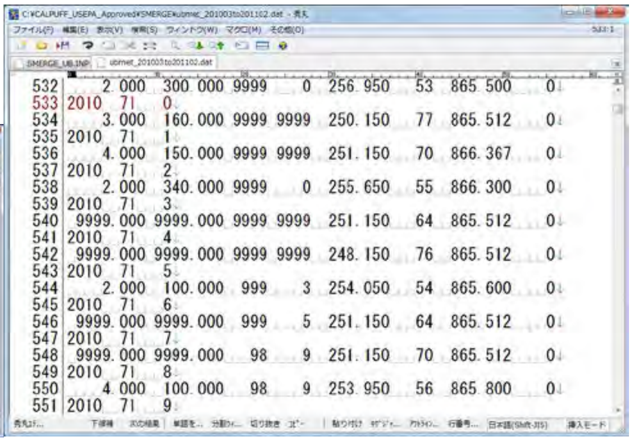


Although the above-mentioned correction was conducted, since the situation did not change, open and check LST file.

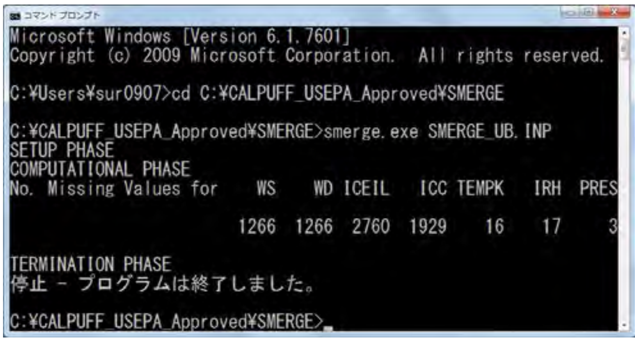


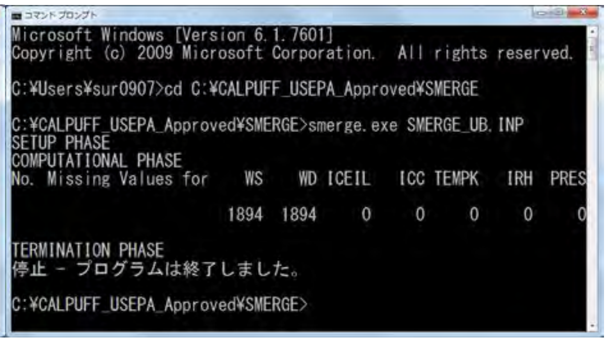
This error message is the message on the surface meteorological data. In this case, this message means that ceiling height data is missing at all observation stations and this data at least one station has to exist. It is preferable to have surface meteorological data that can be interpolated, but if there is no data, it is necessary to interpolating with the data measured at the nearest time to eliminate the missing data. The meteorological items whose data need to exist in at least one station are the ceiling height, cloud cover, the surface temperature, relative humidity and sea level pressure.



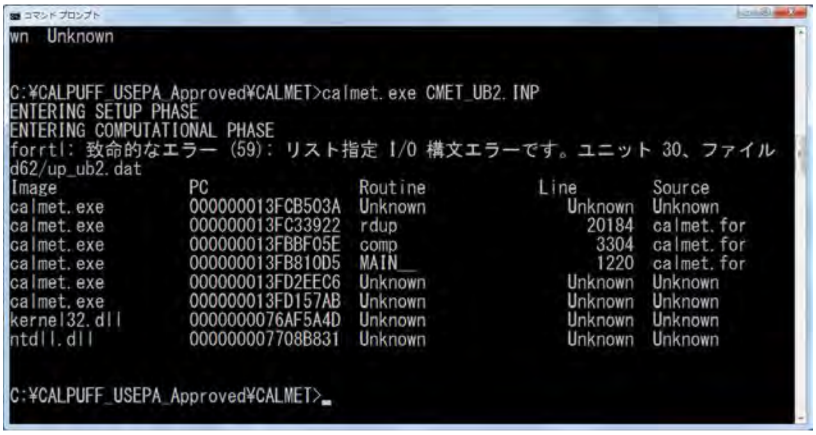


When executing SMERGE, interpolate the data so that the number of missing data becomes 0 as shown on the right. The left figure is the calculation result before interpolating data, and the missing number is counted for each item.

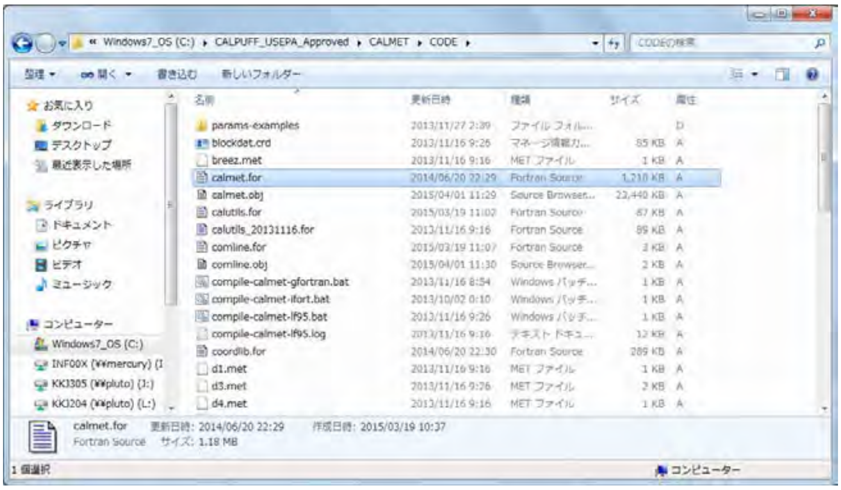




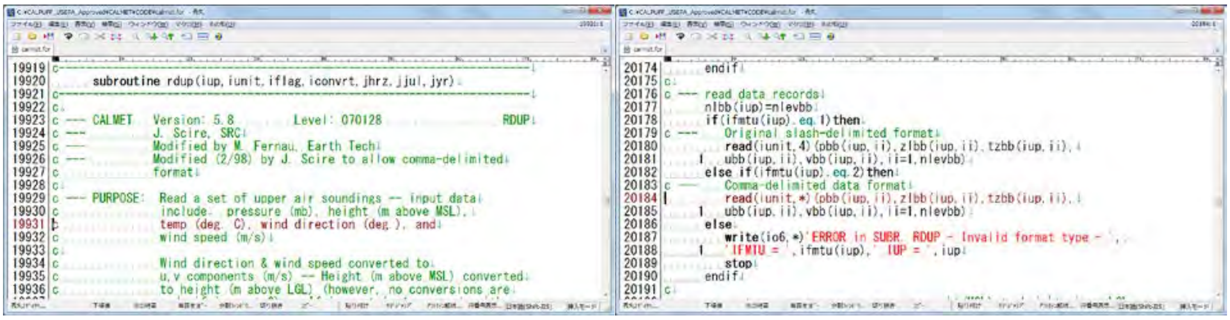
Although executing again after the above correction, the following error message and information on where the error occurred in the program code is displayed. In this case, this message means that error has occurred in line 20184 of “calmet.for” and the subroutine in which the error occurred is “rdup”.



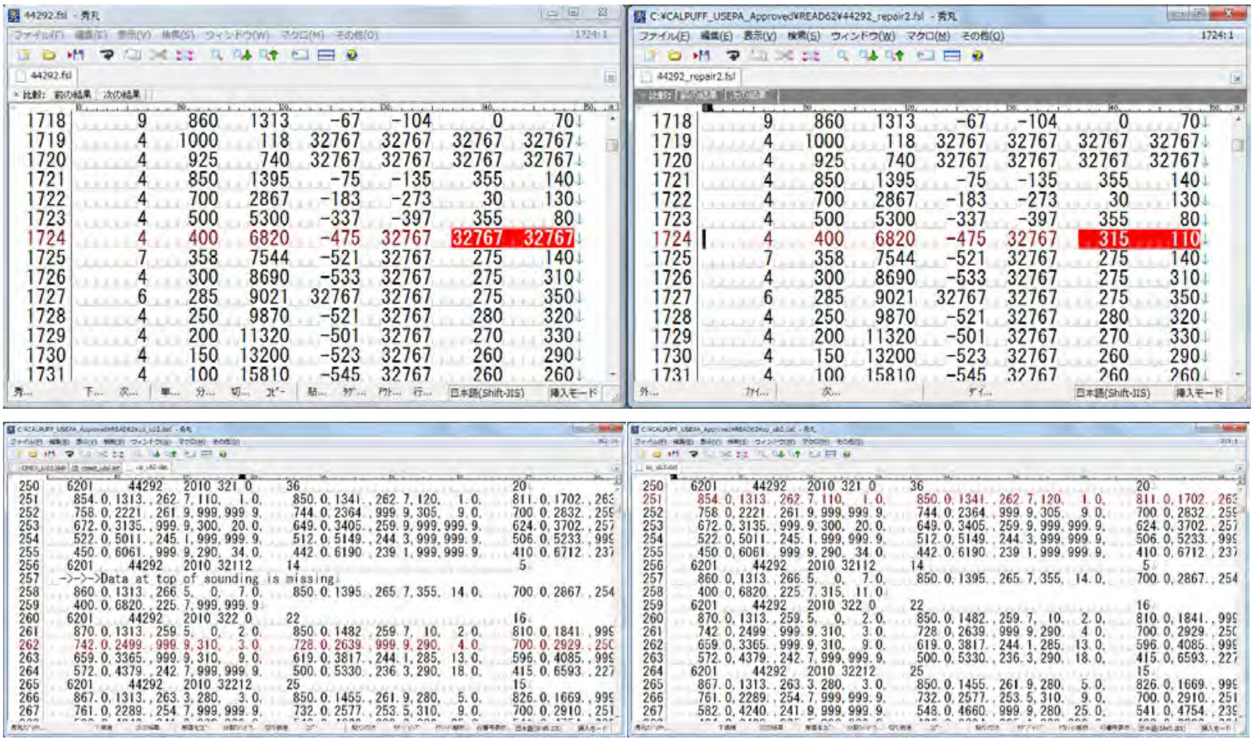
In this case, open “calmet.for” in “CODE” folder with editor and check cause of error.



“rdup” is the subroutine that reads aerological data and it can be seen that an error has occurred in the part where input data is read.



The aerological data created in “READ62” is interrupted by the line beginning with "-> -> ->", so this line may cause the error. Therefore, after searching for the line starting with "-> -> ->", interpolate and correct the original data before executing “READ62” in order to fix the error message so that "-> -> ->" disappears.


44292.fsl
1718 9 860 1313 -67 -104 0 70
1719 4 1000 118 32767 32767 32767 32767
1720 4 925 740 32767 32767 32767 32767
1721 4 850 1395 -75 -135 355 140
1722 4 700 2867 -183 -273 30 130
1723 4 500 5300 -337 -397 355 80
1724 4 400 6820 -475 32767 32767 32767
1725 7 358 7544 -521 32767 275 140
1726 4 300 8690 -533 32767 275 310
1727 6 285 9021 32767 32767 275 350
1728 4 250 9870 -521 32767 280 320
1729 4 200 11320 -501 32767 270 330
1730 4 150 13200 -523 32767 260 290
1731 4 100 15810 -545 32767 260 260
C:¥CALPUFF_USEPA_Approved¥READ62¥44292_repair2.fsl
44292_repair2.fsl
1718 9 860 1313 -67 -104 0 70
1719 4 1000 118 32767 32767 32767 32767
1720 4 925 740 32767 32767 32767 32767
1721 4 850 1395 -75 -135 355 140
1722 4 700 2867 -183 -273 30 130
1723 4 500 5300 -337 -397 355 80
1724 4 400 6820 -475 32767 315 110
1725 7 358 7544 -521 32767 275 140
1726 4 300 8690 -533 32767 275 310
1727 6 285 9021 32767 32767 275 350
1728 4 250 9870 -521 32767 280 320
1729 4 200 11320 -501 32767 270 330
1730 4 150 13200 -523 32767 260 290
1731 4 100 15810 -545 32767 260 260