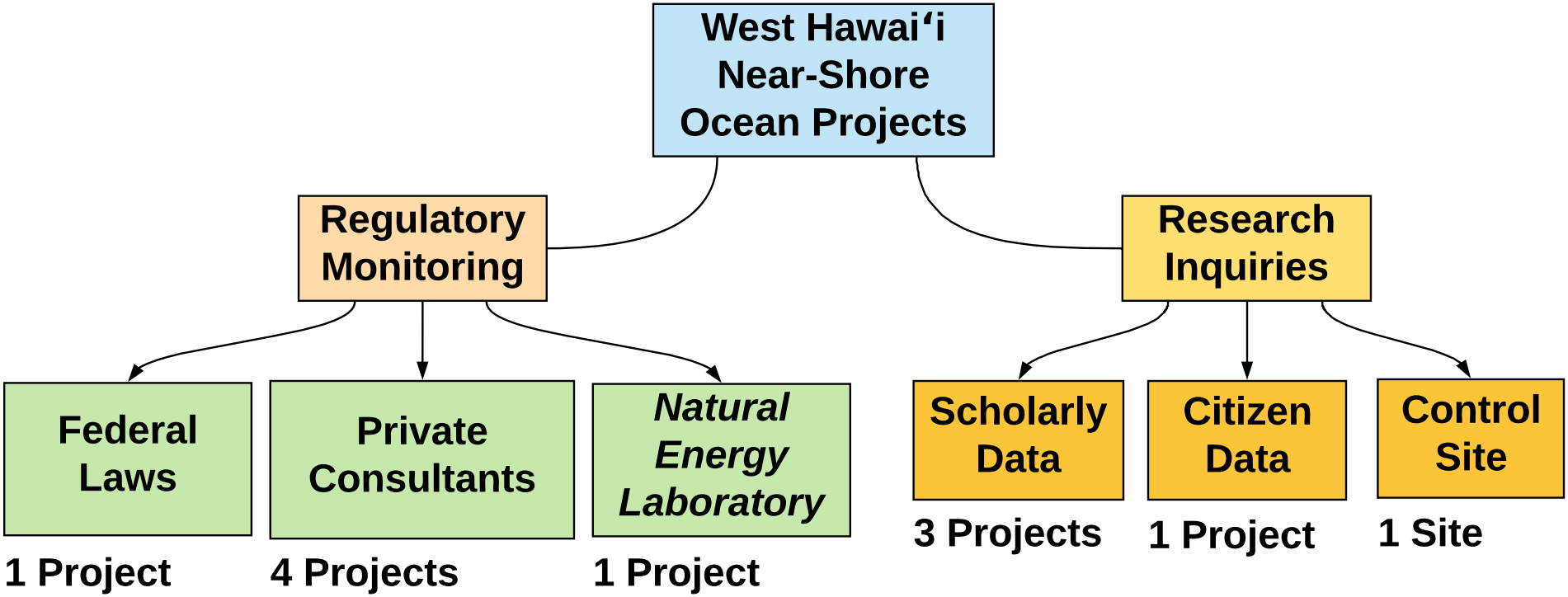
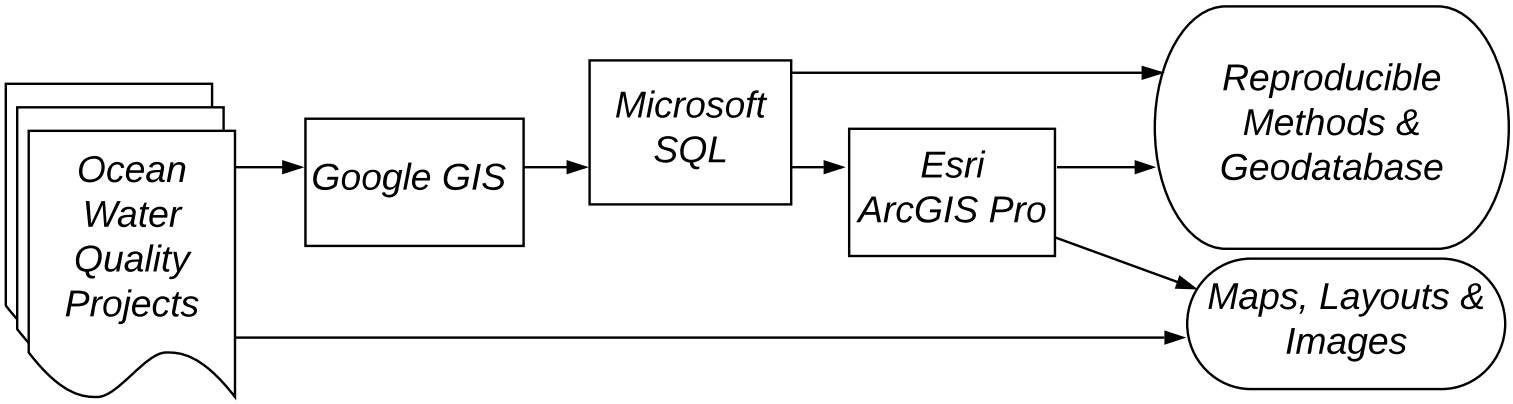

West Hawai‘i Near-Shore Ocean Projects
Regulatory Monitoring
Research Inquiries
Federal Laws
Private Consultants
Natural Energy Laboratory
Scholarly Data
Citizen Data
Control Site
1 Project
4 Projects
1 Project
3 Projects
1 Project
1 Site



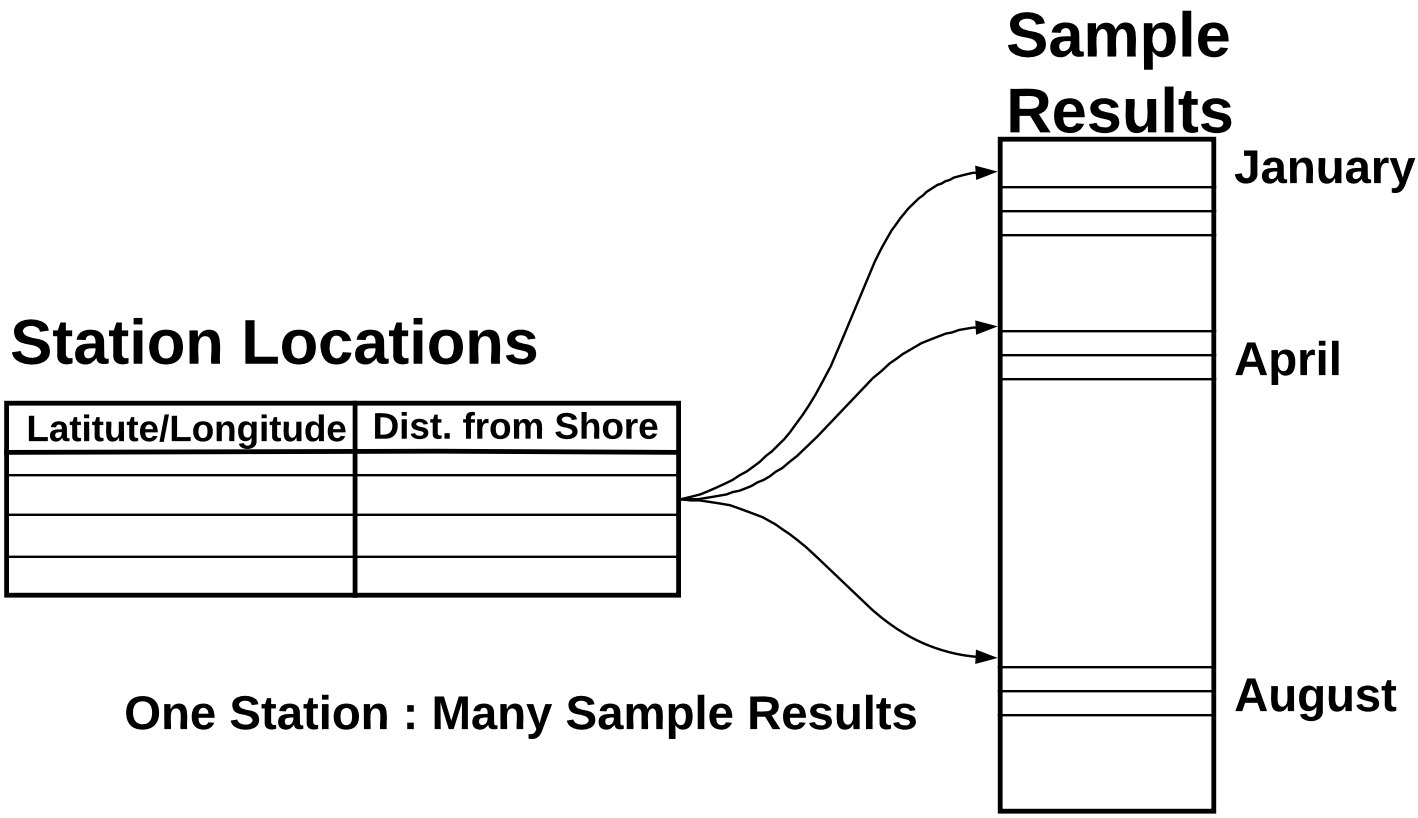
1. Extract analyte results.

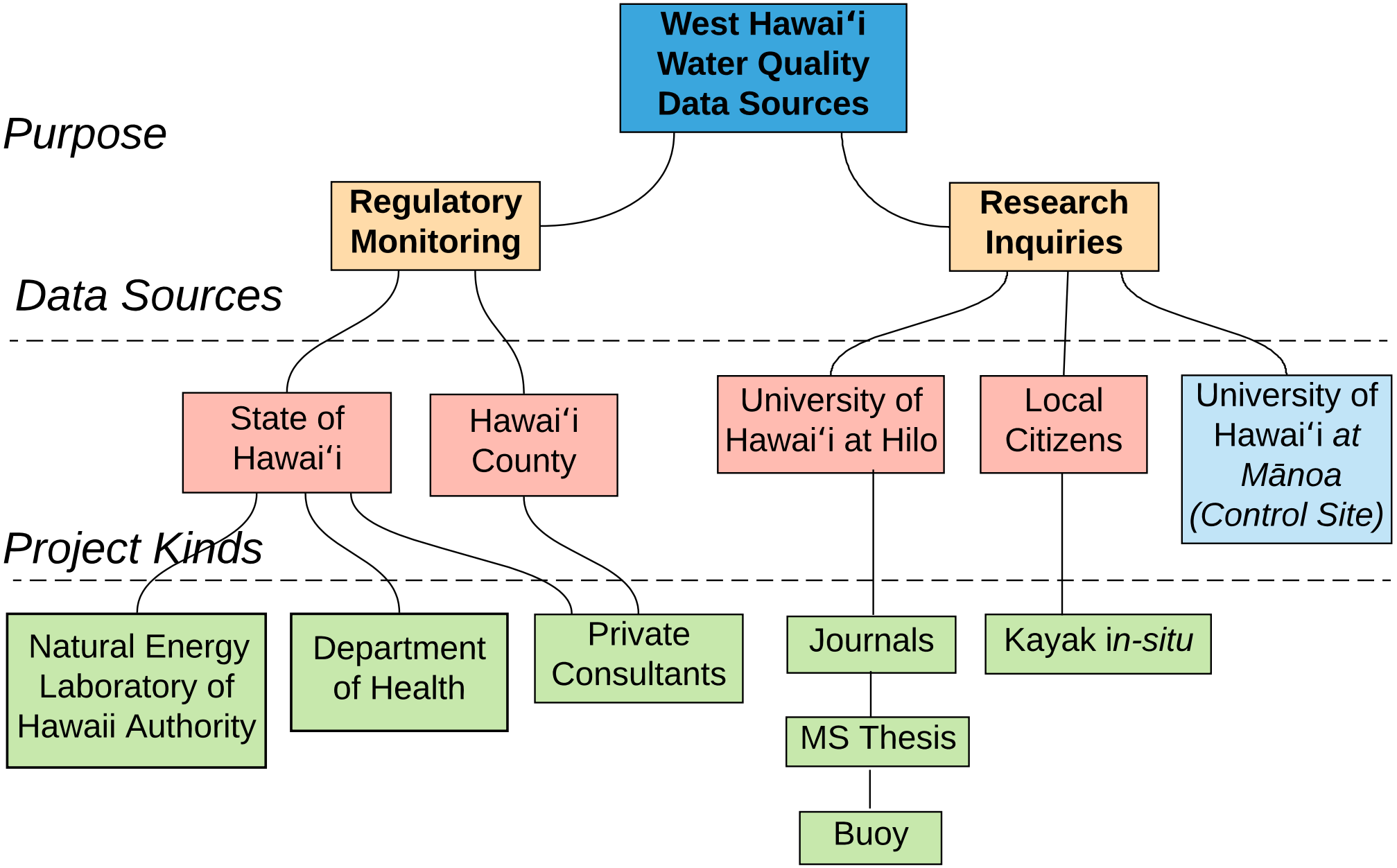
2. Georeference stations.

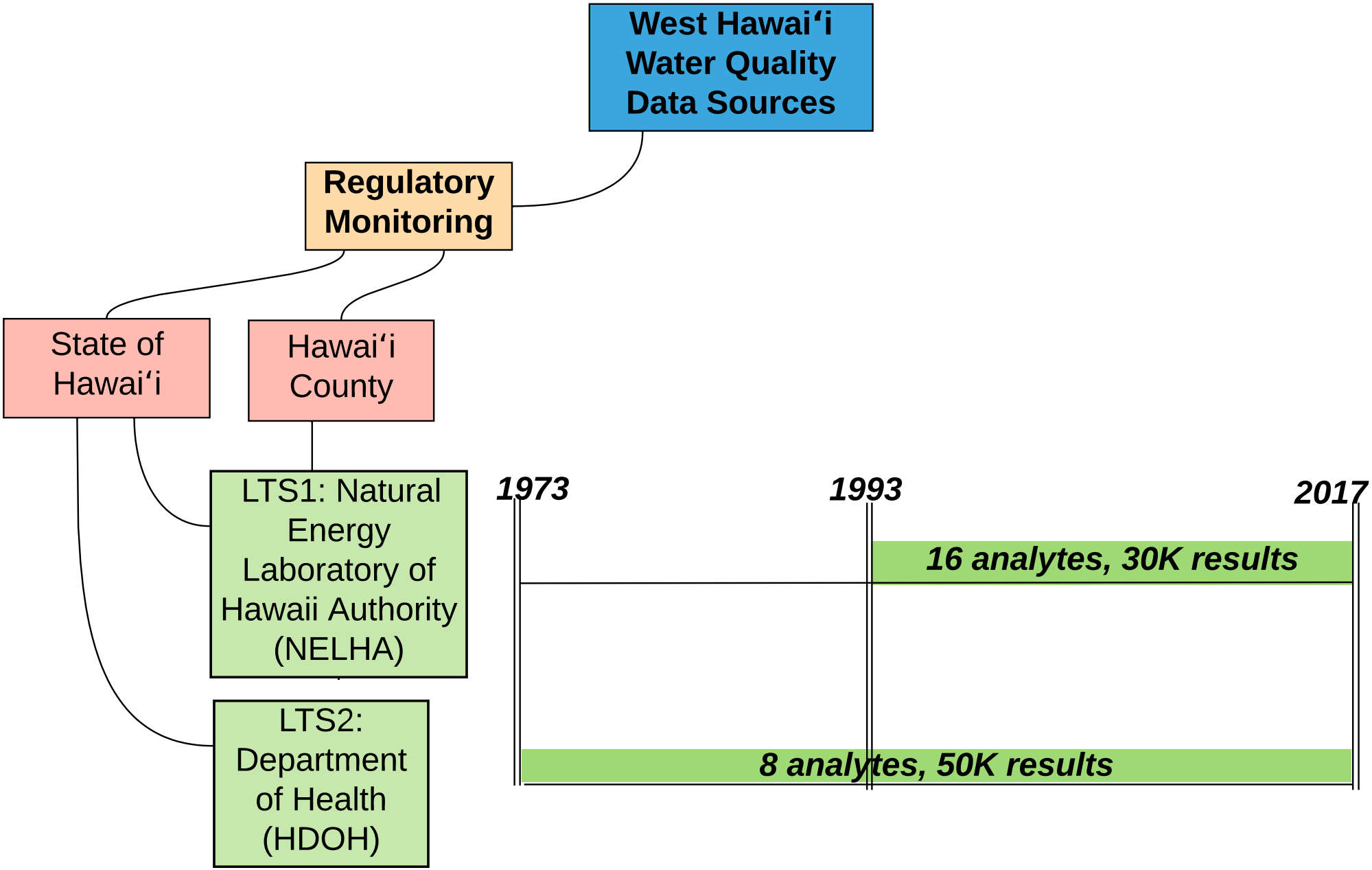
3. Program spatial database methods

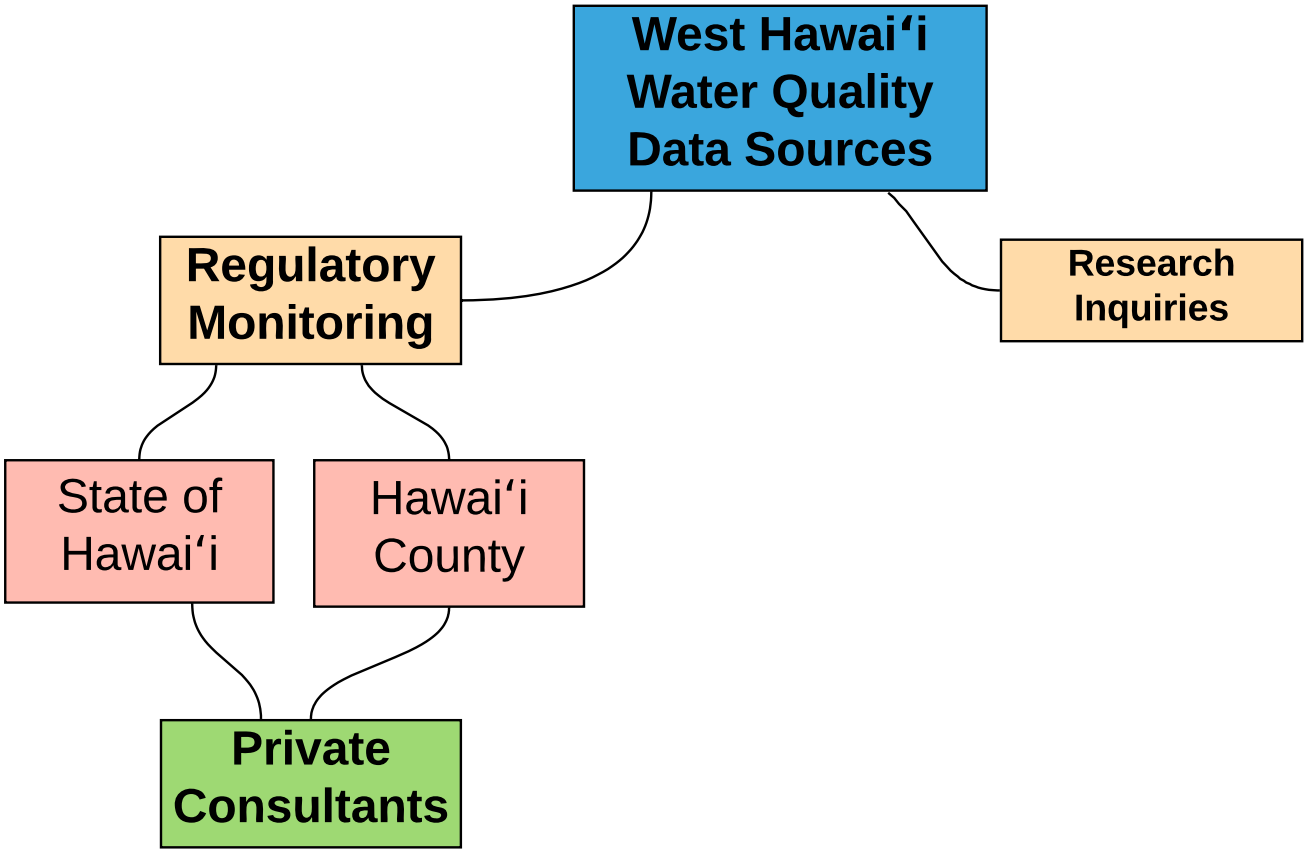
4. Execute geoprocessing methods.

5. Deliver to GitHub public repository.

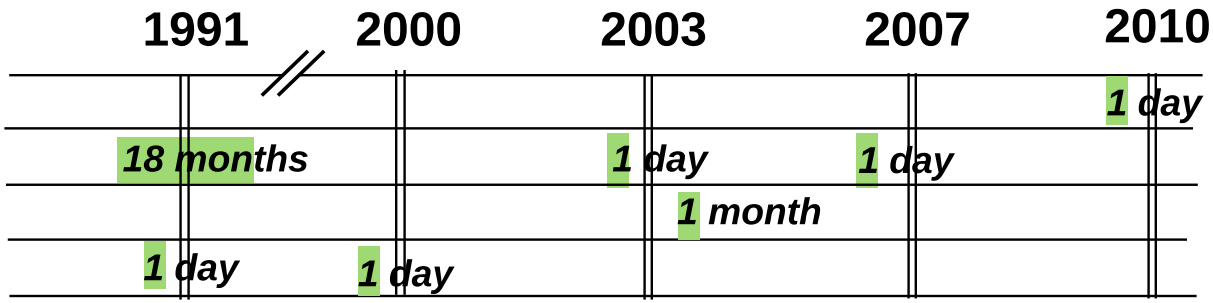

Sample Results
January
April
August
Station Locations
Latitute/Longitude
Dist. from Shore
One Station : Many Sample Results

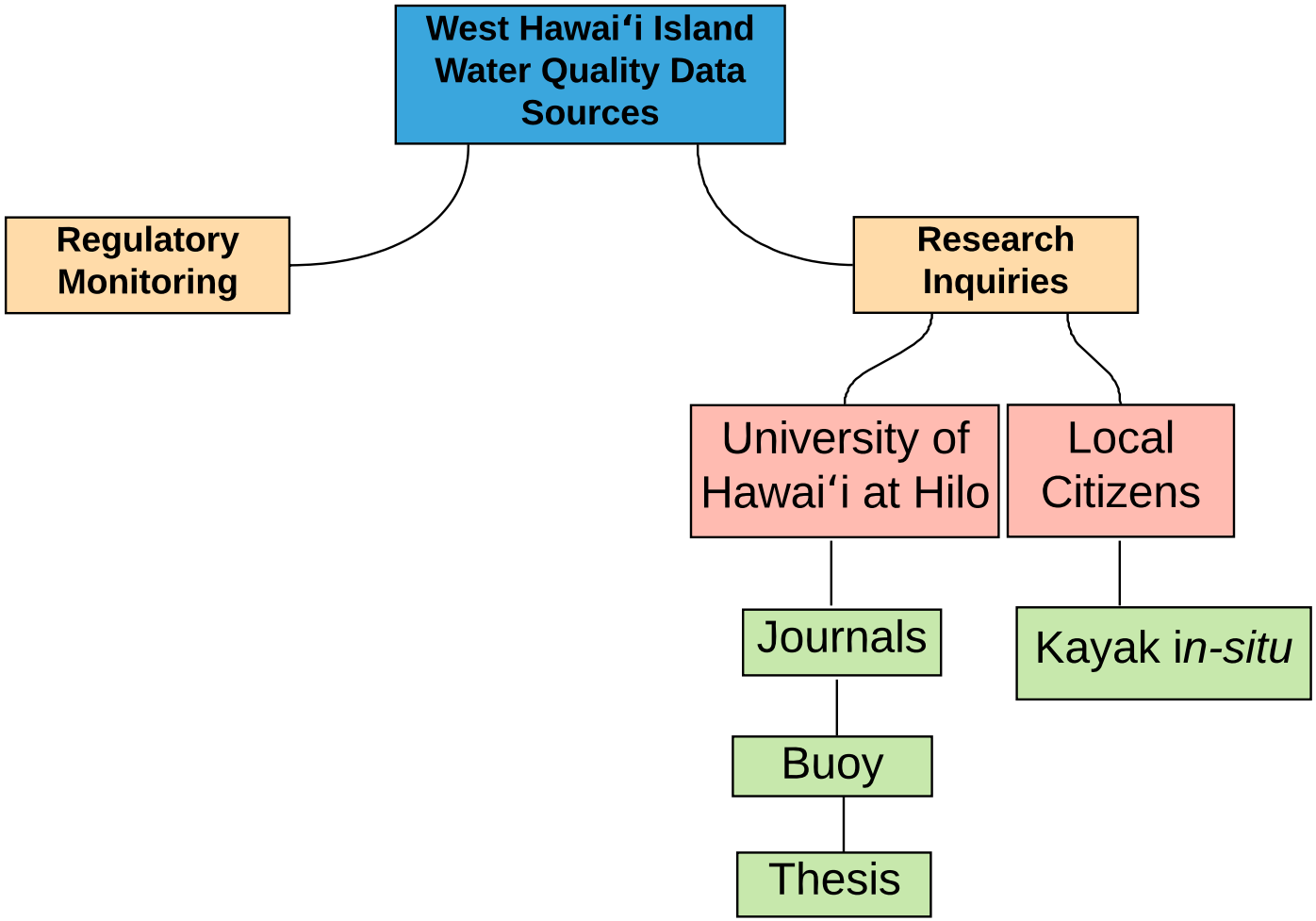

West Hawaiʻi Water Quality Data Sources
Purpose
Regulatory Monitoring
Research Inquiries
Data Sources
State of Hawaiʻi
Hawaiʻi County
University of Hawaiʻi at Hilo
Local Citizens
University of Hawaiʻi at Mānoa (Control Site)
Project Kinds
Natural Energy Laboratory of Hawaii Authority
Department of Health
Private Consultants
Journals
Kayak in-situ
MS Thesis
Buoy


West Hawai‘i Water Quality Data Sources
Regulatory Monitoring
State of Hawai‘i
Hawai‘i County
LTS1: Natural Energy Laboratory of Hawaii Authority (NELHA)
LTS2: Department of Health (HDOH)
1973
1993
2017
16 analytes, 30K results
8 analytes, 50K results

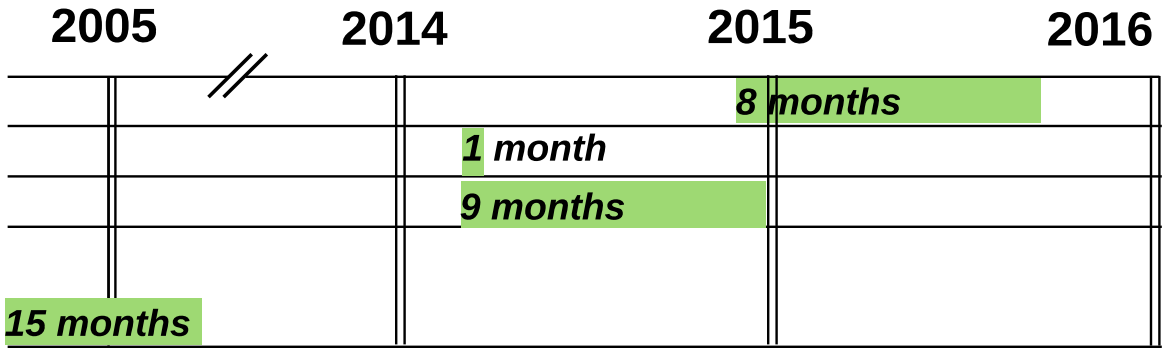


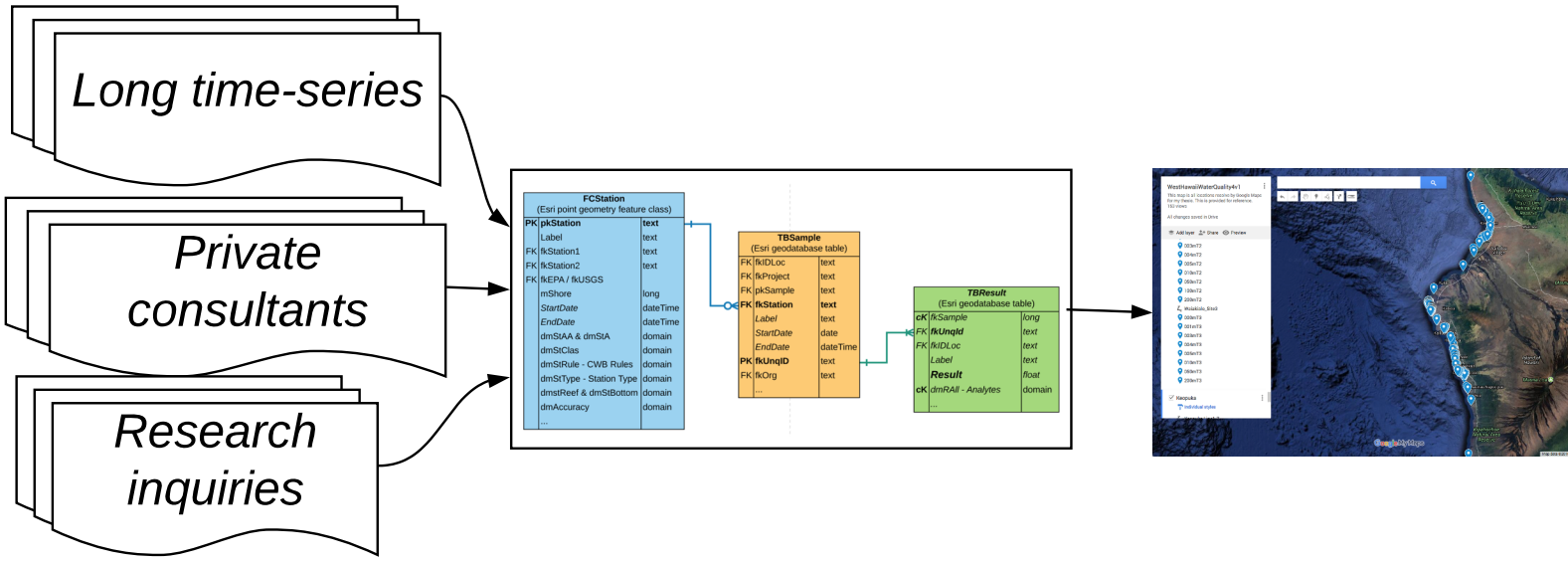
ID	Project	Consultant
PC4	Waiakailio	Steven Dollar
PC3	‘O‘oma	Steven Dollar
PC1	Hokuli‘a	David Ziemann
PC2	Keopuka	Richard Brock





ID	Project	Scientist
UHH3	Puakō	Leilani Abaya
UHH1	Kīholo Buoy	Jason Adolf
CZ1	Keauhou Bay	Dennis Mihalka
UHH2	Honokōhau & Kealakekua	Michael Parsons



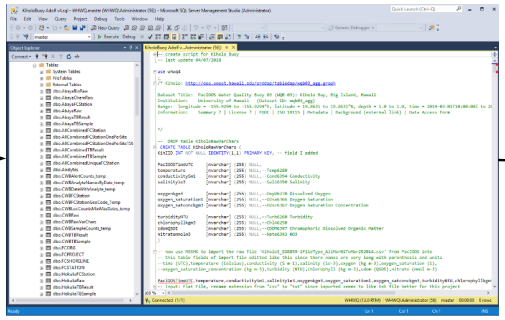


1. Match analytes

2. Adapt professional Water Science schema

3. Georeference w satellite images

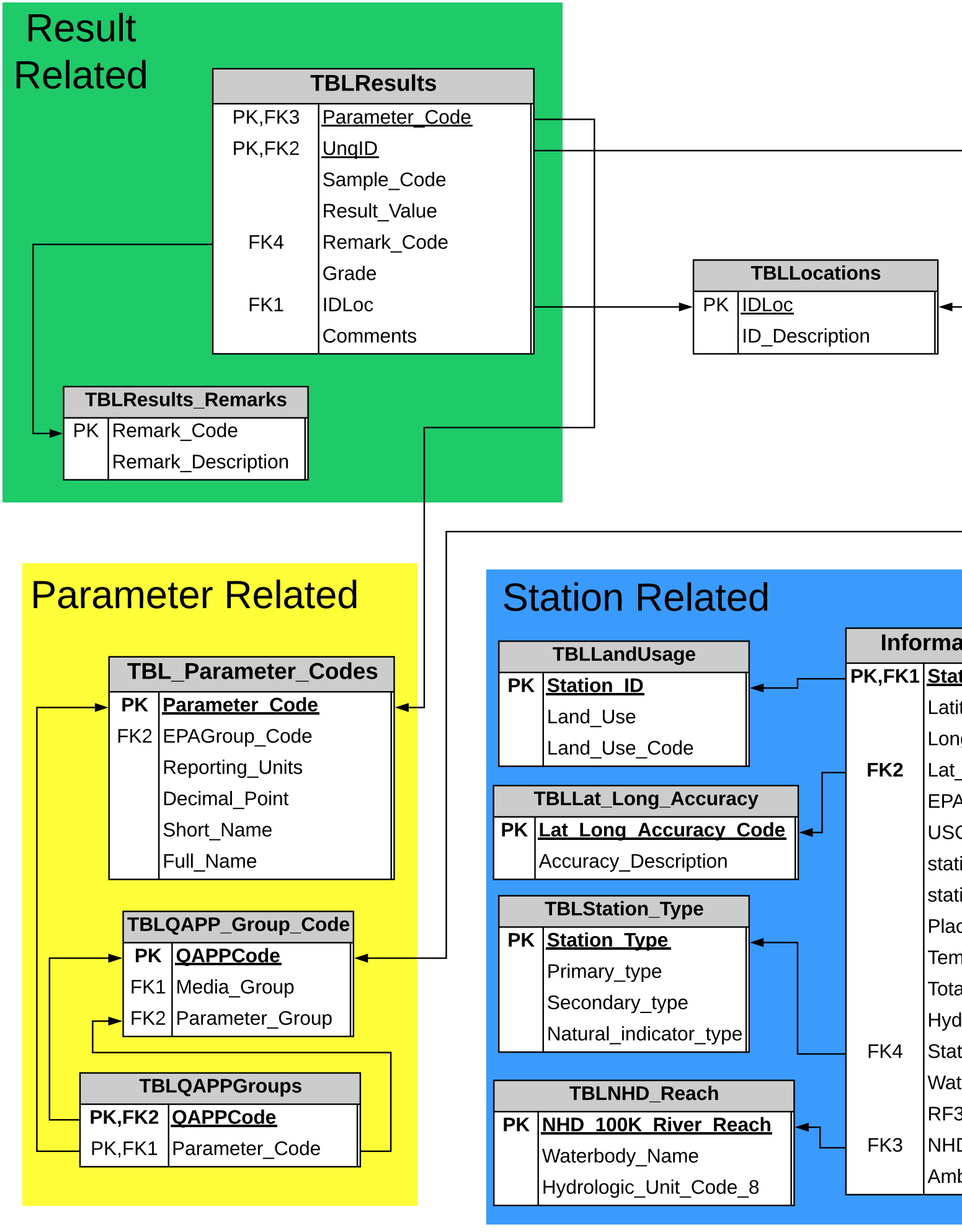
ce with
ages

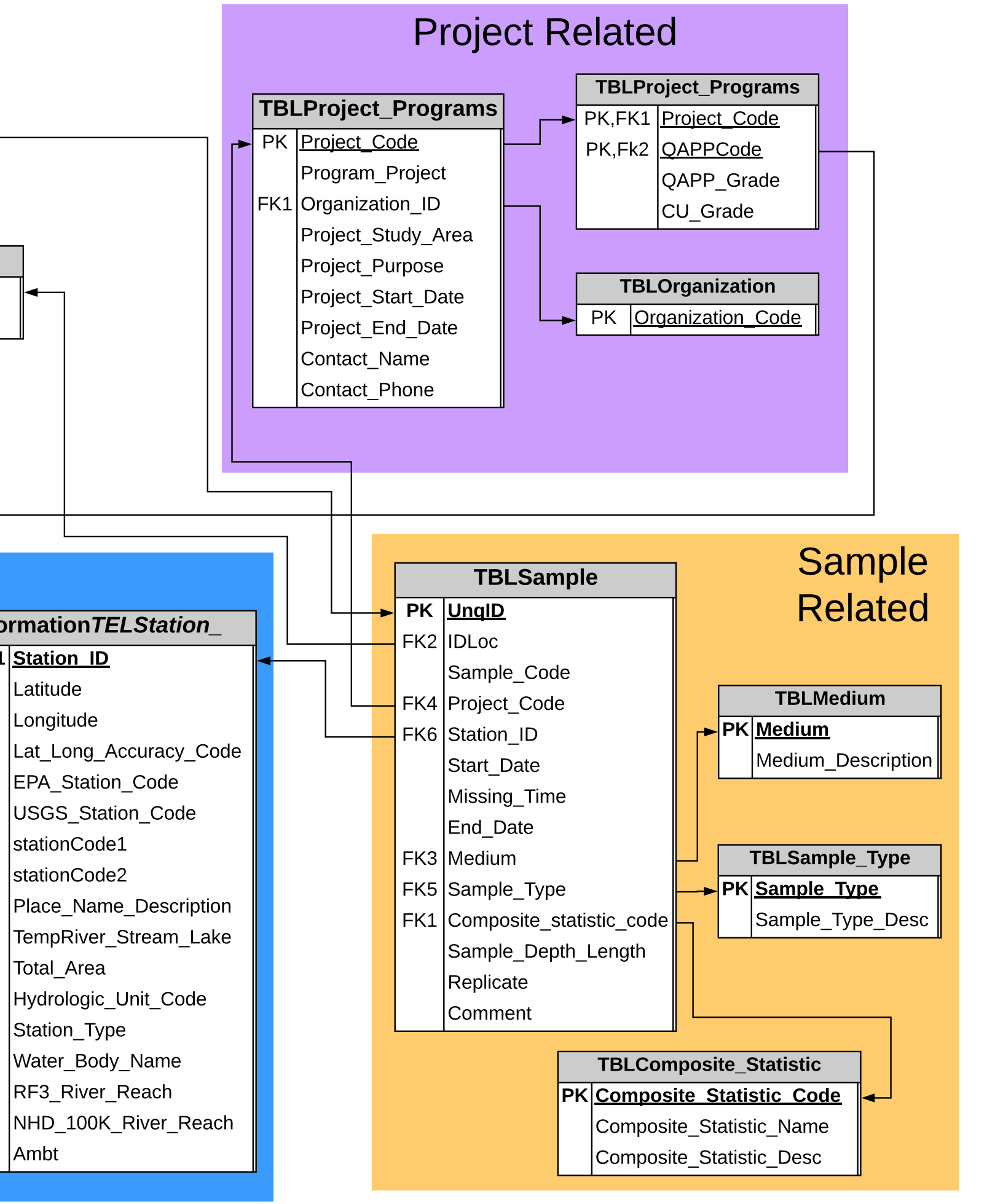


4. Program SQL query scripts

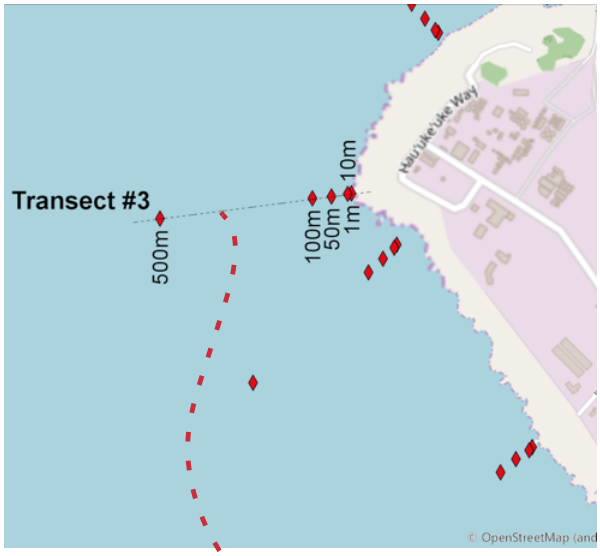
ArcGIS Pro geodatabase

5. Geoprocessing Methods section


Result Related
TBLResults
PK,FK3 Parameter_Code
PK,FK2 UnqID
Sample_Code
Result_Value
FK4 Remark_Code
Grade
FK1 IDLoc
Comments
TBLLocations
PK IDLoc
ID_Description
TBLResults_Remarks
PK Remark_Code
Remark_Description
Parameter Related
TBL_Parameter_Codes
PK Parameter_Code
FK2 EPAGroup_Code
Reporting_Units
Decimal_Point
Short_Name
Full_Name
TBLQAPP_Group_Code
PK QAPPCode
FK1 Media_Group
FK2 Parameter_Group
TBLQAPPGroups
PK,FK2 QAPPCode
PK,FK1 Parameter_Code
Station Related
TBLLandUsage
PK Station_ID
Land_Use
Land_Use_Code
TBLLat_Long_Accuracy
PK Lat_Long_Accuracy_Code
Accuracy_Description
TBLStation_Type
PK Station_Type
Primary_type
Secondary_type
Natural_indicator_type
TBLNHD_Reach
PK NHD_100K_River_Reach
Waterbody_Name
Hydrologic_Unit_Code_8
Informa
PK,FK1
FK2
FK4
FK3

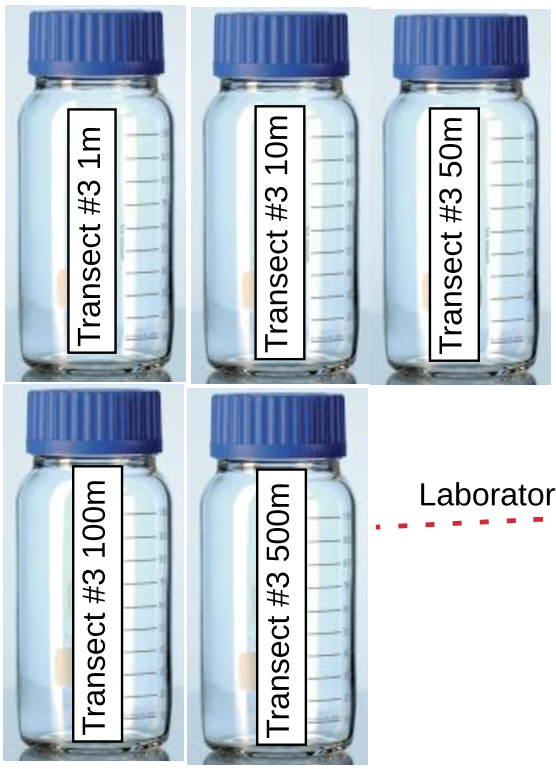

Project Related
TBLProject_Programs
PK Project_Code
Program_Project
FK1 Organization_ID
Project_Study_Area
Project_Purpose
Project_Start_Date
Project_End_Date
Contact_Name
Contact_Phone
TBLProject_Programs
PK,FK1 Project_Code
PK,Fk2 QAPPCode
QAPP_Grade
CU_Grade
TBLOrganization
PK Organization_Code
Sample Related
TBLSample
PK UniqID
FK2 IDLoc
Sample_Code
FK4 Project_Code
FK6 Station_ID
Start_Date
Missing_Time
End_Date
FK3 Medium
FK5 Sample_Type
FK1 Composite_statistic_code
Sample_Depth_Length
Replicate
Comment
TBLMedium
PK Medium
Medium_Description
TBLSample_Type
PK Sample_Type
Sample_Type_Desc
TBLComposite_Statistic
PK Composite_Statistic_Code
Composite_Statistic_Name
Composite_Statistic_Desc
ormationTELStation_
Station_ID
Latitude
Longitude
Lat_Long_Accuracy_Code
EPA_Station_Code
USGS_Station_Code
stationCode1
stationCode2
Place_Name_Description
TempRiver_Stream_Lake
Total_Area
Hydrologic_Unit_Code
Station_Type
Water_Body_Name
RF3_River_Reach
NHD_100K_River_Reach
Ambt

FCStation - location table

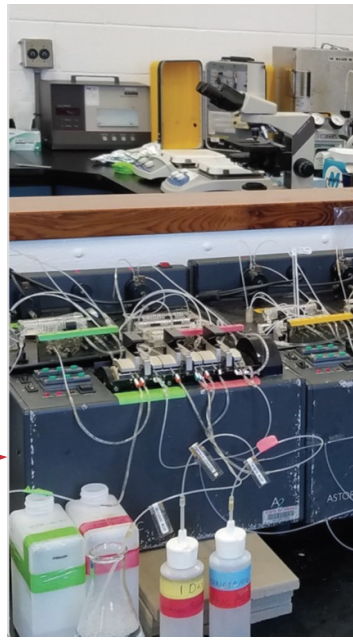


Samples

TBSample - data table



Laboratory

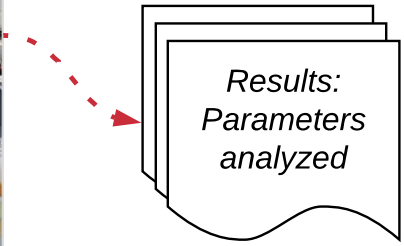


Monitoring station (red diamonds) locations where sample bottles are filled with ocean water.

Sample bottles filled at station locations.

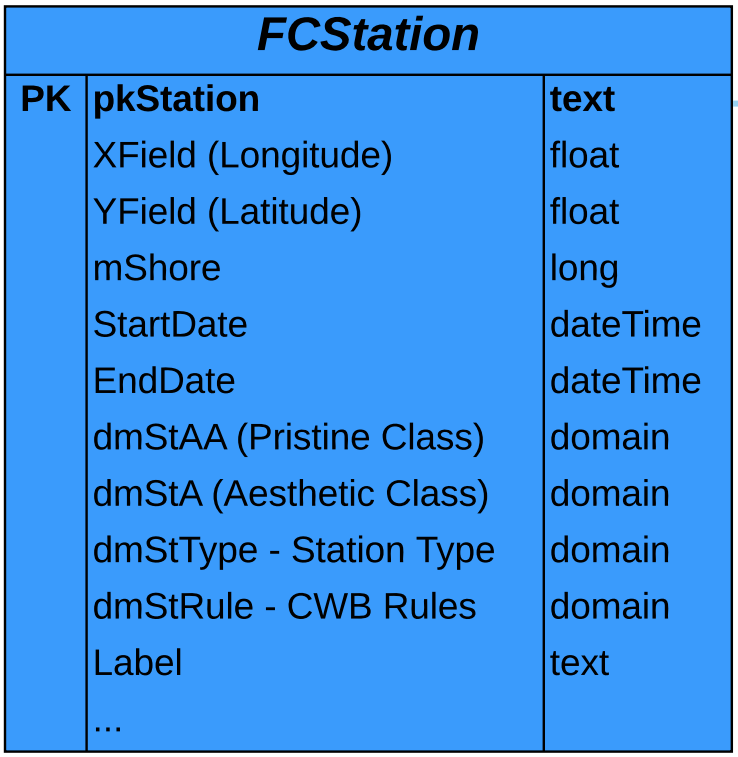
Analyze with laboratory instruments.

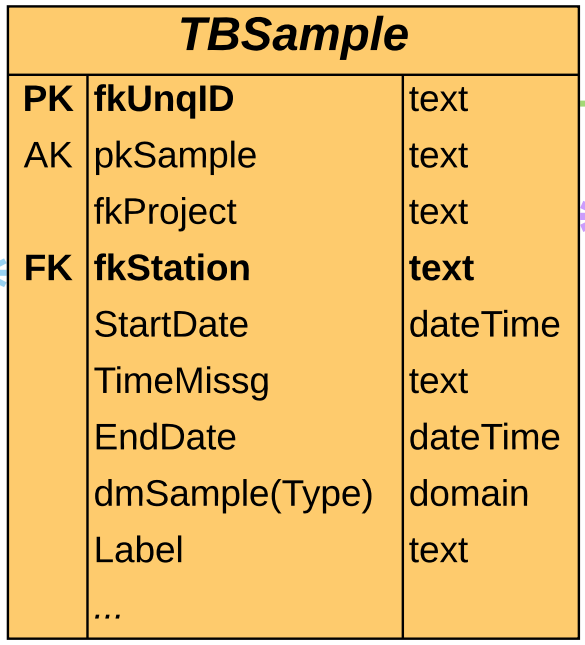
TBResult - data table



tory

Extract result values from published tables.



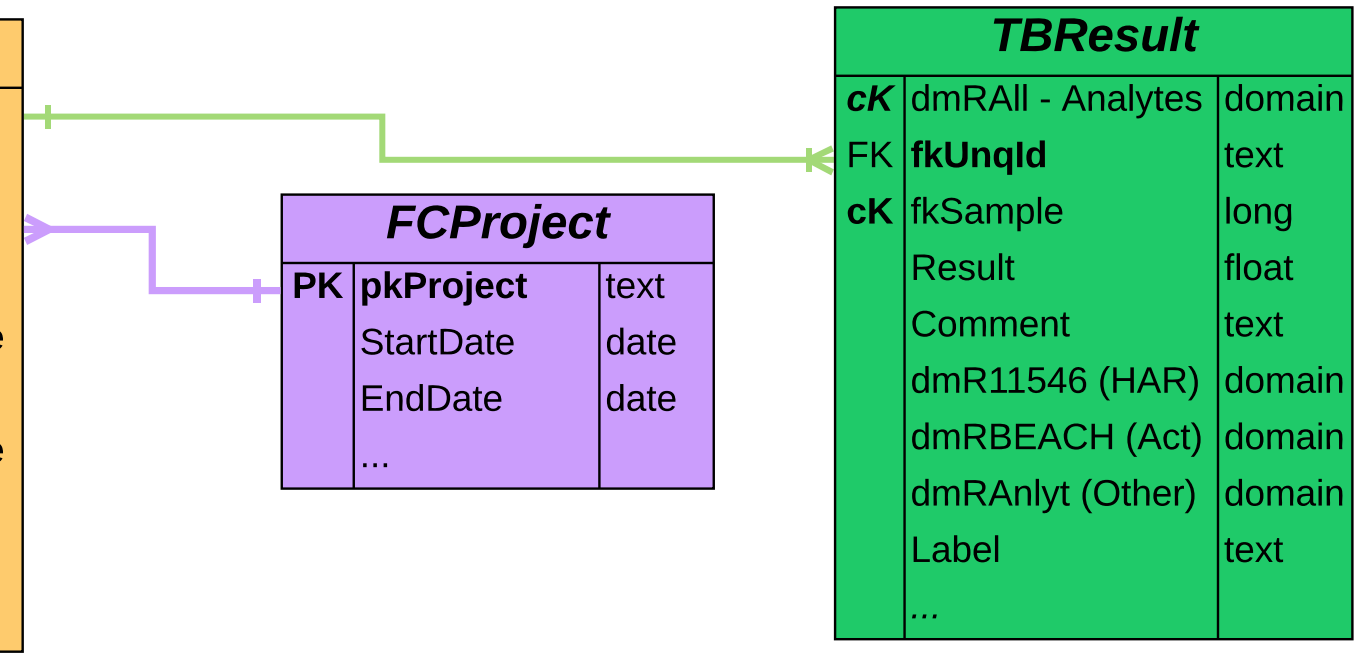


InformationTELStation_	
PK,FK1	**Station_ID**
	Latitude
	Longitude
FK2	Lat_Long_Accuracy_Code
	EPA_Station_Code
	USGS_Station_Code
	stationCode1
	stationCode2
	Place_Name_Description
	TEmpRiver_Stream_Lake
	Total_Area
	Hydrologic_Unit_Code
FK4	Station_Type
	Water_Body_Name
	RF3_River_Reach
FK3	NHD_100K_River_Reach
	Ambt

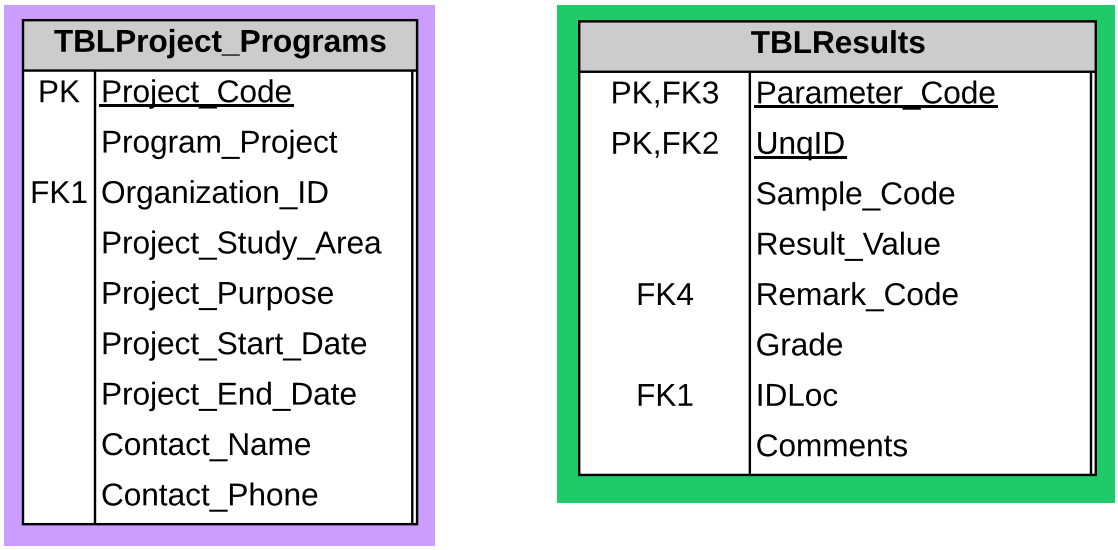
TBLSample	
PK	**UnqID**
FK2	IDLoc
	Sample_Code
FK4	Project_Code
FK6	Station_ID
	Start_Date
	Missing_Time
	End_Date
FK3	Medium
FK5	Sample_Type
FK1	Composite_statistic_code
	Sample_Depth_Length
	Replicate
	Comment

Station Information Table (*FCStation*)	Sample Table (*TBSample*)	Proje
800	**300K**	
300	**15K**	

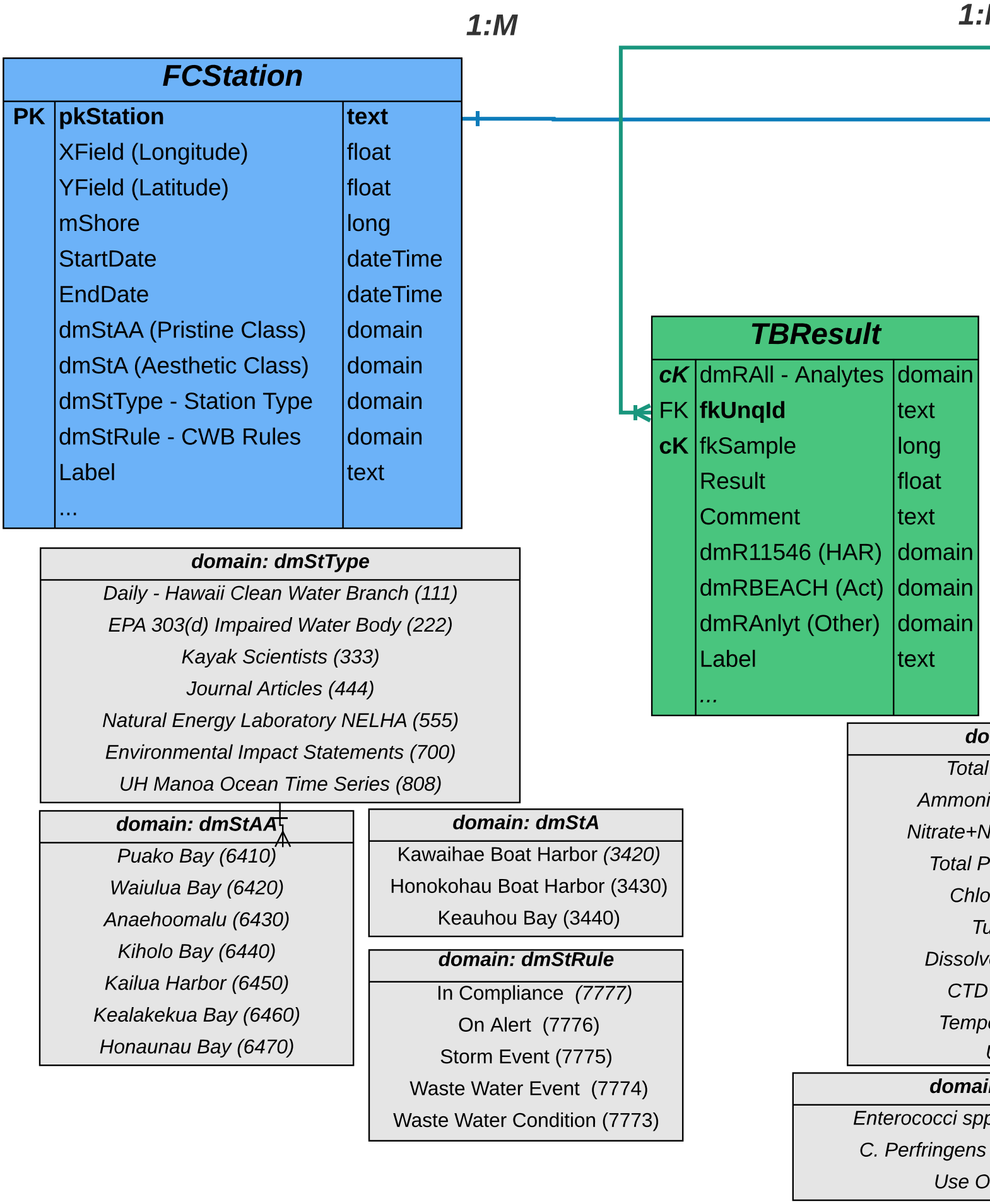
West Hawai‘ i Water Quality feature classes and tables

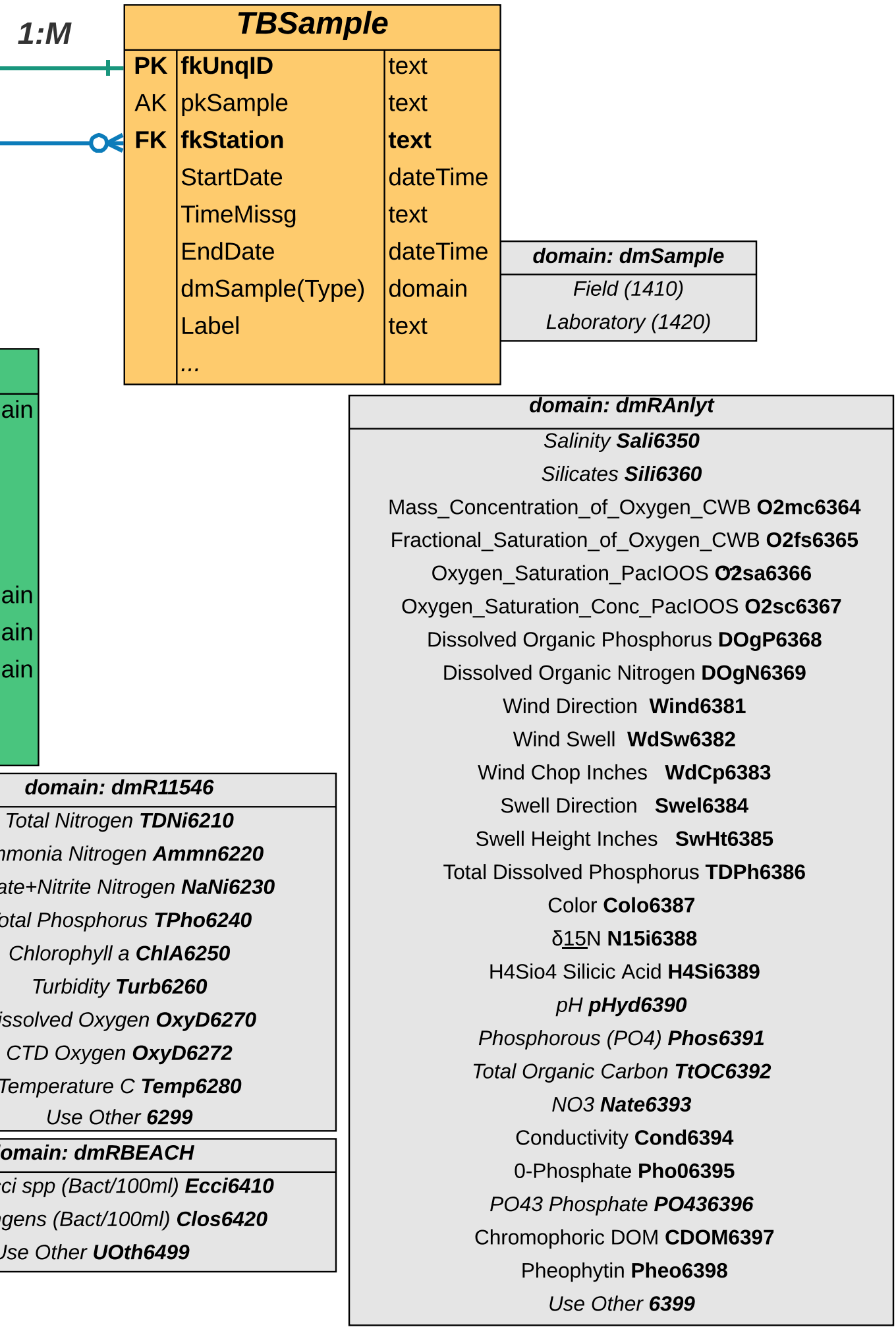


FoxDB tables



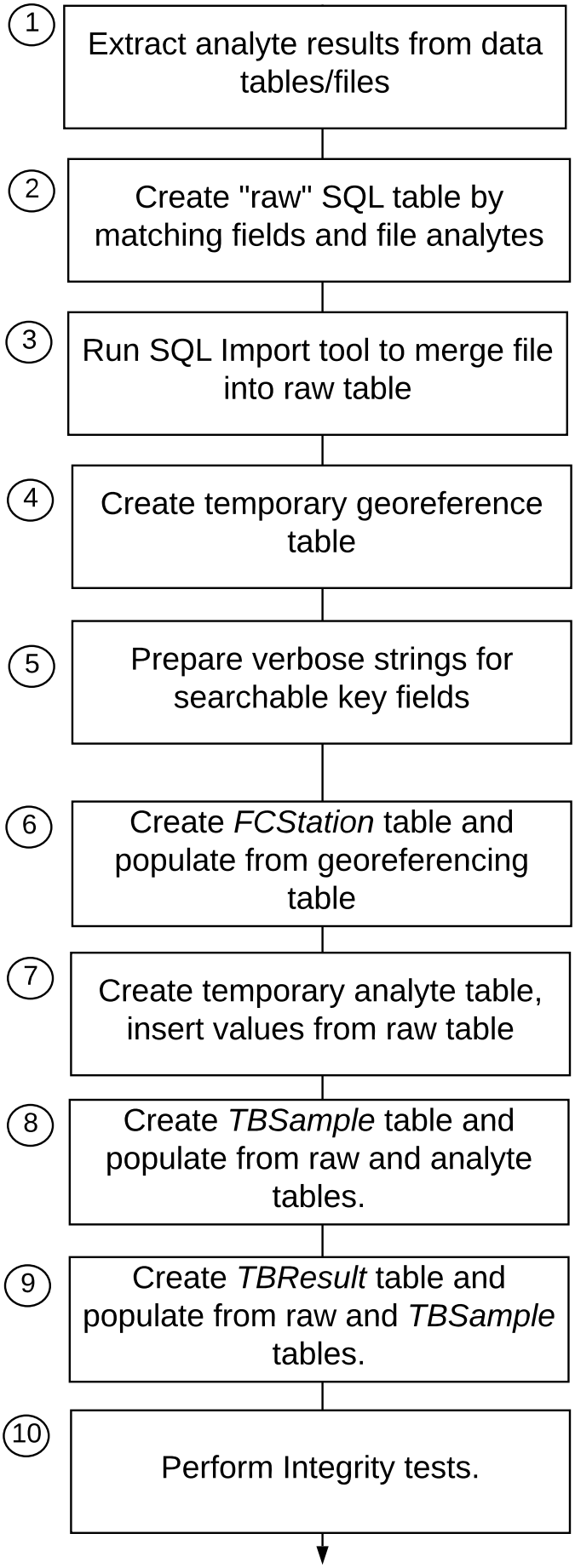
Project Table (*FCProject*)	Results Table (TBResult)	Rounded Row Counts
36	**1.6M**	**Fox River DB (Nov 2017)**
11	**100K**	**West Hawai‘ i Geodatabase**


1:M
1:
FCStation
PK pkStation text
XField (Longitude) float
YField (Latitude) float
mShore long
StartDate dateTime
EndDate dateTime
dmStAA (Pristine Class) domain
dmStA (Aesthetic Class) domain
dmStType - Station Type domain
dmStRule - CWB Rules domain
Label text
...
TBResult
cK dmRAll - Analytes domain
FK fkUnqId text
cK fkSample long
Result float
Comment text
dmR11546 (HAR) domain
dmRBEACH (Act) domain
dmRAnlyt (Other) domain
Label text
...
domain: dmStType
Daily - Hawaii Clean Water Branch (111)
EPA 303(d) Impaired Water Body (222)
Kayak Scientists (333)
Journal Articles (444)
Natural Energy Laboratory NELHA (555)
Environmental Impact Statements (700)
UH Manoa Ocean Time Series (808)
domain: dmStAA
Puako Bay (6410)
Waiulua Bay (6420)
Anaehoomalu (6430)
Kiholo Bay (6440)
Kailua Harbor (6450)
Kealakekua Bay (6460)
Honaunau Bay (6470)
domain: dmStA
Kawaihae Boat Harbor (3420)
Honokohau Boat Harbor (3430)
Keauhou Bay (3440)
domain: dmStRule
In Compliance (7777)
On Alert (7776)
Storm Event (7775)
Waste Water Event (7774)
Waste Water Condition (7773)
do
Total
Ammoni
Nitrate+N
Total P
Chlo
Tu
Dissolv
CTD
Temp
domai
Enterococci spp
C. Perfringens
Use O


1:M
TBSample
PK fkUnqID text
AK pkSample text
FK fkStation text
StartDate dateTime
TimeMissg text
EndDate dateTime
dmSample(Type) domain
Label text
...
domain: dmSample
Field (1410)
Laboratory (1420)
ain
ain
ain
ain
domain: dmR11546
Total Nitrogen TDNi6210
mmonia Nitrogen Ammn6220
ate+Nitrite Nitrogen NaNi6230
otal Phosphorus TPho6240
Chlorophyll a ChlA6250
Turbidity Turb6260
issolved Oxygen OxyD6270
CTD Oxygen OxyD6272
Temperature C Temp6280
Use Other 6299
omain: dmRBEACH
ci spp (Bact/100ml) Ecci6410
gens (Bact/100ml) Clos6420
Use Other UOth6499
domain: dmRAnlyt
Salinity Sali6350
Silicates Sili6360
Mass_Concentration_of_Oxygen_CWB O2mc6364
Fractional_Saturation_of_Oxygen_CWB O2fs6365
Oxygen_Saturation_PacIOOS O2sa6366
Oxygen_Saturation_Conc_PacIOOS O2sc6367
Dissolved Organic Phosphorus DOgP6368
Dissolved Organic Nitrogen DOgN6369
Wind Direction Wind6381
Wind Swell WdSw6382
Wind Chop Inches WdCp6383
Swell Direction Swel6384
Swell Height Inches SwHt6385
Total Dissolved Phosphorus TDPh6386
Color Colo6387
δ15N N15i6388
H4Sio4 Silicic Acid H4Si6389
pH pHyd6390
Phosphorous (PO4) Phos6391
Total Organic Carbon TtOC6392
NO3 Nate6393
Conductivity Cond6394
0-Phosphate Pho06395
PO43 Phosphate PO436396
Chromophoric DOM CDOM6397
Pheophytin Pheo6398
Use Other 6399

Appendix A
Step#

Summary of Actions.



- For PDF files extract data using
source files are at GitHub.
- Match analytes with domains to
table.

- Create the SQL table using Arc
schema is convertible to a geod
- Name fields of the raw table us
assigned in domains (shown in A

- Use this raw table for the SQL c
- Perform clean ups on the data t

- Insert station rows with georefe
POINT_Y and POINT_X for later
Event.

- Concatenate text fields the sam

- Assign and manage values for
and other fields.

- Insert only non-null values for e
there are no null values allowed i

- Assign and manage linkage and
fields.

- Join tables to assign the "result
fields.

- Verify result value sums and ro
and *TBResult* tables match.

using R program "pdftools." All

ains to create fields in the import

ng ArcGIS field types to insure table
geodatabase.
ble using analyte codes as
wn in Appendix M).

SQL queries in the next steps.
data to support SQL queries.

eoreferenced values into fields
r later geoprocessing tool Create XY

e same way across projects.

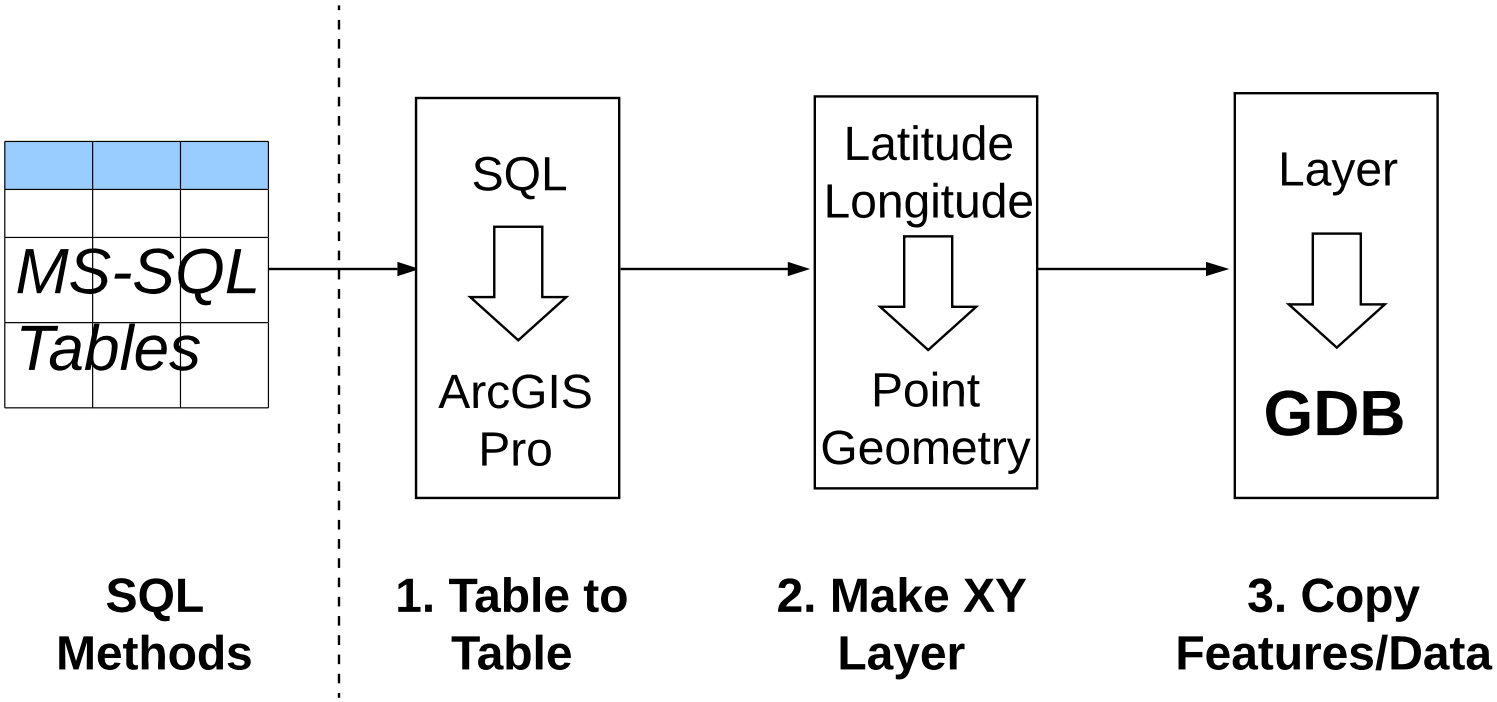
es for domain fields, dates, keys

s for each analyte because
owed in TBResult.

ge and key fields and other

result", domain and other

nd row counts between raw
.

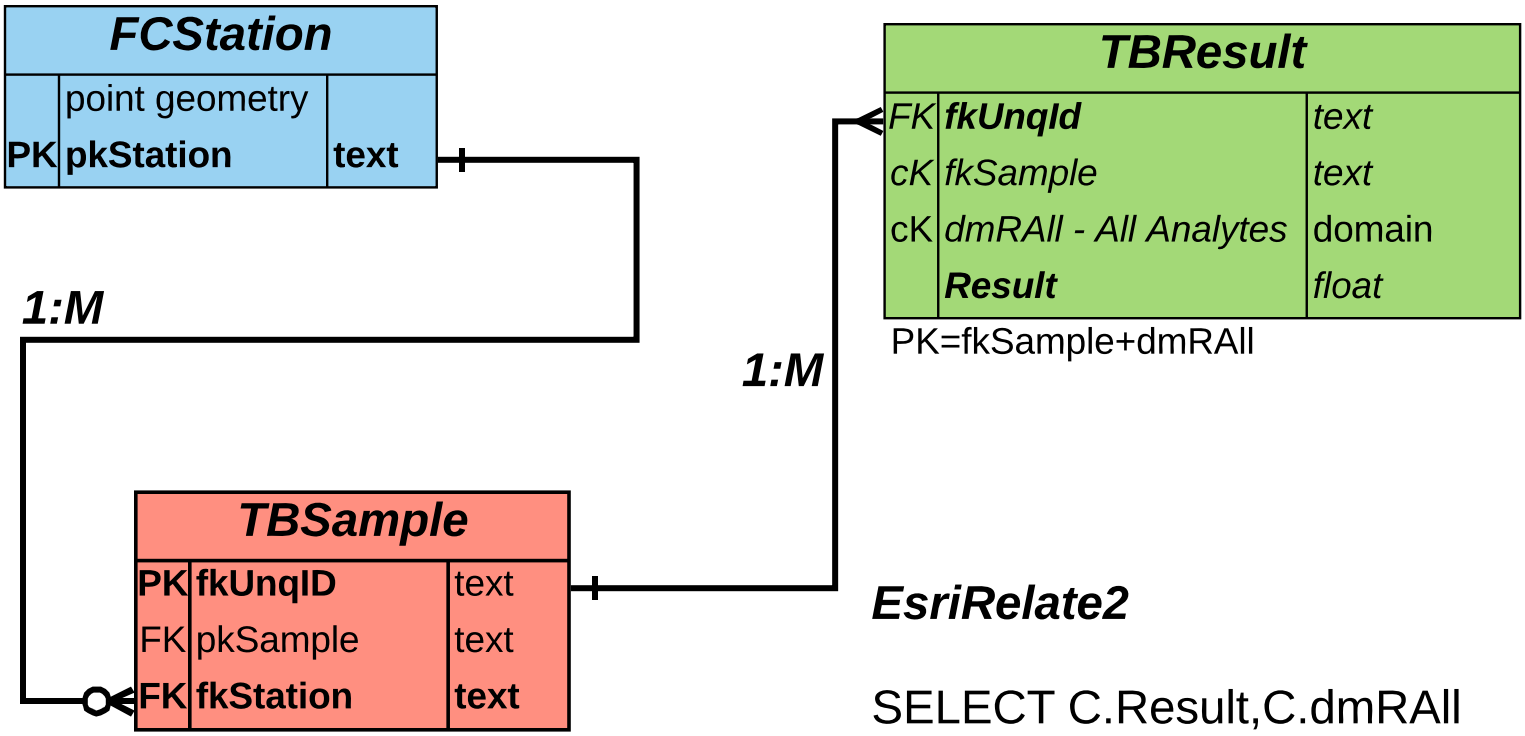


SQL Methods

1. Table to Table

2. Make XY Layer

3. Copy Features/Data



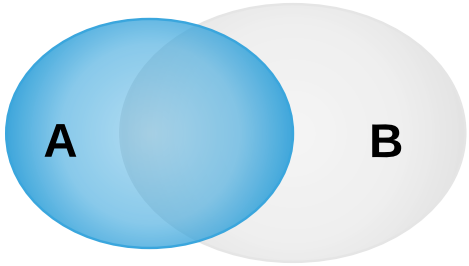
EsriRelate1

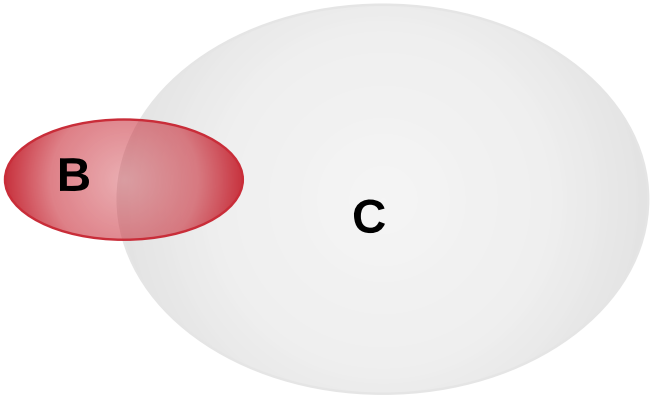
SELECT B.fkUnqID, B.pkSample
FROM **FCStation A**
LEFT JOIN **TBSample B** ON
A.pkStation = B.fkStation

EsriRelate2

SELECT C.Result,C.dmRAll
FROM **TBSample B**
LEFT JOIN **TBResult C** ON
B.fkUnqID = C.fkUnqID

SQL Left Join Equivalent





	A = *FCStation*	B = *TBSample*	C = *TBResult*
~Row Counts	**300**	**15K**	**100K**