

EPA's Volunteer Monitor's Guide to Quality Assurance Project Plans

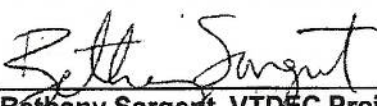
Element 1.


Long-Term
Five Year: 2013 – 2017
QUALITY CONTROL/QUALITY ASSURANCE PROJECT PLAN
LAY MONITORING PROGRAM FOR VERMONT LAKES


Prepared by

Bethany Sargent and Amy Picotte
Vermont Agency of Natural Resources
Department of Environmental Conservation
1 National Life Drive, Main 2
Montpelier, VT 05620-3522
(802) 490-6129
Bethany.Sargent@state.vt.us

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	8/7/13
Bethany Sargent, VTDEC Project Manager	Date

Jeanne Vorhees, USEPA Program Manager	Date
	08-12-13
Steve DiMattei, USEPA QA/QC Officer	Date

	08-08-2013
Dan Needham, VTDEC Laboratory Supervisor	Date

Element 2.

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Appendix B. Attachment – Vermont Department of Environmental Conservation, Vermont Lay Monitoring Program Manual, 2000.	
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Element 3. Distribution List

Bethany Sargent, Project Manager, VTDEC-Watershed Management Division, 1 National Life Drive, Main 2, Montpelier, VT 05620-3522

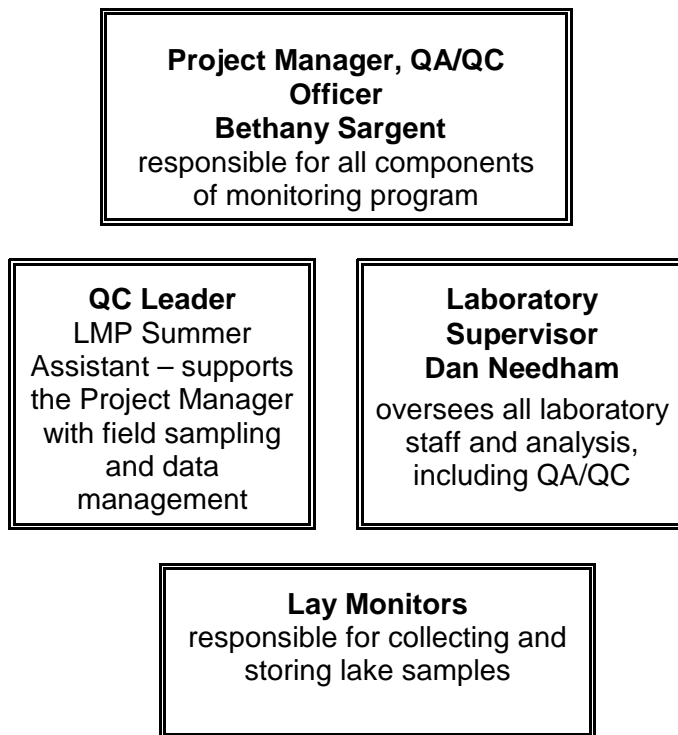
Dan Needham, Laboratory Supervisor, VTDEC Laboratory, University of Vermont, 105 Carrigan Drive, Hills Agriculture Science Building, Burlington, VT 05405

Jeanne Vorhees, USEPA New England, 5 Post office Square – Suite 100 Mail Stop, OEP05-2,, Boston, MA 029109-3912

Steve DiMattei, USEPA New England, 11 Technology Drive, North Chelmsford, MA 01863-2431

Element 4. Project /Task Organization

Figure 1. Organizational Chart



The primary data users are the State DEC, lake associations and citizen watershed groups.

Element 5. Problem/Definition/Background

General Description

This project is a continuation of the water quality monitoring on Vermont lakes, which has been conducted under the Vermont Lay Monitoring Program (LMP) since 1979. Under the LMP, citizen volunteers are trained to measure water clarity and to collect water samples for chlorophyll-a and total phosphorus analysis. Through the use of volunteers, essential baseline water quality data is collected, and lake residents and users are better informed regarding lake biology and lake water quality protection.

Project Objectives

The principal objectives of this project are: (1) to collect water quality data and incorporate it into long-term individual lake eutrophication monitoring databases, (2) to use the data for water quality assessment and management decision-making, and (3) to educate and involve lake users in lake protection.

Element 6. Project/ Task Description

Sampling

Sampling is designed to monitor trophic state parameters. Vermont lakes are known to have suffered declines in water quality due to accelerated eutrophication in some regions. The program therefore measures nutrient concentration and primary productivity. Ninety-one lakes have participated in the program for at least one year between 1979 and 2012.

Sampling Parameters

There are two types of sampling schedules, *Supplemental* and *Basic*. Under the *Supplemental* program, the lakes (Appendix A) are sampled weekly from Memorial Day through Labor Day for the following:

- Secchi disk transparency reading
- Chlorophyll-a concentration samples
- Total phosphorus concentration sample

A hose sampling method is used for lake stations deeper than four meters, while sub-surface grab samples are taken at shallower lake stations. The sampling procedure is repeated to collect two chlorophyll-a samples; therefore all chlorophyll-a samples are taken in duplicate at each station and are analyzed separately. Chlorophyll-a water samples are filtered at a lakeside site. Filters are then frozen and stored until program staff pick them up. Total phosphorus water samples are collected in duplicate at least one time during the summer. Monitors take their duplicates during the LMP staff field visits with the monitors. Also at this time, program staff take an extra phosphorus sample for laboratory analysis of spiked samples (part of the internal lab QA/QC plan). All phosphorus samples are stored in glass test tubes. Program staff transport samples bi-weekly to the DEC Laboratory, currently at the University of Vermont in Burlington, for processing.

Under the *Basic* program, lakes are sampled weekly from Memorial Day through Labor Day for Secchi disk transparency only.

(See Appendix B, Vermont Department of Environmental Conservation, Vermont Lay Monitoring Program Manual, 2000.)

Timeline

Table 1. Timeline

Date	Task
May – June	Monitor training
June – September	Sample collection
June – August	Monitor quality checks
December	All lab analyses completed and submitted to Project Manager
January	Data entry into project database
March	Final project report

Element 7. Data Quality Objectives for Measurement Data

Quantitative QA Objectives

Lab QA Protocol

Table 2. QA Objectives for Precision, Accuracy, and Quantitation Limit

Parameter	Sample Matrix	Practical Quantitation Limit (PQL) ^a	Estimated Accuracy (%Recovery) ^b	Estimated Precision (RPD) ^c	Lab RPD
TP	water	5.0 ug/l	85-115%	14	15 ^d
Chlorophyll-a	water	0.5 ug/l	-	17	10
Secchi Disk	water	n/a	n/a	2.5	n/a

^a PQL is the minimum reported value.

^b Section 5.0, Vermont Department of Environmental Conservation Laboratory QA Plan, 2013.

^c Estimated from average relative percent difference of Lay Monitor field duplicates.

^d RPD for phosphorus calculated from instrument duplicates.

Qualitative QA Objectives

Field QA Protocol

Program staff will accompany each monitor on one normal sampling day and observe monitor technique for error. At this time the sampling procedure is replicated and duplicates are taken by the monitor. Due to weather, boat problems or monitor scheduling needs, seldom, but occasionally, a trained monitor cannot be revisited on the lake as part of the annual check system. If this occurs, visiting these monitors will be prioritized for the following season.

A total of approximately 10% of the field samples will be replicated to validate the accuracy of lay monitoring. Monitors are asked to collect a minimum of nine samples (not including the duplicates) during June, July and August, which is approximately 60% of the maximum number of weekly samples possible to collect during these three summer months. A minimum of eight samples is required to calculate a summer mean for the Vermont Lay Monitoring Program (Vermont Lay Monitoring Field Method Manual, 2000).

Completeness: The weekly sampling frequency allows for adequate characterization of the productivity conditions in each lake.

Comparability: The Vermont Department of Environmental Conservation Laboratory Quality Assurance Plan, including the standard operating procedures, is consistent with current EPA methods. Lake stations are the same ones sampled since 1979, or since the year when lay monitoring first started on a lake.

Representativeness: Lake sampling stations are selected to give a representative sample of the lake.

Performance and System Audits

The LMP staff will inform monitors of any technique errors during quality assurance visits. Staff will review with and demonstrate to monitors the proper technique when necessary. Staff will read monitor comments on data sheets bi-weekly and monitor questions will be answered and assistance given

when needed. Monitors will be encouraged to call staff with any problems they have with any aspect of the program.

Performance and system audits for laboratory analytical centers are detailed in the Laboratory Quality Assurance Plan (VT DEC, 2013) and are the responsibility of the Laboratory Supervisor.

Element 8. Training Requirements and Certification

The LMP Summer Assistant is trained in all aspects of the program by the Project Manager of the program. Typically a new LMP Assistant will spend two weeks shadowing the Project Manager in all aspects of the program. Additionally, the Assistant is given a copy of the Lay Monitoring Program Assistant Guide (Picotte, 2002) to read through and to have on hand in the field.

All Vermont lay monitors are trained in the sampling procedures on their lake by the LMP staff, and a list of trained monitors is maintained by the Project Manager. During training all parts of the sampling procedure are explained in detail and demonstrated. The LMP staff and the monitor take turns performing each part of the sampling procedure. Sections which present difficulties for the monitors are repeated several times until they are comfortable sampling on their own. Monitors are given the data sheet to fill out and to use as a guide for the sampling steps. All sampling steps are written on a laminated card given to each monitor, and monitors are reminded to refer to these steps when sampling. Monitors are encouraged to take notes on procedures and follow along in the LMP Manual as well. Trainings typically take two to four hours for monitors, depending on the size of their lake and the sampling program.

Element 9. Documentation and Records

Monitors are trained to use the program's data sheets and equipment when sampling. Data sheets and samples are properly stored until program staff picks them up once every two weeks (Vermont Department of Environmental Conservation, Lay Monitoring Program Manual, 2000).

Sample Custody Procedures

Samples will be collected from monitors by program staff and brought to the lab bi-weekly in labeled containers. Program staff is responsible for logging the samples into the lab data management system where a unique identification number is assigned to each sample. Program staff then delivers the sample containers to the appropriate storage area in the lab. Individual analysts are responsible for retrieving samples from the storage areas for analysis. Samples will not be used for enforcement purposes. All data results are maintained in the VTDEC Watershed Management Division database.

Element 10. Sampling Process Design

Sampling Site Distribution

Lake sampling stations are located to give a representative sample of the lake. Station one is located at the deepest point in the lake. It is the location from which all supplemental samples are collected. Depending on the size of the lake, a second station is located usually half way between station one and the lake outlet. If station one is located near the outlet, station two is located half way from station one to the further end of the lake. For unusually shaped lakes, a third station will be located in opposite directions from station one and two. Only Secchi disk readings are taken at stations other than station one.

Element 11. Sampling Methods Requirements

Sampling methods are covered in Element 6 of this QA/QC plan and described in the Vermont Department of Environmental Conservation, Lay Monitoring Program Manual (2000).

Table 3. Sampling Method and Quantity Requirements

Location of Weekly Sampling	Sampling Method	Analysis Parameter	Sample Volume (ml)	Sample Container	Field Procedures
Lake Stations < 4 Meters Deep	Secchi Disk	Transparency	-	-	observation
	Sub-Surface Grab	TP	50	Glass tube	none
		Chlorophyll-a	100	Filter paper (Glass Microfiber particular retention 1.6um)	filtration
Lake Stations > 4 Meters Deep	Secchi Disk	Transparency	-	-	observation
	Hose Sample	TP	50	Glass tube	none
		Chlorophyll-a	100	Filter paper (Glass Microfiber particular retention 1.6um)	filtration

Element 12. Sample Handle and Custody Requirements

Reference – Element 9 of this QA/QC Plan.

Element 13. Analytical Methods Requirements

Sample Analysis

Table 4. Parameter Table

Parameter	Number of Samples ^a	Sample Matrix	DEC (SOP) Reference ^b	EPA Analytical Method	Sample Preservation	Holding Time
TP	572	water	1.6	4500-P H ^c	none	28 days
Chlorophyll-a	1144	water	5.4	445 Revision 1.2 ^d	freeze, dark	21 days

^a Includes field QC samples from Program Staff.

^b Vermont Department of Environmental Conservation Laboratory Quality Assurance Plan (2013), Appendix A - Laboratory Standard Operating Procedures (March and June 2005 SOP)

^c Standard Methods for the Examination of Water and Wastewater. 21st Edition. 2005

^d In Vitro Determination of Chlorophyll-a and Pheophytin a in Marine and Freshwater Algae Fluorescence, 1997. National Exposure Research of Research and Development, USEPA.

Element 14. Quality Control Requirements

Laboratory Analytical Procedures

Reference – Section 11 and 14 of Vermont Department of Environmental Conservation Laboratory Quality Assurance Plan, 2013.

Field Samples

Most Vermont lakes, with the exception of Lake Champlain, have two sampling stations. The lakes have a centrally located, deepwater station (station #1) and a second station (station #2) located between the shores, towards the outlet of the lake (see Element 10 of this QA/QC Plan).

Monitors are required to collect two different water samples, sample A and sample B each from a separate sampling at station #1. (All other stations are sampled for Secchi water clarity only.)

Collecting chlorophyll-a samples

The two samples (A and B) are filtered (100 mls each) and are assigned a unique laboratory identification number upon arrival at the lab. The samples are analyzed as individual chlorophyll-a samples and two separate results are reported.

Collecting phosphorus samples

A 50 ml portion of sample B, stored in a glass test tube, is analyzed for total phosphorus. Total phosphorus water samples are collected in duplicate at least one time during the summer (approximately 10% of all phosphorus samples). Duplicate phosphorus samples are collected from a 50 ml portion of sample bottle A and a 50 ml portion from sample bottle B, with the sample from bottle A being labeled as the duplicate. The phosphorus duplicates are collected by the monitors during the LMP staff field visits with the monitors. During the annual LMP staff visits with the Lay Monitors, additional duplicate samples (minimum of 10 %) are taken for the laboratory staff to use as part of their quality assurance program, which includes a sample for analyzing spiked samples. The LMP staff will fill two 50 ml test tubes, one with lake water from sample bottle A to be used by the lab for spikes, and the other with lake water from sample bottle B, also for lab use.

RPD of Monitor Duplicate Samples:

$$RPD = \frac{(C^1 - C^2) \times 100\%}{(C^1 + C^2)/2}$$

RPD = relative percent difference

C1 = larger of the two observed values

C2 = smaller of the two observed values

Reference – Vermont Department of Environmental Conservation, Lay Monitoring Program Manual, 2000.

Due to logistical constraints in picking up and delivering samples to the laboratory, it is not always possible to analyze all chl-a and TP samples within the prescribed 21- and 28-day hold times, although every effort will be made to do so. These samples will be properly stored throughout this time. A remark field in the database will be used to identify samples analyzed in the laboratory past their hold times so that appropriate data screening may be applied if deemed necessary at the time the data are statistically analyzed and reported.

Corrective Action

Upon joining the Lay Monitoring Program, all monitors are given a copy of the Vermont Lay Monitoring Program Manual, which contains explanations, graphics, and check lists for proper sampling techniques. Monitors will be asked to review this manual and also be reminded that step by step sampling procedures are listed on the laminated card to provide guidance while sampling in the field. Monitors are required to follow the LMP sampling procedures to participate in the LMP program and are visited (checked) annually by program staff.

For laboratory use, corrective actions are defined in section 15 of the Vermont Department of Environmental Conservation Laboratory Quality Assurance Plan, 2013.

Element 15. Instrument/Equipment Testing, Inspection and Maintenance Requirements

Laboratory Analysis QA/QC – Calibration Procedures, Analytical Procedures and Preventive Maintenance

Reference – Section 8, 9, and 13 of Vermont Department of Environmental Conservation Laboratory Quality Assurance Plan, 2013.

Field Sampling Equipment

The Vermont DEC supplies all the equipment except for a boat and anchor to the volunteer monitors. Before any equipment is supplied to a volunteer, it is carefully checked by LMP staff. Secchi disk lines are measured and marked off in meters. Hoses are also marked off in meter increments. All Nalgene 500 ml sample bottles (each monitor is given a sample bottle “A” and “B”), hand filtering apparatuses, graduated cylinders, five-gallon buckets, and hoses are acid washed (10% solution of sulfuric acid) and thoroughly rinsed before being given to monitors. The 50 ml glass test tubes are disposable and provided clean and new from the LaRosa Laboratory. All equipment is checked during the annual LMP staff field visits with monitors. On a rotational basis, hoses are collected from the monitors and acid washed by LMP staff before being returned to monitors. The monitors who plan to return to the program for the next season are asked to store the equipment during the winter months. Monitors are given written directions on properly storing equipment during the winter months. New filter papers, glass test tubes, and data sheets are provided at the start of each sampling season.

Reference – Vermont Department of Environmental Conservation, Lay Monitoring Program Manual, 2000.

Element 16. Instrument Calibration and Frequency

Reference – Element 15 of this QA/QC Plan.

Element 17. Inspection and Acceptance Requirements for Supplies

All monitoring supplies used are either the exact same make as equipment used in past years or are comparable replacement products. Most of the sampling equipment used is purchased through the laboratory supplier, VWR Scientific, to ensure consistent use of the exact same filter paper, sample bottles, graduated cylinders, and other field supplies needed. The hoses and rope purchased are non-stretch. Annual records of all equipment purchased and used by the LMP are kept to ensure consistency in selecting new sampling equipment.

Reference – Element 15 of this QA/QC Plan and the Vermont Lay Monitoring Program Manual, 2000.

Element 18. Data Acquisition Requirements

Monitors are provided with Vermont Watershed Management Division Lake Maps that show the locations of the sampling stations. Monitors are trained how to locate their sampling stations using these maps during their training session with the LMP staff.

Element 19. Data Management

All data results are maintained in the VTDEC Watershed Management Division database.

Reference – Element 9 of this QA/QC Plan.

Element 20. Assessments and Response Actions

Reference – Element 7 and Element 14 of this QA/QC Plan.

Element 21. Reports

Data for each monitoring station will be summarized and compiled into an annual report for distribution to volunteer monitors, state agencies, and organizations and individuals interested in Vermont water quality. This annual report is the responsibility of Bethany Sargent, Project Manager.

Element 22. Data Review, Validation and Verification Requirements

Data Reduction

Reference – Section 10 of Vermont Department of Environmental Conservation Laboratory Quality Assurance Plan, 2013.

Element 23. Validation and Verification Methods

The validation of laboratory data is the primary responsibility of the Lab Supervisor utilizing methods documented in Section 10 of the Vermont Department of Environmental Conservation Laboratory Quality Assurance Plan (2013).*

At the program level, the Project Manager validates the data according to the following process: Secchi disk readings and total phosphorus concentrations from each lake are reviewed and compared to previous years' data. If any samples seem unusually high or low, then the monitor data sheets are checked for that day's sampling comments (monitors might be called as well) and the Laboratory Staff is consulted about possible errors. All samples where monitors used questionable techniques, or where they noted problems with sampling or sample storage, and where chemists noted problems are not validated and the data not used.

In order to average both the chlorophyll-a duplicates for a single concentration value, the two samples must be evaluated according the following:

If $H/L^{**} < 2.5$, then both values are kept.

If $H/L > 2.5$ lab and data sheets are checked for an explanation,

- If the lake is eutrophic or if algal blooms were present, both values are kept.
- If there is no written reason, then both values are tossed.
- If only one value is questionable, that value will be tossed and the other used.

* Reference – Vermont Department of Environmental Conservation Laboratory Quality Assurance Plan (2013), Section 9

****H** = high concentration, **L** = low concentration

Element 24. Reconciliation with Data Quality Objectives

The LMP is a cooperative effort between the Vermont DEC and lake users to collect essential baseline water quality data on Vermont lakes. Monitors are asked to collect a minimum of nine samples during June, July and August – a minimum of eight samples are used to calculate summer means. If less than eight samples are collected during the summer months, no annual mean can be calculated for that year and the data is used to describe only current water quality conditions, and not for long term trend analysis. Monitors on more than 91 lakes in Vermont have participated in the LMP and have contributed substantially to the understanding of water quality conditions in Vermont lakes.

Reference – Element 14 of this QA/QC Plan.

Reference – Vermont Lay Monitoring Program Manual, 2000.

References

Standard Methods for the Examination of Water and Wastewater. 21st Edition. 2005 (EPA Analytical Method, 4500-PF 445 Revision 1.2)

In Vitro Determination of Chlorophyll-a and Pheophytin a in Marine and Freshwater Algae Fluorescence, 1997. National Exposure Research of Research and Development, USEPA.

Environmental Protection Agency. 1996. The Volunteer Monitor's Guide to Quality Assurance Project Plans

Vermont Department of Environmental Conservation Laboratory Quality Assurance Plan, 2013. Burlington, VT.

Vermont Department of Environmental Conservation, Vermont Lay Monitoring Program Manual, 2000. Waterbury, VT.

Vermont Department of Environmental Conservation, Vermont Lay Monitoring Assistant Guide, 2002. Waterbury, VT.

Vermont Department of Environmental Conservation, Annual Vermont LMP Reports.

Appendix A. Inland Lake Names and Locations

NAME	Lat DD.MM	Long DD.MM	Total Depth of Station #1 (meters)
AMHERST	4349	7371	21
ARROWHEAD MTN.	4440	7306	7.6
BEEBE (HUB)	4344	7311	12
BLISS	4421	7230	4.5
BOMOSEEN	4339	7313	18.2
BUCK	4428	7224	9.2
BURR (SUD)	4346	7311	4.6
CARMI	4458	7252	11
CASPIAN	4435	7219	30
CEDAR	4415	7308	3.8
CHIPMAN	4324	7302	3.4
COLE	4309	7248	3.0
COLES	4450	7221	6.4
CRYSTAL (BARTON)	4444	7209	30.5
CURTIS	4423	7230	7.6
DANBY	4322	7303	2.0
DERBY	4457	7207	5.2
DUNMORE	4354	7305	30
EAST LONG	4427	7221	30
ECHO (CHARLES)	4452	7200	39
ECHO (HUB)	4345	7311	12.2
EDEN	4443	7230	11.9
ELFIN	4328	7259	11
ELLIGO	4436	7221	30.3
ELMORE	4432	7232	5.2
FAIRFIELD	4451	7259	13
FAIRLEE	4353	7214	15
FERN	4352	7304	12.7

NAME	Lat DD.MM	Long DD.MM	Total Depth of Station #1 (meters)
FOSTERS	4432	7221	3.9
GLEN	4340	7314	18.3
GREAT AVERILL	4459	7142	30
GREAT HOSMER	4442	7222	13
GREEN RIVER RES.	4438	7231	28
GREENWOOD	4427	7225	9
GROTON	4416	7216	13
HALLS	4405	7207	9
HARVEYS	4418	7208	40
HOLLAND	4459	7156	11.5
INDIAN BROOK RES.	TBC	TBC	7.6
HORTONIA	4345	7312	18
IROQUOIS	4422	7305	10
ISLAND	4448	7152	12
JOES (DANVILLE)	4425	7213	15
LOWELL	4313	7246	7.3
LYFORD	4427	7215	6.1
MAIDSTONE	4439	7139	30
MARTINS	4418	7213	5.5
MEMPHREMAGOG	4459	7213	8.3
METCALF	4444	7253	7.6
MILES	4427	7149	16.7
MOREY	4355	7209	11
NELSON (CALAIS)	4424	7227	29
NICHOLS	4427	7221	24
NINEVAH	4328	7245	3.5
NORTH MONTPELIER	4419	7227	3.6
PARAN	4256	7314	7
PARKER	4443	7214	12
PEACHAM	4420	7216	15

NAME	Lat DD.MM	Long DD.MM	Total Depth of Station #1 (meters)
PENSIONER	4452	7203	12
PERCH (BENSON)	4345	7317	9.1
PINNEO	4339	7226	3
RAPONDA	4253	7249	4.8
RESCUE	4327	7242	27
RUNNEMEDE	4329	7223	2.9
SABIN (Woodbury)	4424	7225	5.2
SALEM	4456	7206	18
SEYMOUR	4454	7159	48
SHADOW (GLOV)	4440	7213	42.4
SHELBURNE	4423	7310	7.6
SILVER (BAR)	4344	7237	9.5
SOUTH (EDEN)	4441	7232	20
SPRING (SHREWS)	4330	7255	26
ST. CATHERINE	4328	7313	20
STAR	4325	7249	2
STRATTON	4306	7258	5
SUNRISE	4346	7316	13
SUNSET (BENSON)	4345	7316	32
SUNSET (BROOK)	4402	7236	8.5
TICKLENAKED	4411	7206	15.4
VALLEY	4426	7226	21
WAPANACKI	4433	7224	2
WILLOUGHBY	4445	7204	21.3
WINONA	4410	7305	2
WOODFORD	4253	7304	7.6
WOODWARD	4334	7246	14