Borrego Water District Board of Directors
Special Meeting
April 17, 2018 @ 9:00 a.m.
806 Palm Canyon Drive
Borrego Springs, CA 92004

I. OPENING PROCEDURES

- **A.** Call to Order
- **B.** Pledge of Allegiance
- **C.** Roll Call
- **D.** Approval of Agenda
- **E.** Comments from the Public & Requests for Future Agenda Items (may be limited to 3 min)
- **F.** Comments from Directors

II. ITEMS FOR BOARD CONSIDERATION AND POSSIBLE ACTION

- A. Draft Proposal for Groundwater Quality Sampling Additional Wells – T Driscoll (2-29)
- **B.** Burnand Land Fallowing Acreage Calculations/Water Credit Application – G Poole (30-31)
- **C.** Portable Air Sampler Proposal from Dr. Zender – L Brecht (32-124)
- **D.** Raftelis Spare Capacity Lease Analysis Proposal – L Brecht (125)

III. INORMATIONAL ITEMS (126)

- A. Review of 2018-19 Budget and Discussion of GSP-related Expenses – K Pittman (127-130)
- B. Role of Borrego Water Coalition in GSP Development Process – Core Team
- C. GSP Advisory Committee SDAC Ad Hoc Committee Update – Core Team

IV. CLOSED SESSION:

Conference with legal counsel-anticipated litigation: Initiation of litigation pursuant to subdivision (d) (4) of Government Code Section 54956.9: Two (2) cases

V. CLOSING PROCEDURE

A. Suggested Items for Next/Future Agenda
B. The next Meeting of the Board of Directors is scheduled for April 25, 2018 at the Borrego Water District

BORREGO WATER DISTRICT

BOARD OF DIRECTORS MEETING – APRIL 17, 2018

AGENDA BILL 2.A

April 11, 2018

TO: Board of Directors, Borrego Water District

FROM: Geoff Poole, GM and Director Ehrlich

SUBJECT: Draft Proposal for Groundwater Quality Sampling Additional Wells – T Driscoll

RECOMMENDED ACTION:

Receive Presentation from T Driscoll (scheduled to appear), discuss and authorize the General Manager to sign an agreement with Dudek for the proposed analysis beginning with Task 1 (and Task 2 if needed); allocate up to $10,000 for the work.

ITEM EXPLANATION:

As part of the development of the Groundwater Sustainability Plan (GSP) and related work to provide the BWD with groundwater basin water quality for district water supply pumping, Dudek began obtaining water samples from approximately twenty two wells including the active district wells in November 2017. The sampling is to be semi-annual and tests for about ten constituents including TDS, nitrates, arsenic, etc. The BWD Board authorized additional sampling in July 2017 and allocated funds up to $30,000 for the testing. The first round of expanded sampling only included district wells and those are primarily in the central/west management area leaving a large unsampled area of the basin within the BWD service area..

Status of Well Sampling

Discussions since July 2017 of what and how to expand the water sampling program with the General Manager and Dudek have resulted in a proposal to expand the sampling to possible public and private wells that may be operating and accessible for sampling. An initial staff review of possible wells including the BSUSD, County Airport, County Street Maintenance Facility and several private wells indicates there may be a possible additional five to ten wells that could be easily accessible. The idea is to sample additional operating water wells for groundwater elevation and groundwater quality in the Borrego Springs Groundwater Subbasin (Subbasin), specifically in the North and Central Management Areas. By sampling additional wells in the Subbasin, it is hoped to gain a more informed knowledge of groundwater quality conditions across the basin along with water quality trends over time. In response to a request for a scope of work to do this work, Dudek has prepared the attached proposal and cost estimate to identify and evaluate additional wells for sampling groundwater quality.

Outline of Proposed Work

Dudek has prepared the work by tasks to decide the appropriate approach for identifying additional groundwater quality sampling wells. Task 1 is proposed to locate and evaluate the potential well locations for being easily test sampled of existing operating wells. Task 2 would evaluate other possible wells and determine whether they qualify to sample additional wells. If needed and deemed beneficial, Task 3 and if implemented, Task 4 would include additional evaluation of possible wells by a site reconnaissance to document well conditions. As stated in the proposal, the cost to the BWD will depend on the level of well modification needed to transition existing wells into groundwater sampling wells.

It is recommended that Task 1 be implemented as soon as possible in order for Dudek to use the current well database established for the GSP to identify and confirm potential wells for additional groundwater quality sampling. The database includes historical groundwater wells monitored by the BWD, U.S. Geological Survey (USGS), Department of Water Resources (DWR), and the County of San Diego. Additionally, Dudek will utilize the BWD list of potential wells from public and private well owners. This work will be an initial desk study review to identify available wells. Potential wells will be categorized based on predicted sampling cost efficiency for the BWD. The findings of the desk study will be presented to the BWD for review and direction on adding wells for sampling.

Based on the findings of the desk study and input from the BWD, BWD and Dudek will select wells to perform additional reconnaissance to confirm capability for groundwater quality monitoring. The reconnaissance should include contacting of private well owners, setting up a field visit to document well conditions, requesting well completion information, etc. Dudek proposes to complete one day of field reconnaissance to ensure the well is in working condition and meets the criteria for groundwater quality sampling. Once confirmed, BWD will request an agreement with the well owner to be able to obtain semi-annual WQ testing with no impact to the owners well. The data will be added to the WQ data base for tracking and analyses.

If additional well locations are identified for further analysis, the General Manager and Dudek will agree on the wells to evaluate under Task 2 and consider implementing that work as appropriate.

Financial Budget Impact

The funding for the additional WQ analysis has already been authorized by the Board in July 2017 and additional funds will be needed in the FY 2018-19 Budget depending upon number of wells included in the sampling.

ATTACHMENTS –

1. Proposal by Dudek for Additional Sampling Well Analysis dated April 10, 2018
2. Recent Dudek Presentation to the GSP Advisory Committee on Water Quality
3. Well Sampling Slide for Possible New Wells

DUDEK

MAIN OFFICE
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April 10, 2018

Geoff Poole
Borrego Water District
806 Palm Canyon Drive
Borrego Springs, CA 92004

Subject: Additional Groundwater Quality Sampling of Water Wells for Groundwater Sustainability Plan Preparation and Long-term Monitoring

Dear Mr. Geoff Poole:

Dudek understands that the Borrego Water District (BWD) would like to sample additional water wells for groundwater elevation and groundwater quality in the Borrego Springs Groundwater Subbasin (Subbasin), specifically in the North and Central Management Areas. These water wells would be in addition to wells currently sampled by the Groundwater Sustainability Agency (GSA). By sampling additional wells in the Subbasin, BWD hopes to gain a more robust knowledge of spatial groundwater quality conditions. To minimize the cost of drilling additional target wells, the BWD would like to use existing wells. Dudek has prepared the following proposal and cost estimate to sample additional wells for groundwater quality.

SUMMARY OF TASK

Due to the various well conditions known to exist in the Subbasin, Dudek has prepared task to aid the BWD in deciding the correct approach for additional groundwater quality sampling wells. The cost to the BWD will depend on the level of well modification needed to transition existing wells into groundwater sampling wells. Task 1 and 2 are required to locate and sample additional wells. Task 3 through 4 include optional cost to be determined by a site reconnaissance to document well conditions.

Task 1 Identify Potential Water Quality Wells

Dudek will use the current well database established for the GSP to identify potential wells for additional groundwater quality sampling. The database includes historical groundwater wells monitored by the BWD, U.S. Geological Survey (USGS), Department of Water Resources (DWR), and the County of San Diego. Additionally, Dudek understands that the BWD may have a list of potential wells from private well owners. Dudek will perform an initial desk study review to identify available wells. Potential wells will be categorized based on predicted sampling cost

efficiency for the BWD. The findings of the desk study will be presented to the BWD in a table and map.

Based on the findings of the desk study and input from the BWD, Dudek will select wells to perform additional reconnaissance to determine applicability for groundwater quality monitoring. Reconnaissance will include contacting private well owners, setting up a field visit to document well conditions, requesting well completion information, etc. Dudek will complete one day of field reconnaissance. Field reconnaissance will ensure the well is in working condition and meets the criteria for groundwater quality sampling.

Deliverable: *Map and table of potential wells for groundwater quality monitoring*

Cost for Task 1 .....$3,998.00

Task 2 Groundwater Sampling

Task 2 includes field data collection of groundwater sampling wells. This task includes cost for field personnel to sample up to five (5) wells and laboratory fees. Task 2 also assumed that all wells have existing operating pump, motor, power, and sampling spigot. This task assumes that no modifications will need to be made to the well in order to conduct field data collection and that purged water will not need to be stored and disposed of offsite.

Prior to collecting groundwater samples, Dudek will run the pump in each well for a sufficient amount of time in order to ensure the groundwater sample is representative of the formation water. The determination of representative formation water will be based upon the stabilization of water quality parameters of the discharged water in accordance with EPA guidelines. Dudek will collect manual depth to water field measurements, where accessible, before the pumps are turned on and at the time of sample collection. Dudek will also continually record water quality parameters in the field prior to sampling and again at the time of sample collection. Water quality parameters measured include pH, electrical conductivity (EC), turbidity, and temperature. The water quality samples will be analyzed for the routine and baseline constituents defined in the BVGB Sampling and Analysis Plan and Quality Assurance Project Plan. The routine constituents include arsenic, fluoride, nitrate, sulfate, radionuclides, and total dissolved solids. The baseline constituents include cations and anions. Dudek will submit the water quality samples to Babcock Laboratories, Inc. for analysis. The cost for laboratory analysis for up to five (5) wells per annual sampling event is included in this Task. Dudek will provide the BWD with lab results from sampled wells.

Deliverable: *Lab results and inclusion of data into GSA data management system*

Cost for Task 2 .....$4,218.00

Task 3 Well Modification

Task 3 is subdivided into three (3) subtasks. Each task assumes varying levels of well modification. These task are in addition to Task 1 and 2.

Task 3.1 Minimal Well Modification

Minimal well modification includes wells that have no pump, motor, or power. Field staff will be required to supply necessary temporary equipment for sampling (pump, power, tubing, etc.). Well should be open and clear for lowing sampling equipment down well.

Cost for Task 3.1 (up to five wells) $2,140.00

Task 3.2 Medium Well Modification

Task 3.2 includes the assistance of a sub-contractor for well modifications such as installing a spigot, minor welding to open access for sampling, and other well head modifications. No drill rig is required for medium well modification.

Cost for Task 3.2 (per well).....$1,500.00

Task 3.3 High Well Modification

Task 3.3 includes the cost to pull existing pump and motor from wells, removing old well equipment from the site, sealing well with appropriate lockable lid. A drill rig from a licensed drill contractor will be used to perform well modifications for Task 3.3. Cost includes

Cost for Task 3.3 (per well).....$8,000.00

Task 4 Install Permanent Pump and Motor

The installation of a permanent pump and motor will require the use of a pump contractor to install necessary equipment. Dudek will size the pump and motor for proper sampling and oversee the installation. This estimate includes per well installation cost.

Cost for Task 4 (per well) $4,000.00

TOTAL COST

Dudek understands that direct cost to the BWD will be reliant of the level of well modification required. Dudek has supplied the BWD with a range of costs for the anticipated work based on knowledge of the Subbasin and current well conditions.

The time and materials fee provided in this proposal represents an estimate of the anticipated level of effort required to complete the tasks described in the proposal. Should the actual effort to complete the tasks be less than anticipated, the amount billed will be less than the total fee. Conversely, should the actual effort to complete the tasks be greater than anticipated, additional fee authorizations will be requested.

No work in excess of the proposed fee or outside of the proposed scope of work will be performed without written authorization from the client.

TOTAL COST.....$10,576.00 – $45,756.00

SCHEDULE

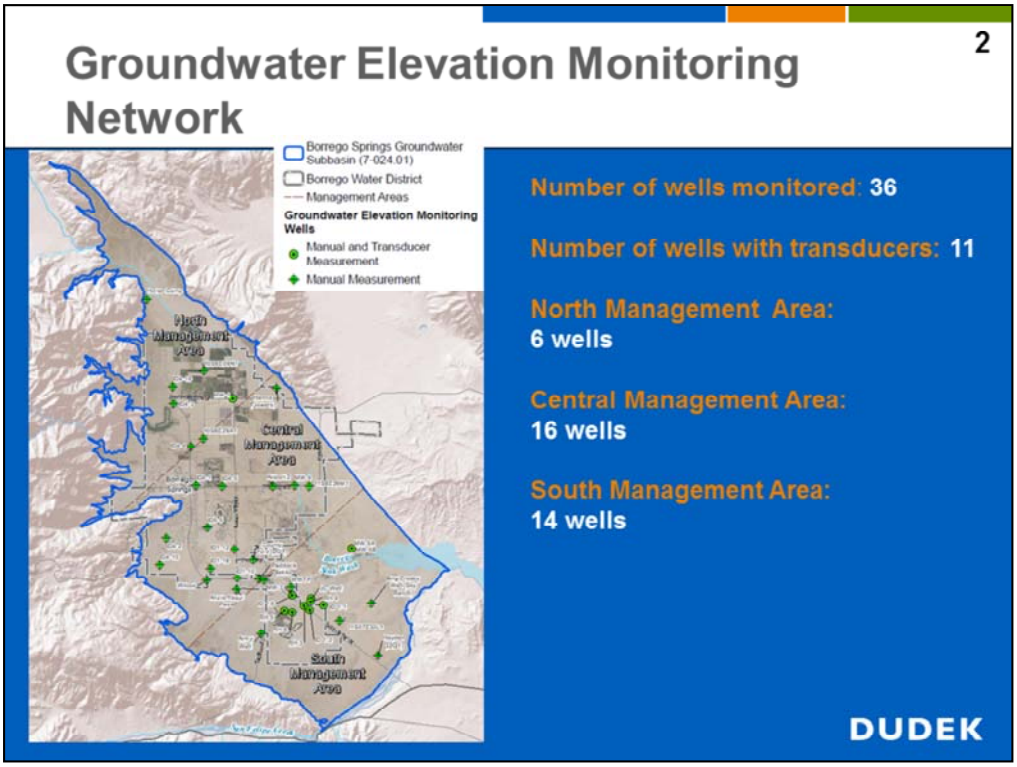
Dudek intends to include the sampling of additional wells as part of the spring 2018 GSA monitoring event that is schedule to occur in April/May 2018.

Sincerely,

Trey Driscoll
Principal Hydrogeologist

cc: Lyle Brecht, BWD Board
Harry Ehrlich, BWD Board

As per Agenda Packet Item IV.A: Informational Items this part of the presentation presents Draft Fall 2017 Groundwater Monitoring Results for Groundwater Levels and Water Quality.

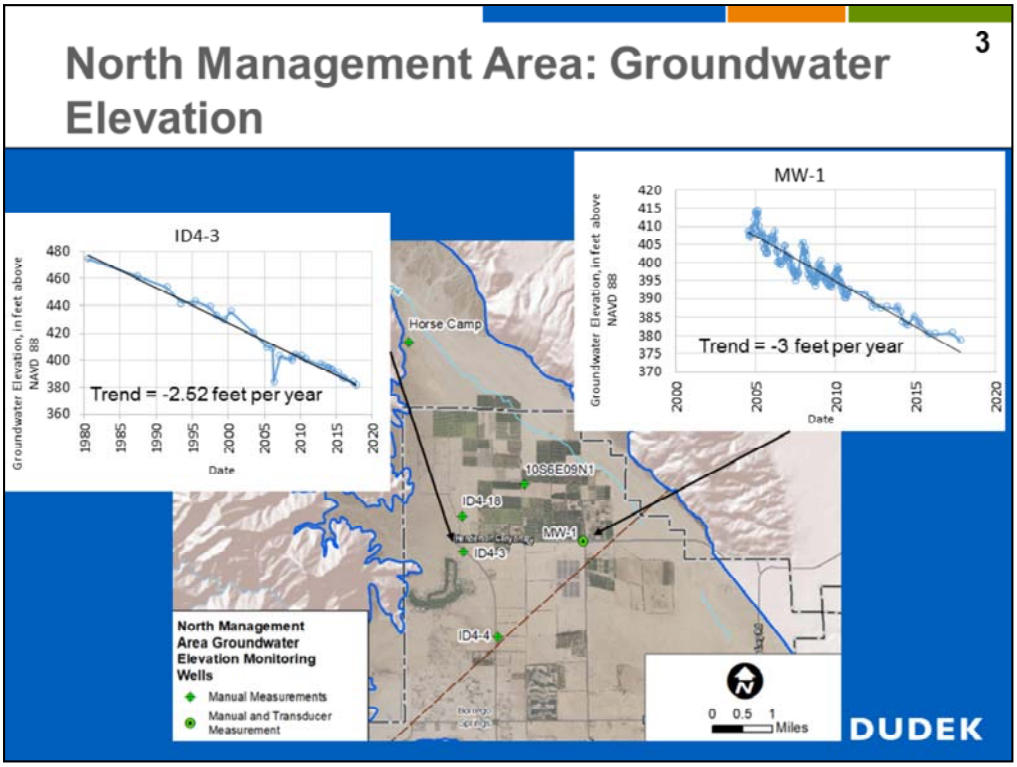


The Borrego Valley Groundwater Sustainability Agency (GSA) groundwater elevation monitoring network currently consists of 36 wells in the Borrego Springs Subbasin. An additional 4 wells are monitored for groundwater levels in the Ocotillo Wells Subbasin. This presentation is focused on the results of the Borrego Springs Subbasin (Subbasin).

Of the 36 wells monitored, 11 of the wells have pressure transducers installed that record groundwater levels at a frequency of every 15 minutes.

Results of groundwater elevation monitoring are presented in the following slides by Subbasin management area, which includes the North Management Area (NMA), Central Management Area (CMA) and South Management Area (SMA). The distribution of wells by management area are 6 wells in the NMA, 16 wells in the CMA and 14 wells in the SMA. As the Borrego Water District (BWD) has included all of their production wells into the GSA network and they predominantly pump form the CMA, there are more wells located in the CMA.

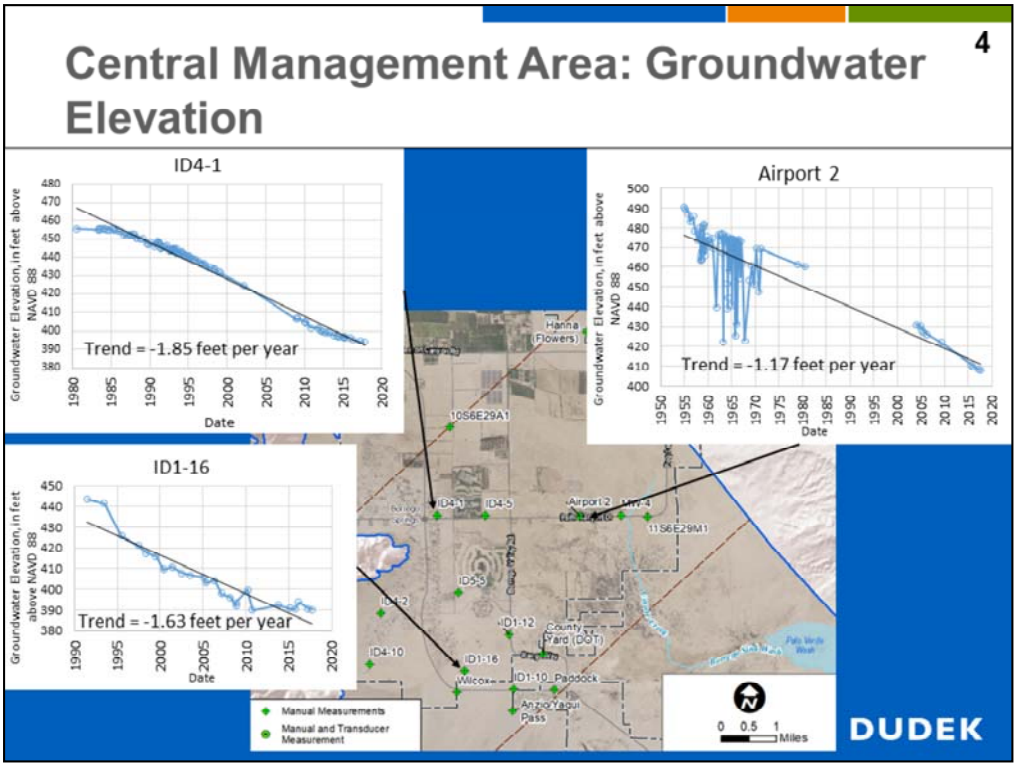
The Borrego Valley GSA monitored groundwater elevations in the spring and fall of 2017. Historical groundwater level data were previously collected by the U.S. Geological Survey (USGS), Department of Water Resources (DWR), BWD and County of San Diego (County).



Historical groundwater levels in wells ID4-3 and MW-1 indicate a declining trend of 2.5 to 3 feet per year in the NMA. Each well hydrograph has a distinct period of record and number of data points based on when the well was originally drilled, lifespan of the well and frequency of data collection.

Proximity of groundwater elevation monitoring wells to pumping centers located in the area of agricultural irrigation will influence overall trend of groundwater level elevations.

Thus, groundwater elevations should be monitored at multiple wells during Groundwater Sustainability Plan (GSP) implementation to track trends and progress toward GSP goals.

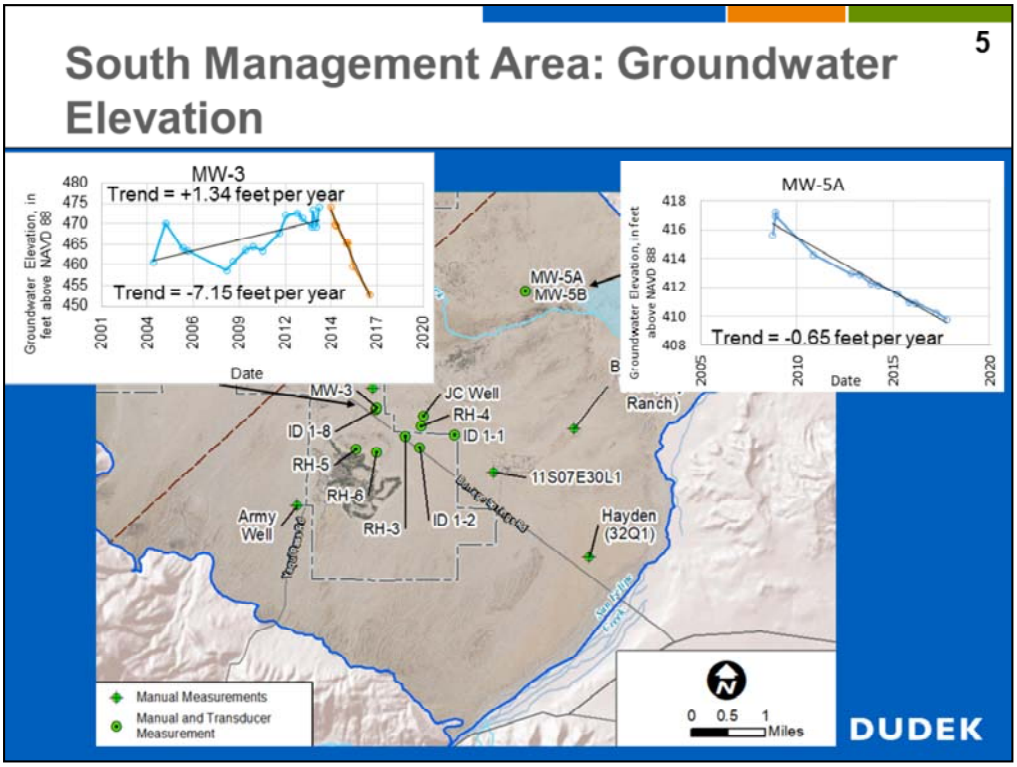


Historical groundwater levels in wells ID4-1, ID1-16 and Airport 2 indicate a declining trend of 1.85, 1.63 and 1.17 feet per year, respectively in the in the CMA.

The historical rate of decline is the CMA is less than the NMA. This is likely because less overall groundwater extraction occurs in the CMA. However, groundwater levels will likely continue to decline in the CMA at the current rate of groundwater extraction regardless of future agricultural land fallowing in the NMA.

Thus, declining groundwater levels are not limited to areas where agricultural extraction is predominantly occurring (i.e. NMA).[1] Reduction in groundwater extraction will likely also need to occur in the CMA in order to reach Subbasin sustainability.

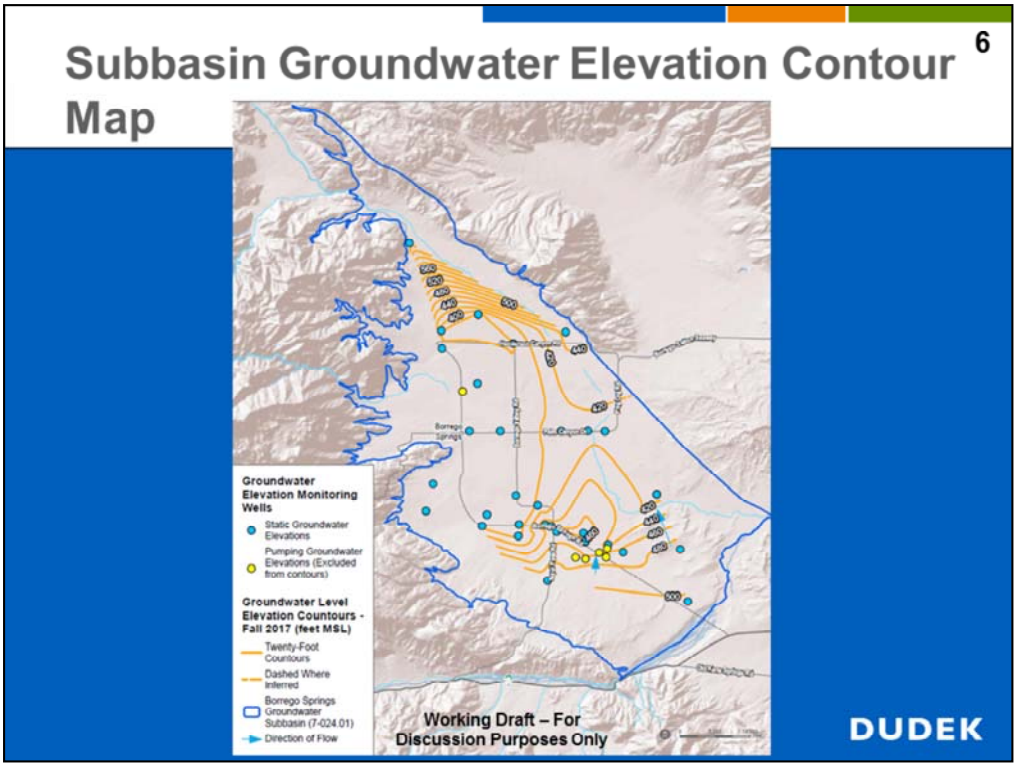
1. Recreation pumping also occurs in the NMA for the De Anza Country Club.



Well MW-5A located in the Borrego Sink in the SMA indicates a declining groundwater trend of 0.65 feet per year. This well is located far from large pumping centers.

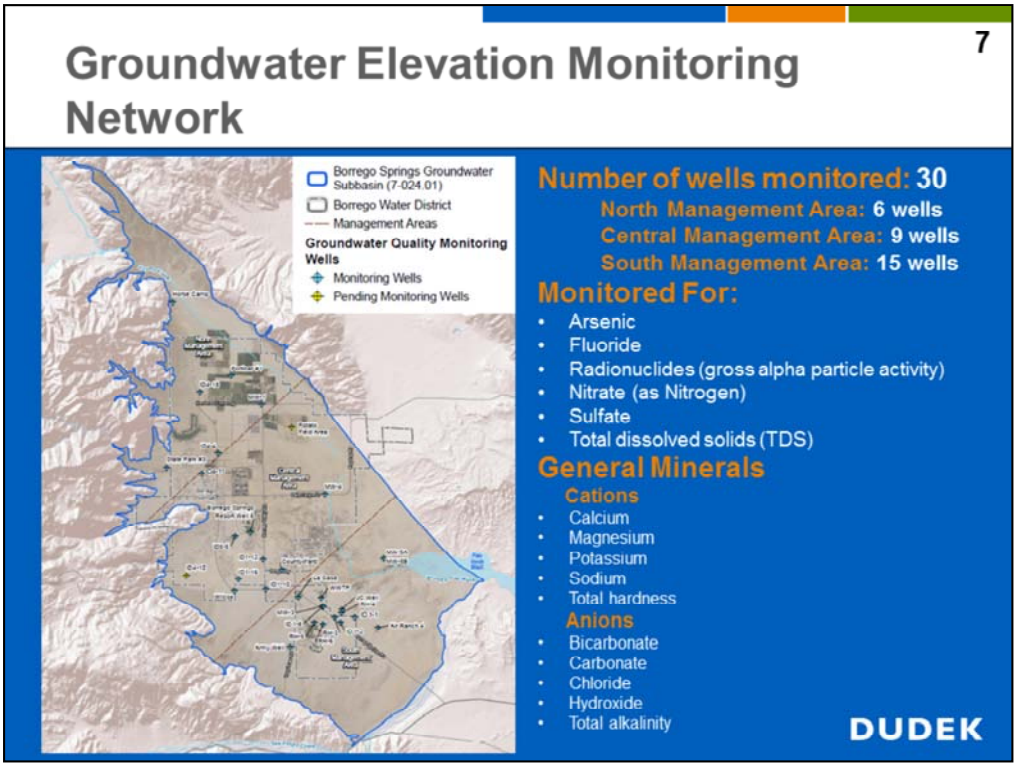
The groundwater trend at Well MW-3 in the SMA reflects the change in water supply for the Rams Hill Golf Course. Prior to 2013 the Rams Hill Golf Course was predominantly supplied from wells located in the CMA. Groundwater levels are observed to be recovering at a rate of 1.34 feet per year in well MW-3 over the 10-year period from 2004 to 2014. This likely was a result of recharge from applied irrigation water at the Rams Hill Golf Course and lack of appreciable groundwater pumping in the SMA during this timeframe.

When the Rams Hill Golf Course reopened in 2014/2015, the water supply was provided by new wells primarily located in the SMA. Pumping from Rams Hill wells in combination with some Borrego Water District (BWD) pumping from well ID1-8 has resulted in a declining groundwater level trend of 7.15 feet per year over the 3 year period from 2015 to 2017. Reduction in groundwater extraction will need to occur in the SMA in order to reach Subbasin sustainability.



Groundwater elevation contours shown in the figure represent groundwater elevations measured in the fall of 2017. Groundwater elevations decrease from the north end (at Coyote Creek), and south end (near Rams Hill) of the Subbasin towards the center of the Subbasin near the town of Borrego Springs, where the current groundwater elevation is approximately 400 feet above the NAVD 88 datum.

Steep groundwater gradients, represented by the closely spaced groundwater contours, and a groundwater elevation depression in the NMA are due to groundwater extraction for agriculture. The lowest groundwater contour elevation in the Subbasin of 380 feet above the NAVD 88 datum is located north of Henderson Canyon Road in the NMA.

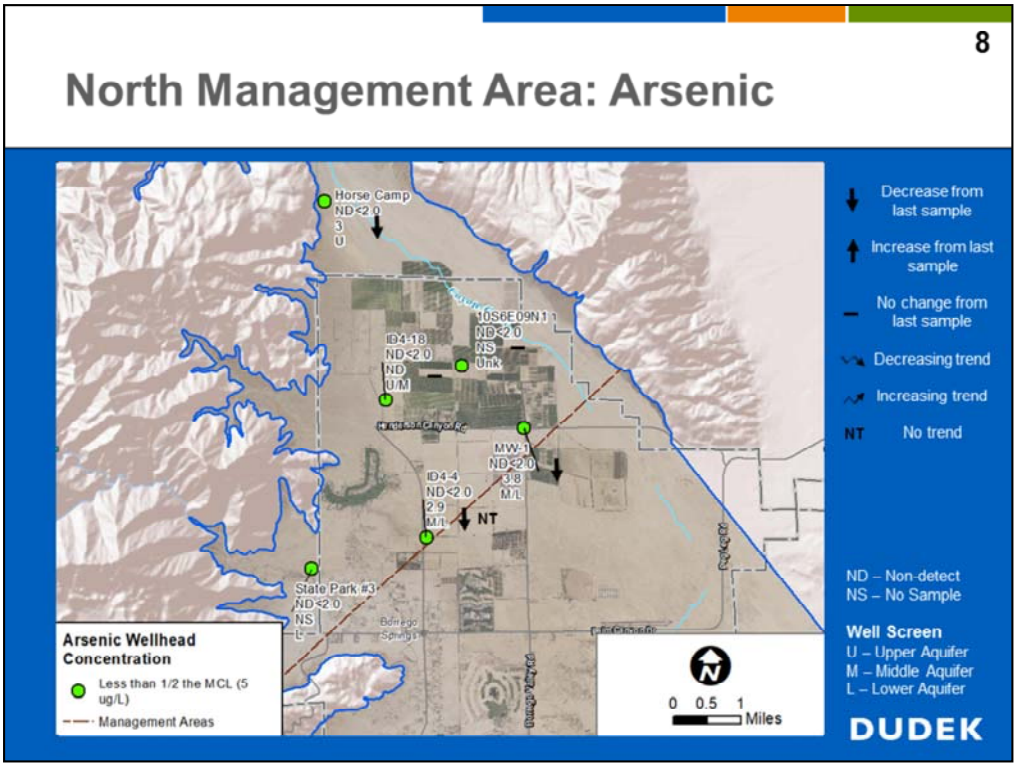


In the fall of 2017, the Borrego Valley Groundwater Sustainability Agency (GSA) performed baseline groundwater quality sampling in order to establish baseline water quality and track water quality trends.

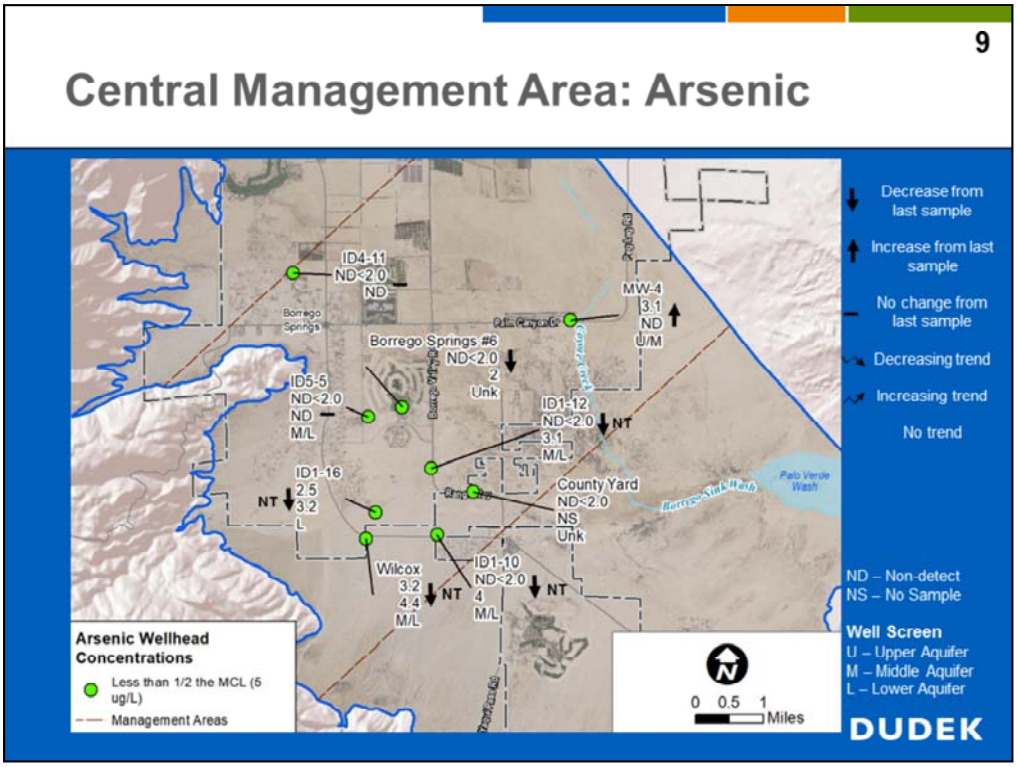
Wells were monitored for potential constituents of concern (COCs) that were previously identified in part by the U.S. Geological Survey (USGS) and Department of Water Resources (DWR), and a review of the historical data by the GSA Consultant team.

The COCs include arsenic, fluoride, radionuclides, nitrate, sulfate and total dissolved solids (TDS). Additionally, general minerals were analyzed to establish baseline water quality and for comparison of water quality type for all wells monitored.

Results of groundwater quality are presented in the following slides by Subbasin Management Area and by constituent of concern.



Groundwater quality results are color coded by concentration relative to their respective California drinking water maximum contaminant level (MCL). Green dots represent concentrations less than one-half the MCL. Yellow dots represent concentrations less than the MCL and red dots indicate concentrations above the MCL. Symbology is used to indicate concentration change since the last sample. The downward arrow represents a decrease, the upward arrow represents an increase and dash indicates no change since the last sample. Additionally, water quality trends over time are indicated by the decreasing wave symbol, increasing wave symbol and “NT” abbreviation. Aquifers intercepted by the well are indicated by the abbreviations “U”, “M”, and “L” to designate the upper, middle and lower aquifers. Individual wells may intercept one or more aquifer units. Arsenic concentrations from the 6 wells sampled in the NMA were all less than one-half the drinking water MCL. The primary MCL for arsenic is 10 micrograms per liter. The fall 2017 results indicate decreasing or stable arsenic concentrations from the previous groundwater sample collected for each of the wells with historical data (indicated by the downward arrow or dash symbol). No historical data were available for the State Park #3 well and well 10S6E09N1. No statistically significant arsenic trend is observed for well ID4-4 (indicated by “NT” abbreviation). A minimum of four samples is required to determine a significant trend. Only well ID4-4 has a sufficient number of historical results to analyze trend. As additional data is collected by the GSA, wells will be continuously tracked to determine water quality trend on a semi-annual basis.



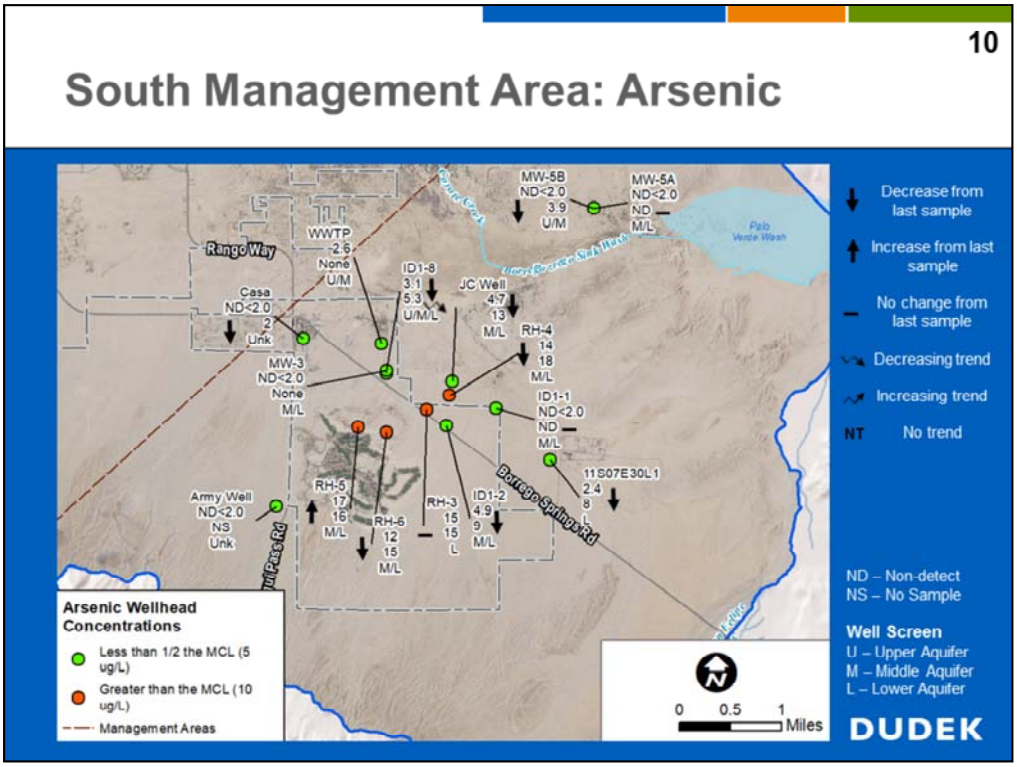
Arsenic concentrations from the 9 wells sampled in the CMA were all less than one-half the drinking water maximum contaminant level (MCL). The primary MCL for arsenic is 10 micrograms per liter.

The fall 2017 results indicate decreasing or stable arsenic concentrations (indicated by the downward arrow or dash symbol) from the previous groundwater sample collected for each of the wells with historical data except well MW-4 (indicated by the upward arrow).

No historical data were available for the County Yard well.

Upward and downward moving concentrations do not represent a trend in water quality. As indicated in the previous slide, a minimum of 4 historical results are required to determine a significant trend.

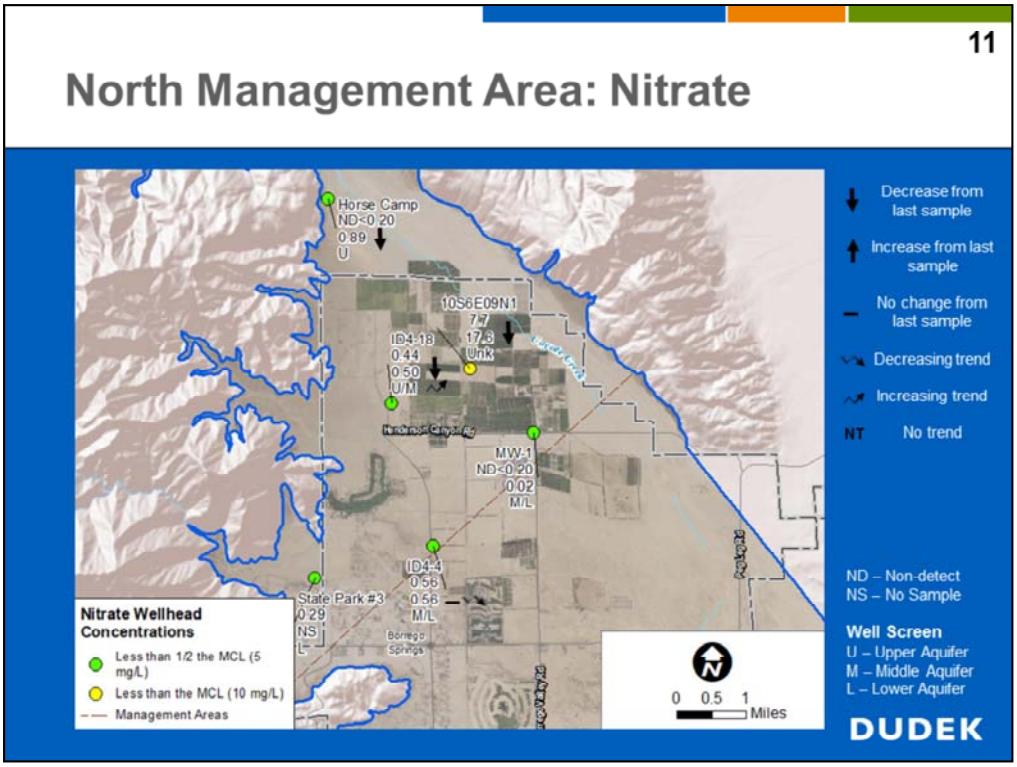
No statistically significant trend is observed for arsenic in the CMA wells. Borrego Water District (BWD) wells ID1-10, ID1-12 ID1-16, and Wilcox have sufficient number of historical results to analyze trend. No trend is indicated for these wells (as indicated by the “NT” abbreviation).



Arsenic concentrations from 4 of the 15 wells sampled in the SMA exceeded the drinking water maximum contaminant level (MCL). The primary MCL for arsenic is 10 micrograms per liter. The other 11 wells sampled had arsenic concentrations less than one-half the drinking water MCL.

The fall 2017 results indicate decreasing or stable arsenic concentrations (indicated by the downward arrow or dash symbol) from the previous groundwater sample collected for each of the wells with historical data except well RH-5 (indicated by the upward arrow). No historical data were available for the Army and WWTP wells.

Only BWD well ID1-8 has sufficient historical data to statistically determine a trend. Interestingly, with the latest two data points, well ID1-8 has a decreasing trend (indicated by downward pointing wave arrow) whereas it previously had an increasing trend if the latest data are ignored. It is uncertain why the trend in ID1-8 is now decreasing (e.g. potentially due to less pumping of the well) and uncertain why many of the wells sampled decreased in concentration from when they were last sampled. Additional data and analysis are required to evaluate potential pumping effects and seasonal effects on arsenic concentration in the SMA. The source of arsenic in the wells is naturally occurring and common in semi-arid and arid groundwater basins in the western United States.

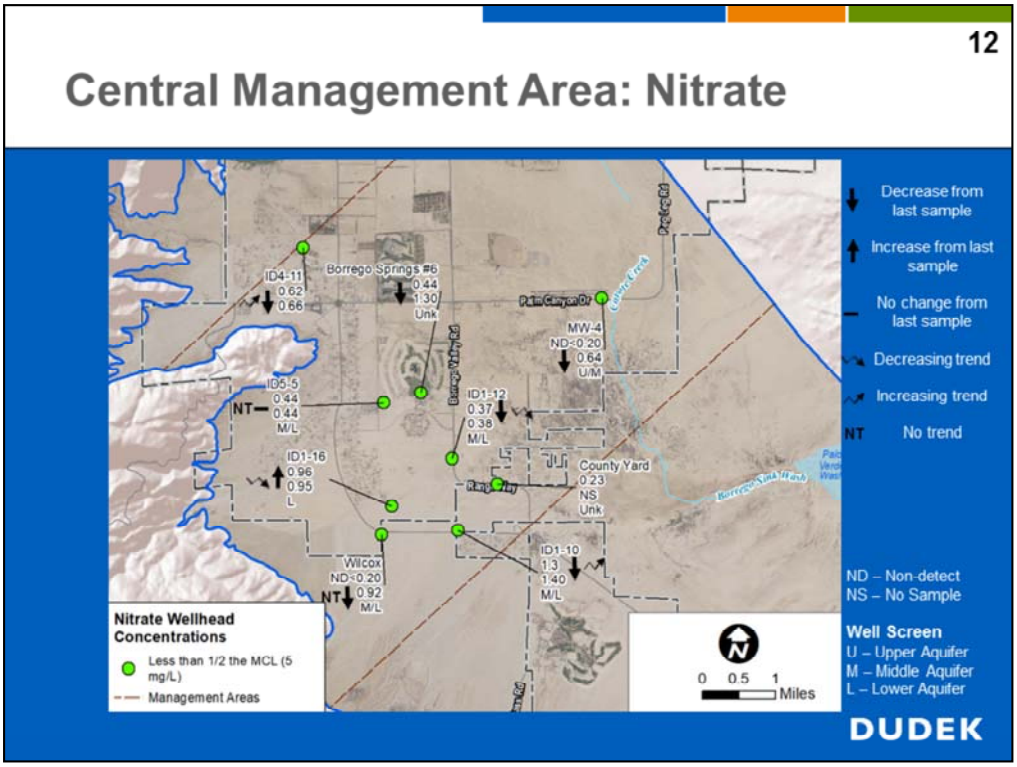


Nitrate concentrations from the 5 of the 6 wells sampled in the NMA were all less than one-half the drinking water maximum contaminant level (MCL). Well 10S6E09N1 was less than the MCL. The primary MCL for nitrate as nitrogen (as N) is 10 milligrams per liter.

The fall 2017 results indicate decreasing or stable nitrate concentrations (indicated by downward arrow or dash symbol) from the previous groundwater sample collected for each of the wells with historical data (indicated by the downward arrow or dash symbol).

Well ID4-18 indicates an increasing trend for nitrate (indicated by the upward wave symbol). However, the nitrate concentration in well ID4-18 is less than one-tenth the MCL. Well ID4-4 indicates a decreasing trend for nitrate (indicated by the downward wave symbol). ID4-4 has similar nitrate concentrations to ID4-18. Well 10S6E09N1 has decreased since the previous sample.

The source of nitrate in these wells in unknown. Potential sources of nitrate include septic recharge, fertilizer applications and/or leaching of natural nitrogen deposition in desert soils. Additional wells screened in the upper aquifer of the NMA are likely required to determine nitrate concentrations in the upper aquifer underlying areas of historical agricultural fertilizer applications.

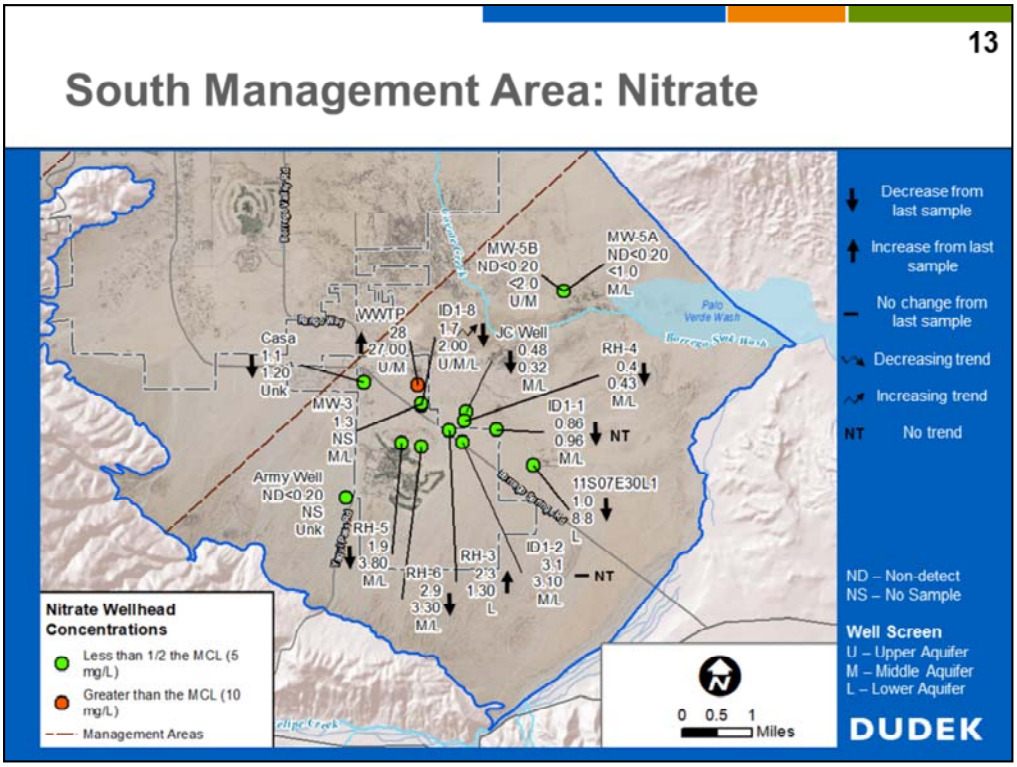


Nitrate concentrations from the 9 wells sampled in the CMA were all less than one-half the drinking water maximum contaminant level (MCL). The primary MCL for nitrate as nitrogen (as N) is 10 milligrams per liter.

The fall 2017 results indicate decreasing or stable nitrate concentrations (indicated by downward arrow or dash symbol) from the previous groundwater sample collected for each of the wells with historical data except for well ID1-16, which displays a slightly increased concentration (indicated by the upward arrow).

Wells ID4-11 and ID1-10 indicate increasing trends for nitrate (indicated by the upward wave symbol). However, the nitrate concentration in well ID4-11 is less than one-tenth the MCL and ID1-10 is less than two-tenths the MCL. Wells ID1-12 and ID1-16 indicate decreasing trends for nitrate (indicated by the downward wave symbol).

The source of nitrate in these wells in unknown. Potential sources of nitrate include septic recharge, fertilizer applications and/or leaching of natural nitrogen deposition in desert soils.

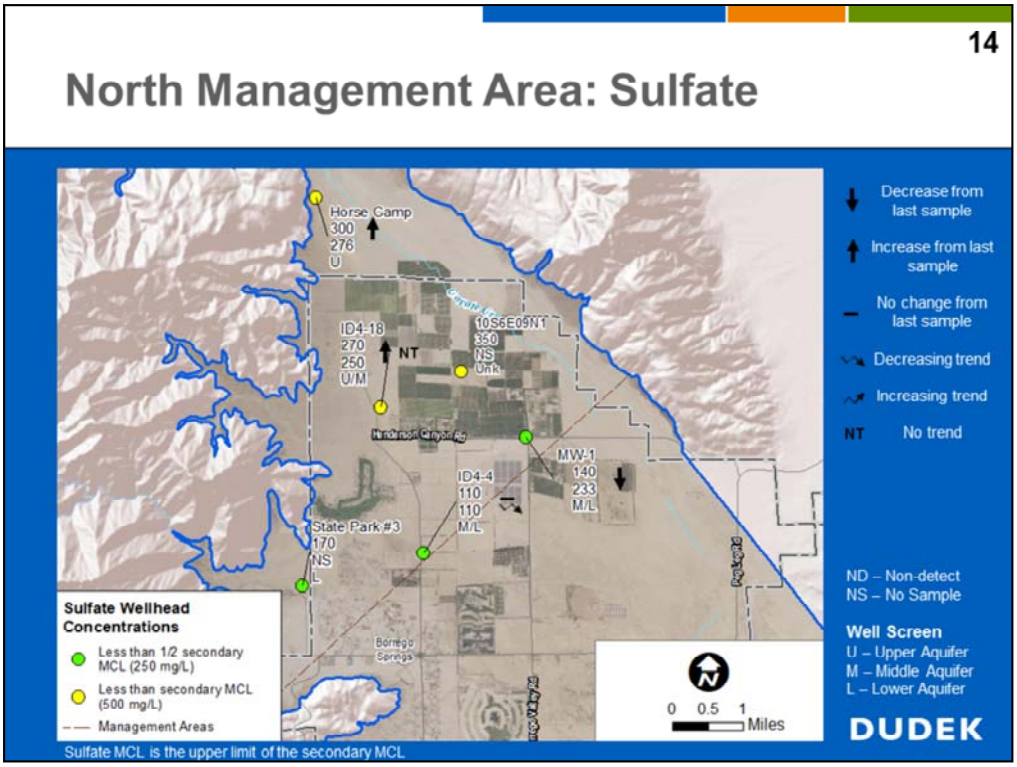


Nitrate concentrations from the 14 wells sampled in the SMA were all less than one-half the drinking water maximum contaminant level (MCL) except for the WWTP well, which exceeded the MCL with a nitrate (as N) concentration of 28 micrograms per liter. The primary MCL for nitrate (as N) is 10 milligrams per liter.

The fall 2017 results indicate decreasing or stable nitrate concentrations (indicated by the downward arrow or dash symbol) from the previous groundwater sample collected for each of the wells with historical data except for the WWTP well and well RH-3 with slightly increased concentrations (indicated by the upward arrow).

Wells ID1-8 indicates an increasing trend for nitrate (indicated by the upward wave symbol). However, the nitrate concentration in well ID1-8 is less than two-tenths the MCL. Wells ID1-1 and ID1-2 indicate no trend for nitrate (indicated by the “NT” abbreviation). None of the other wells have a sufficient number of samples to significantly determine trend.

The source of elevated nitrate in the WWTP well is likely the adjacent percolation ponds for the Rams Hill Wastewater Treatment Facility (WWTF). Review of the effluent data for the WWTF indicated total nitrogen effluent concentrations ranging from 4.2 mg/L to 48.0 mg/L. Dissolved concentrations of nitrate may increase at the percolation ponds as result of evaporation. The elevated nitrate detected in the wells in the vicinity of Rams Hill Golf Course may be from fertilizer application on the golf course or septic recharge.

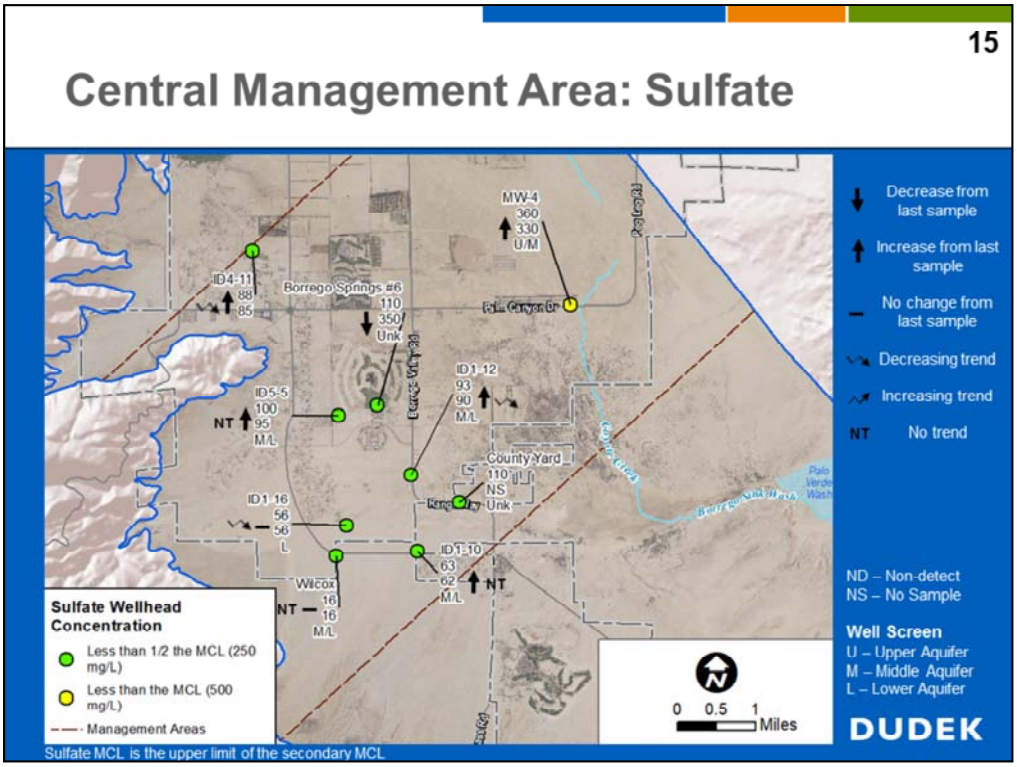


Sulfate concentrations from the 3 of the 6 wells sampled in the NMA were less than one-half the secondary upper drinking water maximum contaminant level (MCL).[1] The Horse Camp well, Well 10S6E09N1, and ID4-18 were less than the secondary MCL. The upper limit secondary MCL for sulfate is 500 milligrams per liter. The fall 2017 results indicate decreasing or stable sulfate concentrations from the previous groundwater sample collected for wells MW-1 and ID4-4 (indicated by the downward arrow or dash symbol). Well ID4-18 and the Horse Camp well indicate an increasing concentration from the last sample collected (indicated by upward arrow). No historical data were available for the State Park #3 well and Well 10S6E09N1.

ID4-4 indicates decreasing trend for sulfate (indicated by the downward wave symbol). Well ID4-18 indicates no trend for sulfate (indicated by the "NT" abbreviation).

The elevated source of sulfate is unknown but may coincide with variable groundwater quality at the edge of the Subbasin near the contact of unconsolidated sediments with metamorphic and igneous fractured rock.

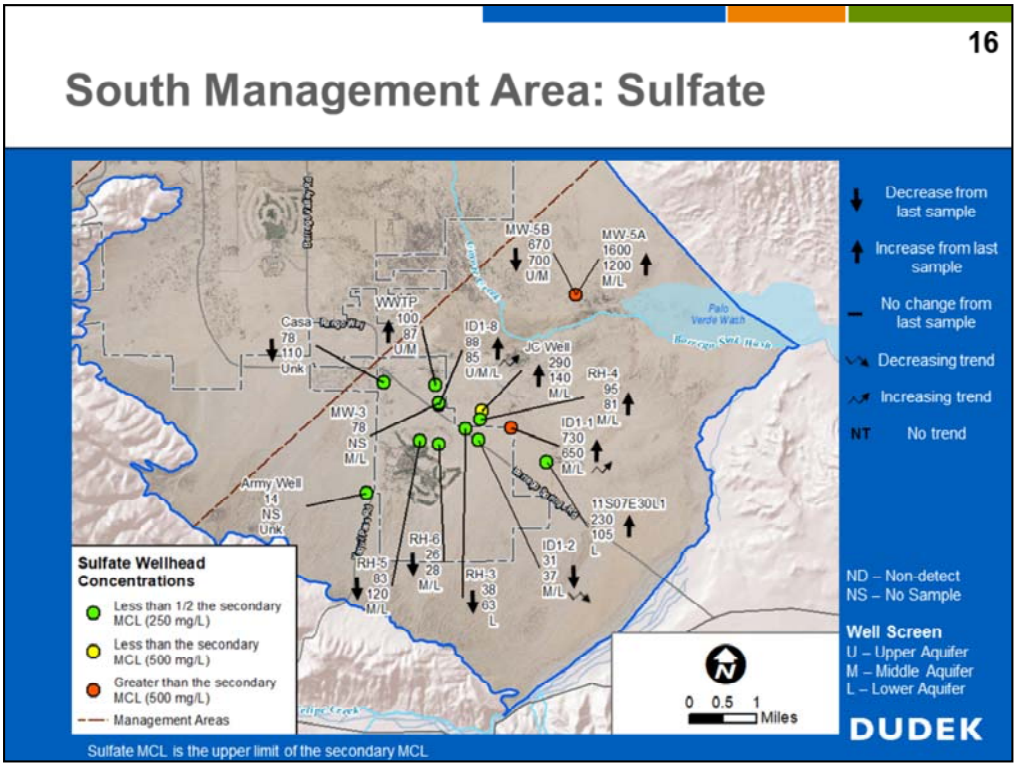
[1] Sulfate has a secondary MCL ranges of recommended (250 mg/L), upper (500 mg/L) and a short term limit of 600 mg/L.



Sulfate concentrations from the 9 wells sampled were all less than one-half the upper limit secondary drinking water maximum contaminant level (MCL) except MW-4, which is less than the secondary upper MCL of 500 milligrams per liter at a concentration of 360 milligrams per liter.

The fall 2017 results indicate increasing or stable sulfate concentrations from the previous groundwater sample collected for each of the wells with historical data (indicated by the upward arrow or dash symbol) except for Borrego Springs #6 with a decreasing concentration (indicated by the downward arrow). No historical data were available for the County Yard well.

Wells ID4-11, ID1-12 and ID1-16 indicate decreasing trends for sulfate (indicated by the downward wave symbol). Wells ID5-5, ID1-10 and Wilcox indicate no trend for sulfate (indicated by the “NT” abbreviation).

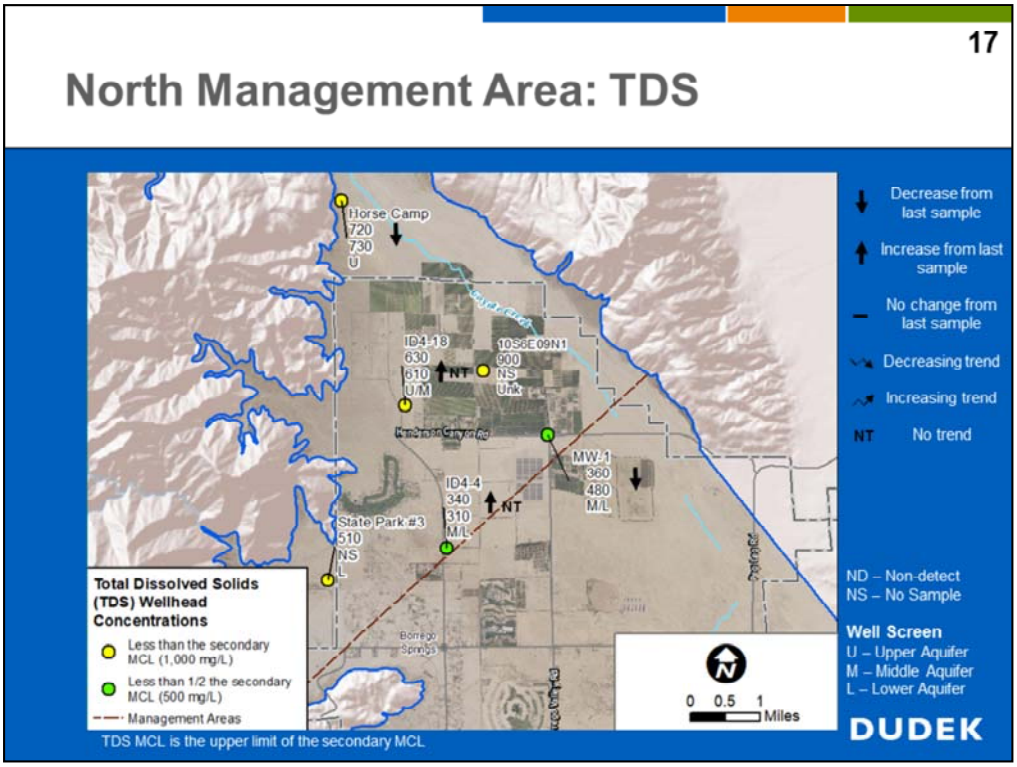


Sulfate concentrations from the 15 wells sampled in the SMA were all less than one-half drinking water upper maximum contaminant level (MCL) except for the JC Well, ID1-1, MW-5A, and MW-5B. The JC Well is less than the secondary upper MCL for sulfate of 500 milligrams per liter. ID1-1, MW-5A, and MW-5B all exceed the secondary upper MCL for sulfate.

The fall 2017 results indicate decreasing or stable sulfate concentrations (indicated by the downward arrow or dash symbol) from the previous groundwater sample collected for each of the wells with historical data except well ID1-1, ID1-8, RH-4, JC well, Well 11S07E30L1, Well-5B, and MW-5A (indicated by the upward arrow).

Wells ID1-1 and ID1-8 indicate increasing trend for sulfate (indicated by the upward wave symbol). Well ID1-2 indicates a decreasing tend for sulfate (indicated by downward wave symbol). None of the other wells have a sufficient number of samples to significantly determine trend.

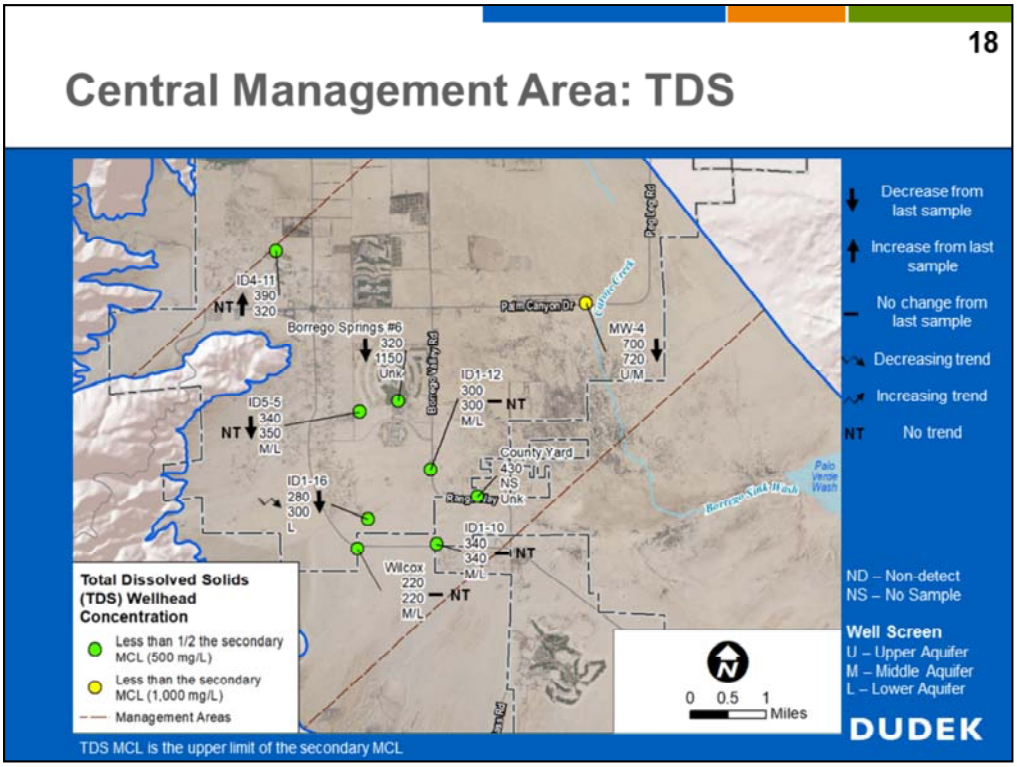
Elevated sulfate appears to be associated with poorer water quality near the Borrego Sink likely due to concentration of dissolved solids as a result of evaporation of water in the Borrego Sink and later leaching of evaporites (sediments formed by the evaporation of water).



Total dissolved solids (TDS) concentrations from the 6 wells sampled in the NMA were all less than one-half the drinking water upper maximum contaminant level (MCL) except the Horse Camp well, State Park #3, Well 10S6E09N1, and ID4-18. The secondary upper MCL for sulfate is 1,000 milligrams per liter.[1]

The fall 2017 results indicate increasing and decreasing TDS concentrations from the previous groundwater sample collected (indicated by the downward/upward arrows). Wells ID4-4 and ID4-18 indicate no trend for TDS (indicated by the “NT” abbreviation).

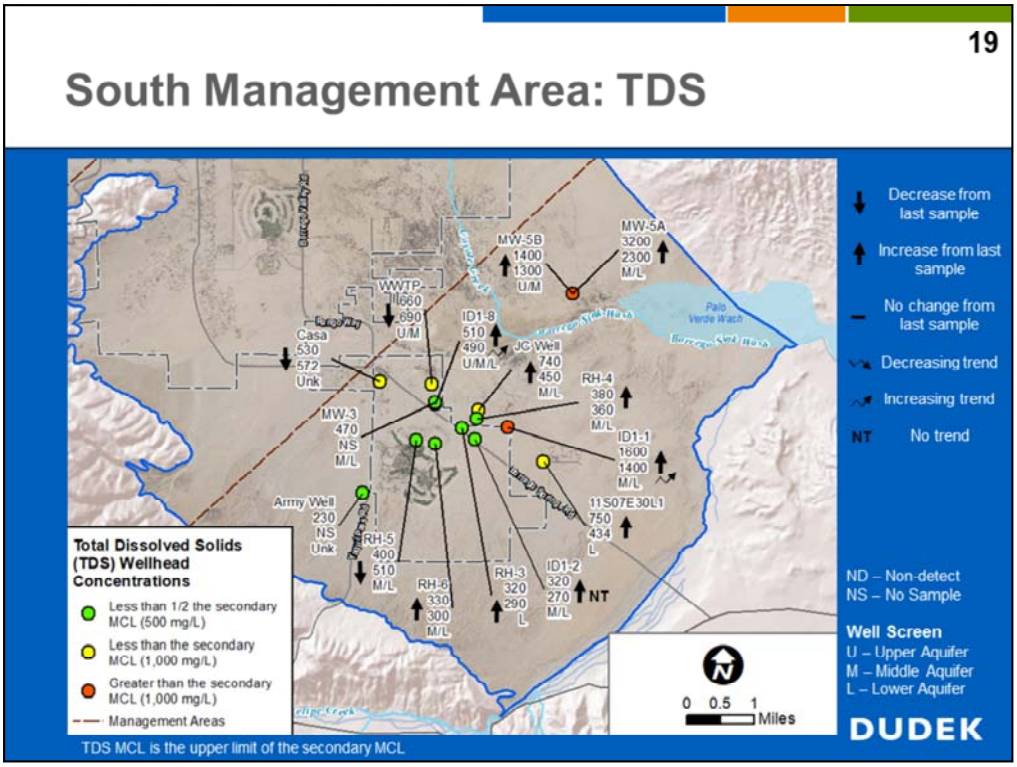
[1] Total Dissolved Solids (TDS) has a secondary MCL ranges of recommended (500 mg/L), upper (1,000 mg/L) and short-term.(1,500 mg/L).



Total dissolved solids (TDS) concentrations from the 9 wells sampled in the CMA were all less than one-half the drinking water upper maximum contaminant level (MCL) except MW-4, which is less than the secondary MCL of 1,000 milligrams per liter at a concentration of 700 milligrams per liter.

The fall 2017 results indicate decreasing or stable TDS concentrations (indicated by the downward arrow or dash symbol) from the previous groundwater sample collected for each of the wells with historical data except for ID4-11 with an increasing concentration (indicated by the upward arrow).

Well ID1-16 indicates a decreasing trend for TDS (indicated by the downward wave symbol). Wells ID1-10, ID1-12, ID4-11 ID5-5 and Wilcox indicate no trend for TDS (indicated by the “NT” abbreviation).



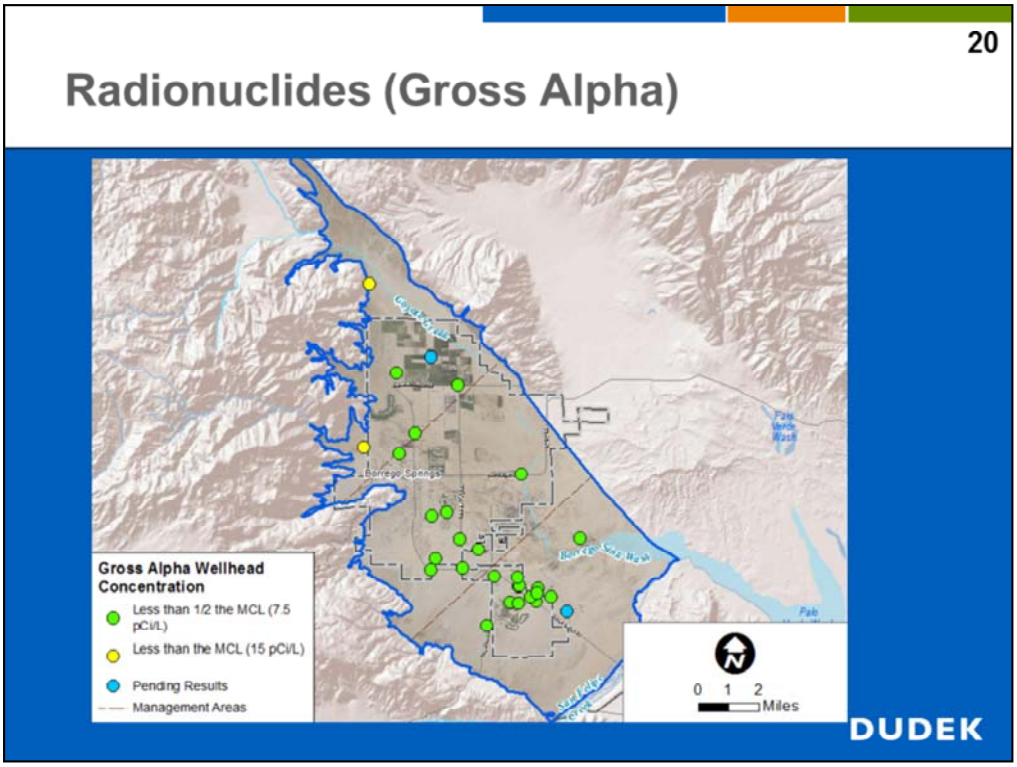
Total dissolved solids (TDS) concentrations from the 15 wells sampled in the SMA were all less than one-half the drinking water upper maximum contaminant level (MCL) except for WWTP well, JC well, Casa well, ID1-1, ID1-8, Well 11S07E30L1, MW-5A, and MW-5B.

The JC well, ID1-8, WWTP well and Casa well are less than the secondary upper MCL for TDS of 1,000 milligrams per liter. ID1-1, MW-5A and MW-5B all exceed the secondary upper MCL for TDS.

The fall 2017 results indicate increasing TDS concentrations (indicated by the upward arrows) from the previous groundwater sample collected for each of the wells with historical data except well WWTP well, Casa well, and RH-5 (indicated by the downward arrows).

Wells ID1-1 and ID1-8 indicate increasing trend for TDS (indicated by the upward wave symbol). Well ID1-2 indicates no trend for TDS (indicated by the “NT” abbreviation). None of the other wells have a sufficient number of samples to significantly determine trend.

Elevated TDS appears to be correlated with poorer water quality near the Borrego Sink as previously explained for sulfates.



Radionuclides were screened in the Borrego Springs Subbasin by analyzing for gross alpha particle activity. Radionuclides are naturally occurring in groundwater as a result of trace levels of radioactive isotopes. Gross alpha measurement is a common screening tool to track general radioactivity in groundwater, and the primary California drinking water maximum contaminant level (MCL) is 15 picocuries per liter.

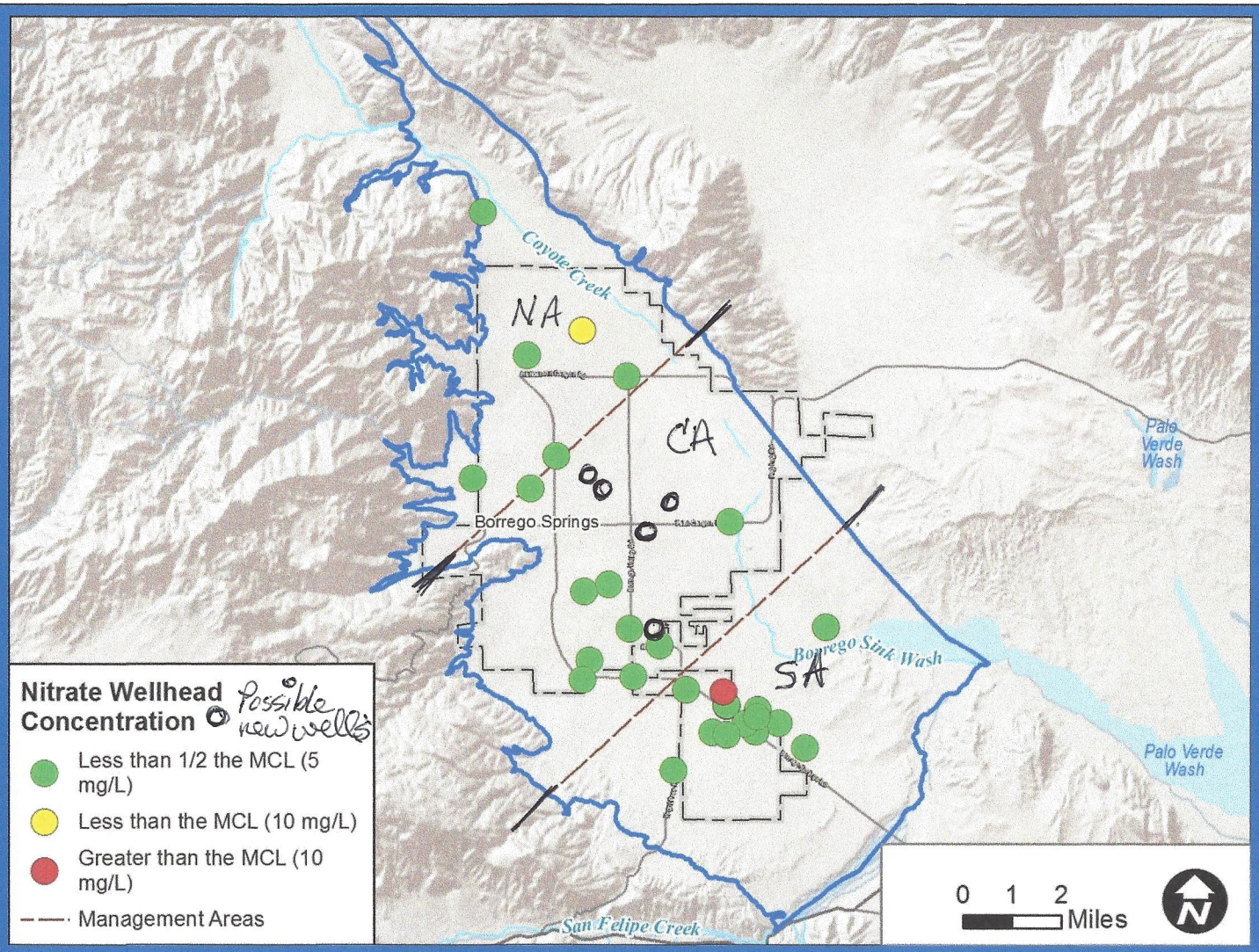
Gross alpha concentrations from the 30 wells sampled in the Subbasin were all less than one-half the primary drinking water MCL except for two wells that were less than the MCL. The mixed metamorphic and igneous rocks which make up the mountain range to the west of the Subbasin may contribute to elevated gross alpha in the two wells with higher than one half the MCL for gross alpha.

Further evaluation will be conducted to determine if radionuclides will continue to be monitored in the Subbasin as a constituent of concern.


Questions and Discussion

2017 Groundwater Quality Results: Nitrate

WELL SAMPLING NOV '17



DUDEK

BORREGO WATER DISTRICT

BOARD OF DIRECTORS MEETING – APRIL 17, 2018

AGENDA BILL 2.B

April 11, 2018

TO: Board of Directors, Borrego Water District

FROM: Geoff Poole, GM and Director Ehrlich

SUBJECT: Burnand Land Fallowing Acreage Calculations/Water Credit Application – G Poole

RECOMMENDED ACTION:

Revise acreage calculations for Burnand Fallowing Proposal and authorize GM to Sign Letter

ITEM EXPLANATION

BWD Staff has been working with Ray Burnand, The County and Dudek on the proposed land fallowing. A meeting was recently held in Borrego Springs and Dudek and Mr Burnand and following the recommendation from Dudek is to use 102 acres for APN 140-070-02 and 50.93 acres for APN 140-010-10 for a total of 152.93 acres and 749.3 water credits. BWD Staff will process this transaction based on the aforementioned acreage and water credits. The attached letter continues the process.

FISCAL IMPACT

N/A

ATTACHMENTS
BWD Letter to Burnand

[BWD Letterhead --- DRAFT MEMO]

April ___, 2018

Mr. Ray Burnand
P.O. Box _____
____ DiGiorgio Road
Borrego Springs, CA 92004

Dear Ray:
This letter constitutes a "Conditional Water Credit Certificate" pursuant to the Borrego Water District's "Demand Offset Mitigation Water Credits Policy," amended June 2014 as related to the Nuevo Oso Ranch water credits application. Outlined below are the agreed upon elements that must be met before water credits will be issued once fallowing is completed on the approximately 152.73 irrigated acres of the approximately 254-acre parcels (APNs 140-070-02-00 and 140-010-10-00) (the Property).

1. The water credit calculation is based on irrigated acreage and is as shown on Exhibit A. [Attach Dudek map showing irrigated acreage and water credit calculation]
2. The Borrego Water District (BWD) has agreed to issue 749 AG-1 water credits, for APNs 140-070-02-00 and 140-010-10-00.
3. The County of San Diego has preliminarily agreed subject to review and acceptance of the draft easement, for BWD to issue 749 AG-1 water credits for the parcels mentioned in #2 above.
4. A land survey of the property is required to develop the required land plat and legal description for the easement.
5. Property owner, or its successor in interest, shall submit its fallowing plan to the BWD for approval. This plan must, at a minimum, include a time frame and procedure for removing the standing trees in the irrigated acres of the Property. It must also address how Property owner will stabilize the remaining land surfaces using standards that are consistent with current and recent past fallowing within the district. The BWD also requires that all trees be removed within 180 days of the date of this letter.
6. After the Fallowing Plan has been fully implemented and confirmed by BWD, a water restrictive easement (BWD Form 102) shall be applied to the Property and recorded by the BWD. (See sample Form 102 attached).
7. Final approval and issuance of water credits for the Property will be subject to:
   - Borrego Water District approval of Property owner-submitted fallowing plan.
   - Approval by the County of the water restrictive easement
   - Approval by Borrego Water District Board of Directors
   - Approval by Nuevo Oso Ranch Property owner or its successors.
8. Water credits will be issued within 10 days of the recordation of the water restrictive easement.

Sincerely,

Geoff Poole
General Manager

Cc: Mr. Jim Bennett, San Diego County Department of Planning & Development Services

BORREGO WATER DISTRICT

BOARD OF DIRECTORS MEETING – APRIL 17, 2018

AGENDA BILL 2.C

April 11, 2018

TO: Board of Directors, Borrego Water District

FROM: Geoff Poole, GM and Director Ehrlich

SUBJECT: Portable Air Sampler Proposal from Dr. Zender – L Brecht

RECOMMENDED ACTION:

Discuss proposal and direct staff as deemed appropriate

ITEM EXPLANATION

Director Brecht received the attached request and supporting information for portable air sampling equipment.

FISCAL IMPACT

$14,985

ATTACHMENTS

1. Proposal/Grant Request
2. Quote
3. Equipment Specifications

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DR. CHARLES S. ZENDER
DEPARTMENTS OF EARTH SYSTEM SCIENCE AND COMPUTER SCIENCE
UNIVERSITY OF CALIFORNIA
IRVINE, CA 92697-3100

zender@uci.edu
http://www.ess.uci.edu/~zender
TEL: (949) 891-2429
FAX: (949) 824-3874

April 5, 2018

To: Borrego Water District
Re: Grant Request for Portable Air Quality Monitoring Device to Assure Reliable, Actionable Air Quality Data ($14,985)

Dear Borrego Water District,

As a Groundwater Sustainability Agency (GSA) mandated to implement a Groundwater Sustainability Plan (GSP) for the Borrego Basin, the Borrego Water District (BWD) is responsible for the consequences, intended and unintended, of implementing the GSP. One of the foreseeable consequences of the GSP will be the fallowing of lands currently under cultivation in Borrego Springs. Such fallowing may have an impact on air quality in the Borrego Valley, making it incumbent upon the GSA to monitor this impact, as well as to monitor mitigation efforts.

A Particulate Matter Air Quality (PMAQ) monitoring program has been established in the Borrego Valley that will allow BWD to fulfill its obligation to monitor the impact of GSP implementation on air quality. This program is a collaboration of multiple organizations. The UCI Steele/Burnand Anza-Borrego Desert ResearchCenter has contributed $210,000 from a National Science Foundation grant for 7 monitoring stations in the Valley. UCI has contributed $80,000 for installation and maintenance of these 7 monitoring stations. The Borrego Water District has provided a $30,000 grant for 5 air quality monitoring devices (nephelometers), and the Borrego Valley Endowment Fund has contributed $60,000 grant to support Charlie Zender, Ph.D. from the UCI Department of Earth System Science (https://www.ess.uci.edu/people/zender) for a 3 year project to gather baseline data in year 1 (completed February 2017), create a model of dust movement in the region in year 2 (completed February 2018), and in year 3 (due February 2019) be able to identify point sources of particulate matter air quality exceedances such as occurred over the 2017 Thanksgiving and 2018 NewYearsweekends (see http://24.223.109.133/index.html).

The five air quality monitoring stations in the Borrego Valley use nephelometers to measure particulate matter (PM) in the PM2.5 and PM10 size ranges that are regulated by the Environmental Protection Agency (EPA). UCI has compared two years of its measurements to measurements from the nearest EPA maintained stations that 1) use a more reliable and expensive measurement technique and 2) are therefore certified to meet the highest regulatory standards for actionable PMAQ data. The five EPA-certified stations near the Salton Sea record substantially more PM than UCI's Borrego network. The reasons for this difference are unclear, and need to be better understood in order to build confidence in UCI's data so it can be trusted as much as the stringently maintained EPA data.

The two leading hypotheses to explain the relatively low UCI PM measurements are: 1) The difference is real, and air in the Borrego Valley contains consistently less PM than air at the EPA measurement sites near the Salton Sea and/or 2) UCI's measurements are inaccurately calibrated, and under-report actual PM.We can test the validity of the second hypothesis by a technique called intercalibration. This technique requires exposing both UCI and EPA instruments to the same air and comparing their measurements. Since the actual UCI and EPA stations are fixed, we propose to purchase and place a new, portable PM measurement sampler alongside a trustworthy EPA station that we will use to calibrate its measurements. **Once calibrated to agree with the EPA station, we will transfer the calibration to the UCI network by placing the portable sampler alongside each UCI station and, if necessary, adjusting the UCI measurement values until they agree with the EPA-based calibration of the portable sampler.**

Based on our own studies and suggestions from colleagues, UCI recommends the GRIMM 11-C Aerosol Spectrometer. This portable sampler will also be useful for short field campaigns at locations not monitored by the fixed stations. Thus a portable sampler will benefit long-term Borrego Springs PMAQ studies as well as being indispensable for the intercalibration needed to obtain actionable PMAQ data from the UCI monitoring network.

Should the BWD approve this grant request, payment for the equipment in the amount of $14,985 may be made directly to the manufacturer:

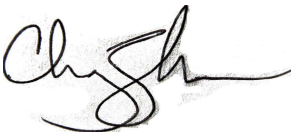
6GRIMM Technologies, Inc.
P.O. Box 6358
Douglasville, GA 30154-6358

A quotation from 6GRIMM Technologies, Inc along with a detailed description of the instrument is attached below for ease of reference.

Delivery of the equipment should be made to:

Sicco Rood
c/o UCI Steele/Burnand Anza-Borrego Desert Research Center
401 Tilting T Drive
Borrego Springs, CA 92004

Sincerely,



Charlie Zender
Professor of Earth System Science
and of Computer Science

6GRIMM Technologies, Inc.

PO Box 6358
Douglasville, GA 30154-6358

Phone: 770/577-0853
Toll-free: 877/474-6872
Fax: 770/577-0955

Email: roe@grimm-aerosol.com
Web:www.grimm-aerosol.com

Quotation 2018-025

March 26, 2018

Via email: mgorris@uci.edu

Morgan Gorris
Randerson & Zender Research Groups
Department of Earth System Science
University of California Irvine
Irvine, CA

RE: Requested Quotation for GRIMM'S Real Time Aerosol Spectrometer Model 11-C System

We are pleased to provide to you this quotation for a GRIMM Aerosol Spectrometer Model 11-C Sampler. The price includes accessories and is priced FOB Irvine CA. . Please review accompanying page for accessories details.

Currently shipment is approximately 10 days from receipt of order with credit terms of Net 30 Days. Please check inventory availability at time of order. Production may take 45 - 60 days.

Please visit our web site for additional technical information.
http://wiki.grimm-aerosol.de/index.php?title=IAQ-11-C

Should you have any questions or need additional information, please contact our office via email or call our toll-free number at 877/474-6872. Thank you.

Regards,

Bill Roe
USA Operations
Enclosure:
Components lists

**** Quotation Valid for 60 Days***
Page 1 of 2

Quotation - 2018-025

GRIMM Model 11-C Aerosol Spectrometer

Basic unit includes the following listed components

Part No.	Description	Qty	Unit cost($)
11-C	.Real Time Aerosol Spectrometer with 31 Size Channels	1	$14,985.00
1.110	Lithium Battery (rechargeable) ******	1	Included
1.111	Radial symmetric sampling head	1	Included
1.112	External power supply	1	Included
1.113A	Package of 25 - 47 mm PTFE Filters	1	Included
1.118A	Operator's Manual (Digital)	1	Included
1.119	Straight sampling tube- 3cm	1	Included
1.142.2	4GB SD Card ******	1	Included
1.141	USB to RS-232 Converter with 1 m cable and driver	1	Included
1.144	Hard carrying case	1	Included
USB-LAN	USB & LAN Connection Ports	1	Included
1.173	Software manual (Digital)	1	Included
1.178	Windows™ based LabView software & license	1	Included
BT	Remote Control via Blue Tooth Capabilities	1	Included
Total Net Price for Above System – FOB Irvine CA			**$14,985.00**

**** Quotation Valid for 60 Days***

Shipping address: GRIMM Technologies, Inc. • 5833 Stewart Parkway, Suite 203 • Douglasville, GA 30135

Portable Laser Aerosol Spectrometer

Model 11-C

Address:

GRIMM Aerosol Technik GmbH & Co.KG

Dorfstraße 9

83404 Ainring

Germany

Website: www.grimm-aerosol.com

E-mail: info@grimm-aerosol.com

Tel.: +49 8654-578-0

Fax: +49 8654-578-35

Registration Office Traunstein, German Commercial Register (HRB) 4803

Managing Directors: Marco Signori, Thomas Eisenmann

Table of contents

List of figures

1 Introduction

Model 11-C is a portable aerosol spectrometer for the detection of dust particles in 31 size channels and the size range of 0.25-32 µm. Measurements can be output as particle concentrations per size channel. Particles/litre is typically used as the unit. For measurements in fast mode (via terminal program) with a time resolution of six seconds or faster, the particle concentration is output in the unit of particles/100ml.

The model 11-C is designed for particle concentrations of 1 - 2,000,000 particles/litre of air or a dust mass of 0.1 - 100,000 µg/m³ of air.

The measurement data can be interpreted according to the occupational medicine values for inhalable, thoracic and respirable particle sizes or the environmental data according to US EPA in PM1, PM2.5, PM10, total counts using the GRIMM Windows Software 1178. The particle distribution is shown as the particle concentration across all channels in particles/litre.

The smallest measuring interval is 1 second for 16 channels or 6 seconds for all 31 channels.

A constant purge air flow of 0.4 l/min is taken from the sample air and used as purified air for cleaning the measuring cell.

Self-diagnosis is performed each time the device is restarted or according to the corresponding setting.

The measurements are stored on a µSD memory card.

The measurement device has various interfaces and can be connected to a PC with the supplied data cables. Measurement data can be visualised with the PC connection and use of the software.

Since it can be operated on battery and thanks to the compact design size, the 11-C is ideal as a portable dust monitor.

Various optional sensors are available as accessories. They are introduced in this manual.

The 11-C is designed as a filter collector for 47 mm PTFE filters for the gravimetric determination of the collected dust. This system can also be equipped with what is known as a bio-measurement cell as an option. This makes it possible to quickly differentiate between biotic and abiotic particles on site. The 11-C captures each individual airborne particle in real time (single particle count) from 0.25 to 32µm with the highest precision and classifies the particles in 31 size channels. After the measurement, the sample collected on the integrated specimen holder can be analysed for bacteria and the bacterial count can be determined.

A correlation can be prepared on site by comparing the counted bacteria to the optically measured particles.

2 Instructions for safe operation

2.1 Comments

Many software and hardware designations used in this manual are registered trademarks and have to be treated as such. The author has attempted to provide complete and accurate information in this manual. GRIMM Aerosol Technik does not guarantee the integrity and accuracy of this information. Therefore, it is not liable for damages caused directly or indirectly due to the use of this information, the hardware or the software. Furthermore, GRIMM Aerosol Technik is not responsible for damages due to the abuse of patent rights or third-party rights.

Since the hardware and software is always being improved and expanded, deviations are possible between the descriptions and illustrations in this manual and the hardware and software delivered to you. Please request a current version of this document if needed.

Study the operating instructions in detail before operating the hardware and software! The manufacturer is not liable for damages caused by improper putting into operation, use, cleaning or by operating errors.

GRIMM Aerosol Technik GmbH & Co. KG

Dorfstraße 9
D-83404 Ainring, Germany

Phone: ++49 / 86 54 / 5 78 – 0
Fax: ++49 / 86 54 / 5 78 – 35
E-mail: support@grimm-aerosol.com
Homepage: www.grimm-aerosol.com

This manual applies to the portable dust monitor 11-C

M_D_11-C_V2-3 (14-03-16)

2.2 Warranty

The company GRIMM Aerosol Technik warrants to each customer that the device described in this document has been developed, designed and manufactured according to the existing technical requirements for the application described, is entirely free of material defects and is delivered free of assembly errors due to strict quality control. However, no further warranty is given for an application-specific function or damages due to material defects or assembly errors. Detailed records are prepared for each unit through production technology, especially the calibration and validation data.

Should the device fail during the 1-year warranty period or fail to meet the requirements, the company GRIMM Aerosol Technik has the right to replace defective parts or the device; operating errors are excepted. The company GRIMM Aerosol Technik shall perform repairs free of charge at the factory. Only transportation costs and the resulting incidental costs are borne by the customer. On-site repairs are only carried out in exchange for reimbursement of the travel expenses and service costs. GRIMM Aerosol Technik assumes no liability for any further claims that would be derived from the warranty.

GRIMM Aerosol Technik only warrants the goods sold if they are used under normal conditions and according to the instructions in this manual. The warranty expires at the end of the 12-month period, starting on the day of delivery from the plant. Returns for warranty work are at the customer's expense.

The warranty is subject to the following exceptions:

- For replacement parts that are replaced or repaired during the warranty period in order to make the device operational again, the warranty is 90 days under conditions of normal use.
- The supplier is not liable for third-party products, batteries or consumables – only the original warranty is maintained.
- Without its written confirmation, GRIMM Aerosol Technik offers no warranty on parts from suppliers that were modified and/or removed or installed by untrained personnel.
- All of the above replaces any other warranty agreements and/or restrictions. There are no further warranty claims, especially outside of normal use.
- The buyer is responsible for use and/or operation. Complying with the applicable legal requirements and regulations as well as operating the device in accordance with the applicable legal and operating technology provisions is the responsibility of the buyer. Deviations void the warranty.
- Legal means against GRIMM Aerosol Technik from any party after more than 12 months are all groundless.
- The buyer and seller agree that this LIMITATION OF LIABILITY which describes the requirements and limits shall not be called into question. Both partners are general merchants according to German law.
- Should a dispute nevertheless arise, the jurisdiction is Traunstein in the Federal Republic of Germany.

2.3 Explanation of symbols

This manual uses the following graphical symbols to make important information easier to find:

This symbol points out useful tips that can simplify and optimise your work.

This symbol points out potential hazards that can lead to malfunctions or even damage to the hardware, and describes how these can be avoided.

2.4 Fundamental safety instructions

2.4.1 Safety provisions

The manufacturer rejects any direct or indirect liability if the operator opens or manipulates the device! The device was built and inspected according to DIN EN 61326-1: 2013 “Electrical equipment for measurement, control and laboratory use – EMC requirements”, and left the plant in flawless safety-related condition. In order to maintain this condition and ensure safe operation, the user has to observe the information and warnings contained in these instructions for use.

If it can be assumed that safe operation is no longer possible, the device must be taken out of operation and secured against unintended use. It can be assumed that safe operation is no longer possible in the following cases:

- If the device exhibits visible damage
- If the device no longer functions after use
- After extended storage under unfavourable conditions, or
- After transportation under unfavourable conditions.

Failure to observe the acclimatisation time prior to operation after transport at temperatures below the transportation temperature range can cause damage to the pump due to condensation. In this case the electronic overcurrent protection device will shut the unit down entirely. The wait time until resuming operation can be reduced by drying in a heating cabinet. We recommend an acclimatisation time of approximately 8 hours at about 20°C and 40-45% relative humidity.

Do not operate the measuring equipment without the PTFE filter, since the PTFE filter is installed before the pump and therefore protects it!

2.4.2 Electrical safety

Before using the power supply, verify that the mains voltage is in the allowable range for the device. The dust monitor may only be operated with the specified voltage (power supply, 18VDC).

- The optional lithium-ion battery (Li-Ion battery back 11.1V 44.4 Wh) is used to temporarily operate the 11-C without requiring a mains connection.
- The fuses installed in the device may only be replaced by trained service personnel!

Since the device is protected by an electronic overcurrent protection device, the fuses only burn out in case of a serious fault.

2.4.3 Electrostatic sensitivity

When exposed to high levels of electrostatic charges, the 11-C restarts. When operating the 11-C, please take note of possible electrostatic sources and do not operate the device in their vicinity. Special ESD-safe clothing is not required to operate the 11-C.

2.4.4 Laser safety

Attention! Laser class 3B in the open state of the measurement device!

The aerosol spectrometer may only be opened by trained service personnel. Class 3B laser radiation may be emitted if the laser unit is opened. The maximum output of class 3B lasers in continuous-wave operation is 0.5 watts. Looking directly into the beam or a mirrored reflection can cause eye damage, even with only a short exposure time.

Consult DIN EN 60825 for further information. The corresponding requirements of the Employer's Liability Insurance Association Regulation (BGV) B2 “Laser Radiation” must be observed!

Figure 2-1: Safety markings in and on the 11-C

The warning shown here is found on the rear of the device or directly in the device on the laser holder, warning the user against laser radiation if the device is opened. Class 1 laser when the measurement device is **closed**!
Class 1 lasers are “safe during normal operation […], even when looking directly into the beam for an extended period of time and with radiation exposure using telescope optics”.[1]

[1] DIN EN 60825-1 (VDE 0837-1):2015-07, page 83, German version

2.5 Intended use and fields of application

2.5.1 Operating environment

The 11-C was developed for indoor immission measurements. Equipped with the bio-measuring cell available as an option, the 11-C fine dust monitor is also suitable for use in occupational safety and health protection, in hospitals and doctor's practices to monitor air hygiene, and as a research device at universities and research institutions. It is intended for indoor use. Its suitability for outdoor fine dust measurement is limited.

2.5.2 Information about direct on-site and remote control

With its comprehensive interface configuration (Bluetooth, USB, LAN, RS232), the 11-C is flexible in regards to data transmission and only limited by the maximum cable length or range of the Bluetooth connection.

2.5.3 Notes on starting/stopping measurements

A measurement starts after the device has been turned on and has run the self-test.
Ending a measurement is possible at any time by pressing the "Standby" button or, in case of online measurement, with "Stop Device" in the GRIMM Windows Software 1178.

2.5.4 Self-test of the 11-C

Each time the device starts, it performs a self-test which provides information about the device status. The 11-C also asks every time whether the installed PTFE filter has been replaced.

2.5.5 Restrictions on use

To keep the 11-C in working order, the operating conditions for the device summarised in Section 7 must be observed. These restrictions apply both to the concentration being measured and the relative humidity at the measuring location.

A coincidence error may occur if the particle concentration is too high. At a particle concentration in excess of 2,000,000 particles per litre, the sample air should be diluted with dry, particle-free air.

If the relative humidity is too high, there is a risk of condensation in the device which can lead to extensive damage.

Excessive relative humidity also means there is a risk of condensation on the particles, increasing the particle size. The 11-C assigns the fine dust particles to a higher size channel, which leads to a distortion of the mass-specific values. When the relative humidity is too high, we advise you to dry the sample air.

In case of doubt or questions about the use of the 11-C, contact the dealer or sales representative of GRIMM Aerosol Technik GmbH & Co. KG nearest you.

2.5.6 Ambient conditions

The 11-C is designed for indoor immission measurements. It can be used with or without accessories, serving as a portable environmental measurement device. With corresponding accessories such as the isokinetic duct probe, the 11-C can also be used in areas with air flows (such as air ducts). Its suitability for fine dust measurement in the environment/outdoors is limited.

2.6 Transportation

The goods described here are delivered in a carton or case. Please verify that the delivery is complete and free of visible damage. If transport damage is discovered at the time of delivery, this must be reported immediately. For safety reasons, do **NOT** operate the device in this case. The device must be switched off for transportation and only the original packaging may be used. The aerosol intake has to be closed with the cover cap. Please note that the device may contain a lithium-ion battery which may not be exposed to ambient temperatures higher than 50°C.

Especially after transporting the device at low temperatures, sufficient acclimatisation time must be allowed before operating it. Otherwise the device may be damaged.

2.7 Storage

The device must be switched off for storage, and may only be stored in the original packaging or a cabinet. The aerosol intake has to be closed with the cover cap. Please note that the device may contain a lithium-ion battery which may not be exposed to ambient temperatures higher than 50°C during storage.

Please inspect all parts of the measuring system after unpacking. If it can be assumed that safe operation is no longer possible, the device cannot be put into operation and must be secured against unintended use.

It can be assumed that safe operation is no longer possible in the following cases:

- If the device exhibits visible damage.
- If the device no longer functions after use.
- After extended storage under unfavourable conditions.
- After transportation under unfavourable conditions.

2.8 Disposal

2.8.1 Expected service life of the device

When used as intended and with regular service and maintenance by an authorised service technician, the 11-C has a service life of many years. Statements about the expected service life cannot be made and depend on care and the applications for the device.

2.8.2 Disposal of consumables

The PTFE filters or BQ filters of the 11-C are considered consumables. These filters, provided the dust they were exposed to is free of contaminants, are disposed of in household or commercial waste. If substances that are hazardous to health were knowingly or presumably collected on the filter, it must be disposed of according to the respective contaminants. Pertinent information on proper disposal is available from your specialised disposal firm.

The reusable specimen holder has to be sterilised using suitable methods after use, preferably by autoclaving for at least 15 minutes at 121 °C.

3 Device description

Only put the device into operation after reading this manual!

3.1 Connections on the 11-C

The section that follows explains the various control elements of your dust monitor. In operating the device, one differentiates between standby mode and operating mode. All settings can be read and changed in standby mode. In operating mode, the device is taking measurements; all settings are fixed and cannot be changed.

3.1.1 Connections and control elements

Figure 3-1: Connections and control elements of the 11-C

1	Display	6	Analogue jack
2	Memory card LED	7	Status LED
3	Memory card slot	8	Mains charger connection
4	Membrane keyboard	9	RS-232 interface
5	Sample intake (closed)	10	Bluetooth antenna

Figure 3-2: Connections on the right side of the 11-C

10 Bluetooth antenna

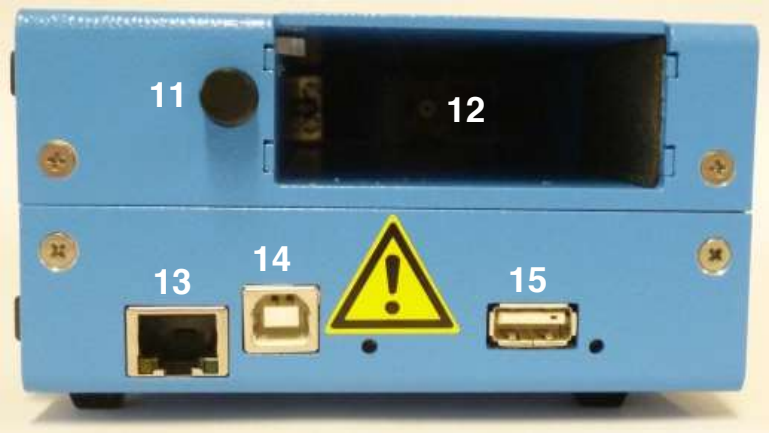


Figure 3-3: Connections on the left side of the 11-C

11 Battery eject button
12 Battery compartment
13 LAN connection
14 USB-B connection
15 USB-A connection

3.1.3 Filter chamber and certifications on the top and rear of the device

Figure 3-4: Rear of the device

16 PTFE filter (indicated in the figure)
17 Filter chamber with bayonet closure
18 Type plate of the 11-C
19 Laser warnings
20 Sample air return

Figure 3-5: Top of the device

21 Calibration label

3.1.4 Rear with optional bio-measuring cell installed

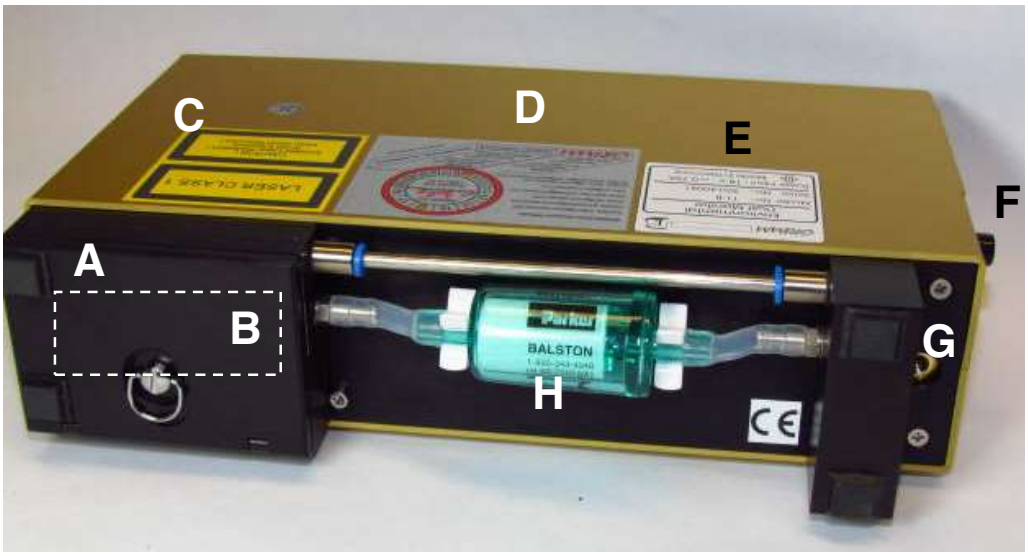


Figure 3-6: Control elements on the rear and labels on the top of model 11-C (Figure similar)

A Impactor chamber with bayonet closure

B Specimen holder (indicated in the figure)

C Laser warnings

D Calibration label

E Type plate with device designation and serial number

F Fuse for battery compartment (on the side) and battery

G Sample air discharge

H BQ filter

3.2 Display

Figure 3-7: Display of the 11-C

The optical display of the device is an OLED (organic light emitting diode) display with a total of 2 x 16 characters. Measurements and optional sensor values are shown on the display along with all settings such as the date, time, measuring location number, battery charge level, storage interval and all required messages.

3.3 Data storage with SD card

Using a memory card is recommended so that measurement series over time can be recorded without a connection to a PC. Only SD memory cards can be used. The maximum storage time depends on the chosen storage interval and the capacity of the memory card.

The memory card must be installed in standby mode before measuring begins.

3.3.1 Initialising the memory card

Figure 3-8: SD card, front and rear

The memory card is inserted into the SD card slot on the front of the 11-C with the beveled corner at the top right. Make sure that the SD card is not write protected.

Figure 3-9: Inserting the memory card

Once the memory card has been inserted in standby mode, all measured values are automatically saved to the memory card.

The memory card may only be removed from the device in standby mode.

The memory card can be read and erased using any Windows PC with a card slot or external card reader. The memory card cannot be read or erased in the 11-C.

3.3.2 Meaning of the LEDs on the front

There are is a LED (1) to the left of the SD card slot and a LED (2) to the right of the membrane keyboard.

LED 1 lights up red when a firmware update is being installed. This LED also lights up red while writing to the SD card. Do not remove the SD card during the save/write process, otherwise the datasets being saved are lost and all saved datasets may be damaged.

LED 2 changes colour to indicate the charge level of the integrated battery.

Meaning of the LED colours:	**Green**	- On battery without power supply
		- Flashing when battery charge level < 10%
	Red	- On power supply, battery is being charged

After the charging process, LED 2 lights up green when the battery is fully charged.

Figure 3-10: Function LEDs

3.3.3 Writing to the SD card and USB storage medium

LED 1: This LED lights up red while writing to the SD card. Do not remove the SD card during the save/write process, otherwise the datasets being saved are lost and all saved datasets may be damaged.

USB storage medium: A USB storage medium may be used as an alternative for saving datasets. There is a LED next to the USB-A connection, indicating activity on the USB storage medium. This LED flashes when datasets are being saved to the USB storage medium. Do not remove the USB storage medium during the save/write process, otherwise the datasets being saved are lost and all saved datasets may be damaged.

3.3.4 Data preservation and storage times

The data on the memory card/USB stick are written to an internal flash memory. An SD card/USB stick can be written between 100,000 and 1,000,000 times depending on the storage used on the SD card/USB stick.

Only SD cards/USB sticks with a storage volume up to 4 GB may be used in the 11-C.

Even with a 6-second measuring interval, the storage capacity is sufficient for several months.

Further information:

- The SD card/USB stick should only be changed in standby mode, otherwise data may be lost.
- If the SD card/USB stick was not inserted before starting a measurement, the device has to be put into standby mode again by pressing the **{Standby}** button before the SD card/USB is inserted.
- The SD card/USB stick can be read using a PC with an SD card reader.

3.4 Membrane keyboard and button functions

The device has 10 function keys. Use the **{ON/OFF}** button to turn the device on or off. To avoid unintentionally interrupting the measurements, shutdown is delayed for about 1 second by the software. The button has to be pressed until a beep sounds. Wait at least 5 seconds before switching the device on again.

A measurement in progress should be ended by pressing the **{Standby}** button. Pressing the **{Standby}** button stops the sample air flow and flushes the measuring cell with clean, particle-free air. If the device is switched off while a measurement is in progress, the 11-C interprets this as a power loss and will continue measuring automatically when it is switched on again, without asking about filter replacement and with the mean values of the preceding measurements. The measuring cell is not flushed if there is a sudden loss of power. Fine dust particles remain in the measuring cell as contaminants. Therefore switching to standby mode before shutting off the device is always recommended.

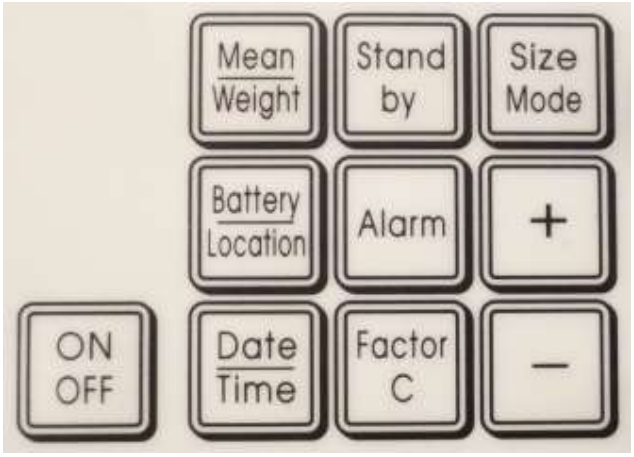


Figure 3-11: Membrane keyboard on the 11-C with 10 function keys and speaker behind the membrane for outputting audible warnings (alarms)

Some buttons are assigned to different functions in measuring and standby mode. These are described in detail on the pages that follow. To enter changes, the respective function key has to be pressed and held before setting the desired value by pressing the **{+}** and **{-}** buttons. All changes entered using the membrane keyboard are confirmed by a brief beep.

3.4.1 Button functions in standby mode

The settings of the dust monitor can be changed in standby mode.

Reading the mean values

The mean **dust concentration** value with the corresponding sample volume is displayed for all measurements when the device is powered up. The gravimetry factor is taken into account for this display.

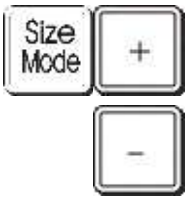
In **particle concentration** display mode, the mean values of both selected channels are displayed and an underscore serves as the distinguishing feature. The sample volume for the mean values appears after approximately 5 seconds and is displayed as long as the button is pressed.

Pressing the **{Mean/Weight}** button and the **{+}** button at the same time displays the calculated filter weight and the corresponding sample volume. The gravimetry factor is not taken into account for the filter weight.

Starting a new measurement

Pressing this button exits standby mode and starts a new measurement series.

Setting the measuring mode and selecting the size channels to be displayed

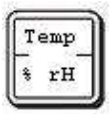


Press and hold the **{Size Mode}** button and then also press the **{+}** or **{-}** button several times to change the channel that is shown on the first and second line of the display.

The channel shown in the first line of the display is used for the alarm value.

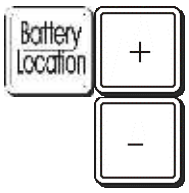
Please note that data sent over the RS-232 interface and recorded on the memory card are of the same type shown on the display. This means that either mass or particle concentrations can be displayed and recorded!

Display of the analogue values



Pressing the **{Temp %rH}** button shows the values for the analogue input jack, e.g. the external sensor for temperature and humidity, and the time. This operating mode remains selected until any button is pressed.

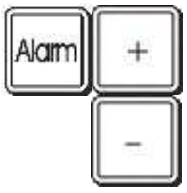
Displaying the battery charge level and determining the measuring location number



Pressing the **{Battery/Location}** button displays the current battery charge level in % and the configured measuring location number. 130% is shown when operating on the power supply and values in excess of 100% are possible when the battery is fully charged. By pressing and holding the **{Battery/Location}** button, the measuring location number can be changed with the **{+}** and **{-}** buttons.

The measuring location number is used to differentiate between measurements and can be set between 1 and 99.

Displaying and changing the alarm threshold, need for dilution in case of coincidence

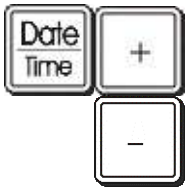


Pressing the **{Alarm}** button and the **{+}** or **{-}** button changes the alarm threshold. At 0 the alarm function is deactivated. A value greater than zero activates the alarm. The alarm value always refers to the size channel in the upper line of the display and the selected operating mode (mass or particle concentration).

Coincidence is the simultaneous occurrence of at least two particles in the course of the beam, which are counted as one particle of a different diameter.

As a result, the size is assigned to an incorrect channel compared to the individual measurement. Dilution should therefore be applied for particle concentrations of more than 2,000,000 particles per litre, since the coincidence is too high starting with this concentration and cannot be corrected internally anymore. The alarm threshold is also used to monitor interior rooms and to trigger a corresponding alarm when a certain particle concentration is reached.

Setting the time and date



Short press: Display of date and time.
Longer press: Adjust date and time.

The location of the flashing cursor can be changed by pressing the **{+}** or **{-}** button. Pressing the **{Date/Time}** button again advances the cursor. If no button is pressed for some time (approximately 3 seconds), the device returns to standby mode. When changing the minutes, the seconds are simultaneously reset to zero.

3.4.2 Button functions in measuring mode

In measuring mode – while a measurement is in progress – all settings are fixed and can only be read using the membrane keyboard.

In measuring mode – during an active measurement – all settings are fixed and can only be read!

Mean values and calculated filter weight

Pressing this button displays the mean values for the selected channels. Here the selected channels are shown underlined. The mean values include all measurements since the device was powered up or last reset.

Pressing the **{Mean/Weight}** button and the **{+}** button at the same time displays the calculated filter weight and the corresponding sample volume. The gravimetry factor is not taken into account for the filter weight.

Ending the measurement

Pressing the **{Standby}** button ends the current measurement. The device goes into standby mode. To record complete measurement series, the measurement should always be stopped at the end of the measuring cycle.

Freezing the current measurement on the display

A new value is shown on the display every 6 seconds. Holding this button freezes the measurement that is currently displayed (measuring continues in the meantime).

Reading the battery charge level and determining the measuring location number

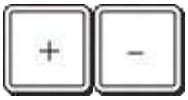
Display of the battery charge level and measuring location number.

Reading the alarm threshold

Pressing this button reads the current alarm threshold. The alarm value always refers to the size channel selected in the upper line of the display. When the alarm value is 0 the alarm function is inactive.

The speaker for the audible warning signal is behind the membrane keyboard.

Reading the analogue input values



Pressing the **{+}** button activates the cyclical display of the analogue input values for the connected sensor. The cyclical display is deactivated with the **{-}** button. The sensor values appear in the bottom row of this display, alternating with the measurements for the chosen operating mode.

Reading the date/time

The current date and time are displayed by pressing this button.

Alarm and error messages

If the configured alarm threshold is exceeded and in case of device errors, such as a low battery charge level, high nominal pump current and others, a message appears on the display and a warning signal sounds. The error states are also stored in the datasets on the memory card and output over the RS-232 interface.

3.4.3 Brief overview of the button functions

Certain keyboard functions can only be activated in measuring mode or in standby mode. Two buttons must be pressed at the same time for some functions. This is identified by the word and in the column on the left.

Table 1: Brief overview of the button functions

Buttons	**Function display**	**Measuring mode**	**Standby**
[ON/OFF]	Turn the device on or off		X
[Mean/Weight]	Display of the accumulated dust mass and the sample volume as a mean value for all measurements after powering up, or since the mean values were last reset.	X	X
[Mean/Weight] and [+]	Mean value for all measurements after the filter change. Additional display of the calculated weight and corresponding sample volume.	X	X
[Standby]	End the current measurement	X	
[Standby]	Start a new measurement		X
[Size/Mode]	Freeze the current display	X	
[Size/Mode] and {+} or {-}	Select the channels to display		X
[Battery/Location]	Display the current battery charge level Display of the measuring location (1...99)	X	X
[Battery/Location] and [+] or [-]	Display the current battery charge level Change the measuring location number		X
[Alarm]	Read the configured alarm value	X	X
[Alarm] and {+} or {-}	Increase or decrease the alarm threshold		X
[Date/Time]	short press: Display	X	X
[Date/Time]	long press: Adjust date/time		X
[+]	Cyclical display of the analogue input values (sensors) is activated	X	
[-]	Cyclical display of the analogue input values (sensors) is deactivated	X	
[Mean/Weight]	During question “Filter Changed? Yes or No?”: Display of the calculated dust volume collected on the filter and the corresponding sample volume.		X
[Standby]	During question “Filter Changed? Yes or No?”: Display of the serial number and hours of operation.		X
[+] or [-]	During question “Filter Changed? Yes or No?”: [-]: Calculation of the filter weight continues [+]: Calculated filter weight is reset to zero		X

3.5 Sample intake

Sample air is suctioned into the device and measuring cell at 1.2 L/min through the sample intake. The sample intake is equipped with a quick coupling.

When the device is not in operation, the sample intake should be closed with the supplied cover cap to prevent the penetration of particles and keep the measuring cell from getting dirty. An internal flow of purge air protects the measuring cell against dirt when the device is powered up.

3.5.1 Inserting the radially symmetrical sample collection head (1111)

The sample collection head can be installed in the sample intake quickly and leak-tight without the use of tools.

Figure 3-12: Inserting the sample collection head

3.5.2 Removing the sample collection head

Figure 3-13: Removing the sample collection head

To loosen and remove the sample collection head, the blue plastic lip must be held using a finger or small tool. Then the suction head is easily removed. Various sample collection systems are available depending on the application. Also see Section 7.3 Accessories.

3.6 Analogue jack

The 6-pin analogue jack has 3 analogue inputs to record measurements from various sensors with an output voltage between 0 and 10 volts. Furthermore, the jack can provide a supply voltage of +10 volts with up to 40 mA to the sensors.

Possible sensors include the temperature and moisture sensor (model 1158-EE) or the temperature, moisture and air speed sensor (model 1154). The measured analogue values are saved to the memory card and shown sequentially on the display. 10-bit resolution is used (approx. 10mV). The texts and factors for the display can be changed.

1	Eingang 1
2	Eingang 2
3	Eingang 3
4	GND (Masse)
5	+10V/40mA
6	1-Wire Bus

Figure 3-14: Pin assignment of the analogue input jack

3.7 Mains charger connection

With the connection on the right side, the aerosol spectrometer can be connected to the supplied 1112C mains charger (18 VDC). The polarity of the 2.5 mm plug connection is described for the 1112C mains charger. The installed lithium-ion battery has sufficient capacity for at least 8 hours of operation.

Figure 3-15: Battery/Location button

The charge level f the 11-C can be shown on the display after the filter query with the **{Battery/Location}** button.

Before operating the device on battery, always check that the battery charge level is sufficient.

Note the correct polarity when other power supplies are used.

Figure 3-16: Section of the 1112C type plate showing the polarity

Before the 11-C spectrometer is used for the first time, the lithium-ion battery in the device has to be fully charged. It should be charged for at least 8 hours. Connect the 1112C mains charger to the jack on the 11-C.

3.8 RS-232 interface

The serial interface in the form of a 9-pin jack is on the front. This interface can be used to control the dust monitor and send the measurement data to a PC. Always use the original GRIMM USB/RS-232 data cable with the catalogue number 1141A, see Figure 7-2. By default the RS-232 interface is prioritised and can be deactivated by the USB, LAN or Bluetooth interface.

Pin assignment of the "RS-232 to PC" jack on the dust monitor:

Pin2: RxD	(receive data)
Pin3: TxD	(send data)
Pin5: GND	(signal/operating ground)
Pin8: CTS	(ready to transmit)

Due to the alarm output on the 9-pin RS-232 sub-miniature jack, only use the original GRIMM data cable.

3.1 Impactor block

Model 11-C can be supplied with an optional impactor block; see Figure 3-17. This impactor block collects the measured particles on the internal specimen holder. There is a bayonet closure on the chamber for the specimen holder that can be opened and closed without the use of tools. The two O-rings in the chamber should be inspected regularly for cracks and aging. If the O-rings in the chamber are defective, external air may be drawn in which falsifies the flow of sample air through the laser measuring chamber.

Please note: With the use of the impactor block, only specimen holders can be used. Using PTFE filters with the impactor block is not intended. This means no gravimetry measurements are possible with the 11-C with bio-measuring cell.

Figure 3-17: Impactor block

3.2 Bluetooth interface

Bluetooth is an industry standard for the short-distance wireless transfer of data between devices. It was developed by an international workgroup in the 1990s. The Bluetooth module installed in the 11-C has a range of 100 m outdoors. Indoors the range can be reduced by walls and ceilings. The 11-C has a Bluetooth antenna as standard equipment. By connecting a Bluetooth-capable receiver (tablet PC, laptop, smart phone with Bluetooth-capable terminal app) to your 11-C, you can:

- Control the device using a terminal program
- Control the device using the GRIMM-1178 software

Connecting a PC to the measurement device via Bluetooth

Each measurement device has a unique Bluetooth name; see Figure 2-4 or the type plate on the bottom of the device. Start a search for Bluetooth devices in the vicinity and select your measurement device. You will be prompted for the password. The password is 1234 and cannot be changed. In the terminal program, the interface assigned by the operating system has to be selected.

For details on connecting the measurement device to your PC, laptop, smart phone or tablet using the Bluetooth interface, please see the corresponding user manual. No action has to be taken on the measurement device; the Bluetooth interface is always operational. Subsequently operation using a terminal program or the GRIMM Windows Software 1178 is possible.

3.3 USB (universal serial bus) connection

The universal serial bus (USB) is a serial bus system for connecting a computer to external devices. Devices or storage media equipped with USB, such as USB sticks and external hard drives, can be connected to each other and connected devices along with their properties are recognised automatically.

The 11-C has two USB interfaces on the left side of the device:

- One USB interface for control
- One USB interface for storage

When you connect a USB stick to your 11-C via USB-A, you can use the following functions:

- Measurement data backup to a USB stick
- Installing firmware updates from a USB stick

When you connect your 11-C to a computer via USB-B, you can use the following

functions:

- Controlling the 11-C using a terminal program (see Section 5.2)
- Controlling the 11-C using the GRIMM Windows Software 1178 (see Section 5.3)

Connect the USB interface on the 11-C to a Windows PC and, in the terminal program, select the interface proposed to you for communicating with the spectrometer. Then send a V to initialise the current interface.

3.4 LAN (local area network) connection

A **local area network**, **LAN** for short, is a computer network that connects various devices to each other (computers, printers, fax machines and more). The LAN connection of the 11-C is shown in Section 2.1.1.

When you connect your 11-C to a computer network via the LAN connection, you can use the following functions:

- Visualising the measurement data
- Backing up the measurement data to a network
- Controlling the device using terminal software
- Controlling the device using the GRIMM Windows Software 1178.

The device is configured with an internal IP address at the factory. This can be adjusted by the user as needed for use on a network.

Changing the IP address:

Using HyperTerminal:

- Put the device in standby mode.
- Connect the 11-C to the PC with a USB or RS-232 cable and start the terminal program.
- Contact your network administrator to establish the IP address.
- Input the \ character to display the IP address.

\

IP:192.168.187.9

IP:192.168.187.9

The output line at the top shows the configured IP address of the measurement device. The output line on the bottom is an editor line where the IP address can be changed. Use the Return or Enter key to confirm your input. After changing the IP address, the device restarts automatically. The IP address can only be changed from left to right, and all characters to the right of the cursor have to be reentered.

- Now end the active terminal connection by clicking Disconnect

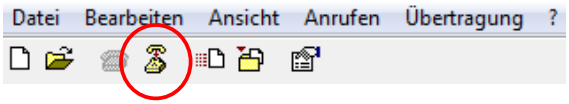


Figure 3-18: Ending an active HyperTerminal connection

- Then go to Properties in HyperTerminal:

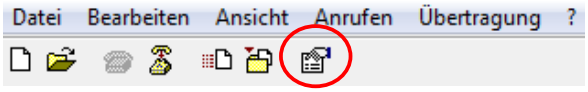


Figure 3-19: Accessing Properties in HyperTerminal

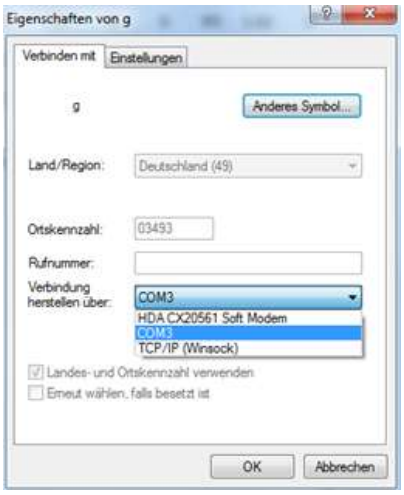


Figure 3-20: HyperTerminal properties before the change

HyperTerminal is usually preconfigured for a serial interface with country code and area code.

With the mouse pointer, go to the drop-down menu “Connect via:” and display the possible choices.

First select TCP/IP (Winsock).

- Settings in the terminal program

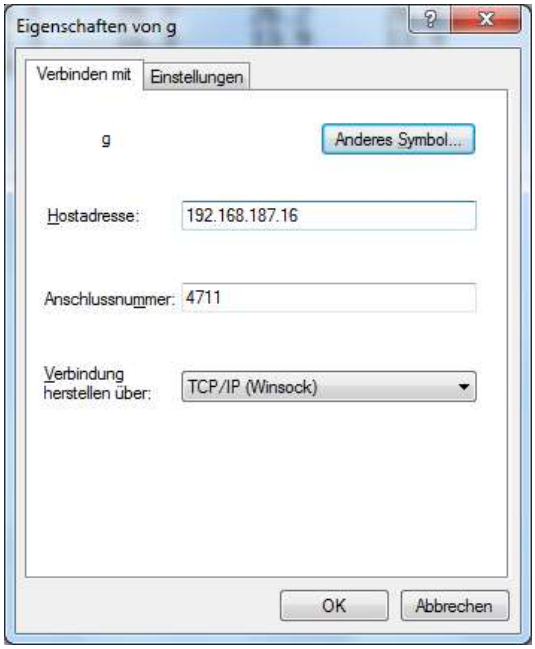


Figure 3-21: Configuring the TCP/IP connection

Now enter the network address of the 11-C under “Host address” on the screen.

Assign the number 4711 as the port for all 11-C units.

Then confirm the settings with OK.

- Connect the terminal program and 11-C using the supplied LAN cable

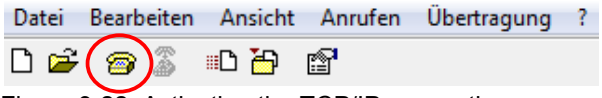


Figure 3-22: Activating the TCP/IP connection

- Activate the connection in HyperTerminal and send a “v” to activate the interface on the 11-C and check the connection.
- The version number of the device is displayed.

```
V
Vers:12.40 E
```

Now you can control the 11-C using HyperTerminal. Alternatively you can control the 11-C with the GRIMM Windows Software 1178 (see Section 5.3).

3.5 Filter chamber

11-C series devices are supplied with a filter chamber on the rear as standard equipment. The filter chamber must be equipped with a special 47mm PTFE filter (1113A). There is a bayonet closure on the filter chamber that can be opened and closed without the use of tools. The two O-rings on the filter chamber should be inspected regularly for cracks and aging. If the O-rings on the filter chamber are defective, external air may be drawn in which falsifies the flow of sample air through the measuring chamber and therefore the measurement.

Figure 3-23: Filter chamber

3.6 PTFE filter

The sample air is suctioned through a PTFE filter after leaving the measuring cell. This filter serves as a dust collector and can be used for gravimetric control of the optical measuring results (see Section 4.5 “Determining the gravimetry factor”). Microscopic and chemical analyses may also be performed on the particles collected on the filter.

If the device is operated without a PTFE filter, dust gets directly into the pump in the device where it can cause damage or total pump failure.

3.7 Laser warnings

A corresponding warning is found on the back of the device. Please observe the general information on handling lasers and laser radiation in Section 1.4 “General safety requirements”.

3.8 Calibration label

Figure 3-24: Calibration label

The calibration label on bottom of the device indicates the month and year when the calibration expires. After expiry, GRIMM Aerosol Technik assumes no liability for the accuracy of the measurements within the specified error limits. This also applies if the calibration label is damaged or removed.

3.9 Device designation and serial number

The model designation and serial number are shown on the type plate on the underside of the device. The serial number has eight characters. Example:

Figure 3-25: 11-C type plate

11C14P01
↳ Model: “11” for series 11
↳ Hardware version: “C”
↳ Year of manufacture, two digits: “14”, “15”, etc.
↳ Serial number of a model (three characters) in the year of manufacture: “001”, “002”...

3.10 Sample air discharge/Sample air return

On the sample air discharge located on the left rear of the device, 1.2 litres of air which enters through the sample air intake leaves the device per minute. Do not block the sample air discharge, otherwise the device will shut down. The sample air discharge can also be used for leak testing.

If the optional duct probe is used, the sample air discharge can also be used for sample air return.

4 Particle measuring with GRIMM dual technology

The 11-C series dust monitors and aerosol spectrometers are compact, portable measurement devices constructed for the continuous measurement of dust in air. They are equipped with an integrated gravimetry filter that collects all particles after the optical measurement, so they are available for further tests. This dual technology is unique and patented by GRIMM Aerosol Technik.

The measurements can be output as a particle concentration in the unit of particles per litre or as a mass concentration in the unit µg/m³. Various standardised dust mass fractions and the calculated particle surface can also be output with the GRIMM Windows Software 1178.

The sample air is suctioned through the measuring cell and into a gravimetry filter with the help of an internal volume flow regulated pump. This filter serves as a dust collector and can be used for gravimetric control of the optical measuring results. The pump also conveys purge air which is collected from the pump exhaust air through an ultra-fine filter and kept constant by a purge air regulator. The purge air protects the laser optics and other components of the optical measuring cell against dirt and serves as particle-free reference air during the device self-test.

At the start of each measurement, the device performs a self-test. This takes approximately 30 seconds. Then the actual measurement begins and the measurements are shown continuously on the display every 6 seconds. All measurements are also stored on an inserted SD memory card at a configurable interval. The data can be transferred to a computer via the integrated interfaces (RS-232, USB, Ethernet, Bluetooth). Data output can be set at intervals from 6 seconds to 60 minutes.

4.1 Measuring principle

The sample air is conducted into the measuring chamber directly from the aerosol intake or through the application-specific sample air collector. Particles contained in the sample air are captured in the measuring chamber using light-scattering photometry. The scattered light impulse of each individual particle is counted and the intensity of the scattered light signal is assigned to a particle size. A laser diode serves as the light source in all GRIMM laser aerosol spectrometers and dust monitors.

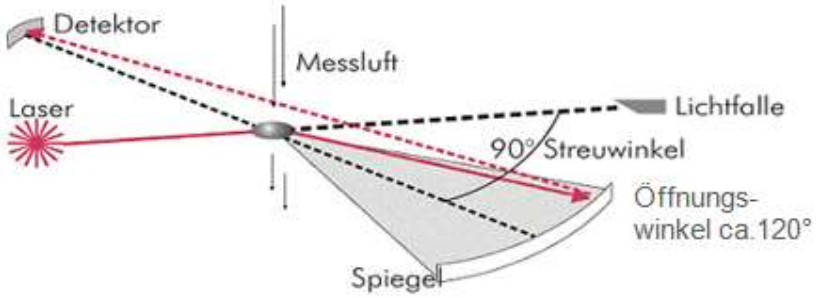


Figure 4-1: Measuring principle (schematic representation)

With the 11-C, the wavelength is in the visible range of 660 nm. The laser diode can be operated in what is known as multiplex mode, which means that the intensity of the laser beam is modulated. This allows particles to be detected in a very broad size range from 0.22 µm to 32 µm with this model. The laser beam is focused into a flat band by lighting optics. In focus, the laser beam evenly lights a small sensing volume and is then conducted into a light trap. The sample air is aerodynamically focused and conducted through the interior of the sensing volume as a particle stream.

Very high particle concentrations are possible for measurements on particle sources, technical aerosols and workstations, so that diluting the sample air is required. The scattered light emitted by each particle is captured by a second set of optics with a scatter angle of 90° and deflected to a receiver diode by a mirror with an opening angle of 120°. After amplification, the signal from the detector is classified into size channels depending on the intensity. The sample air is conducted into the sensing volume perpendicular to the viewing plane.

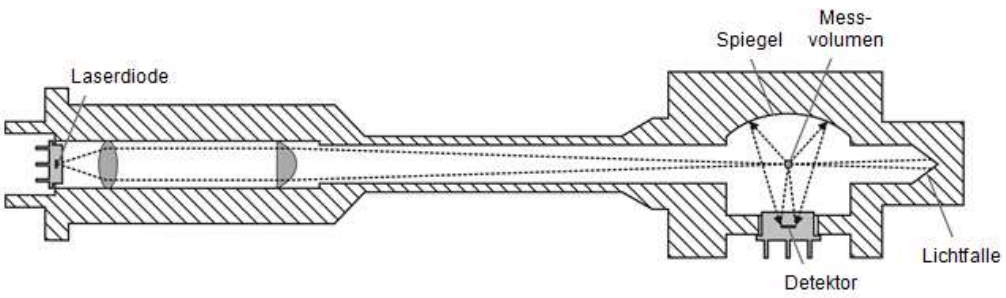


Figure 4-2: Schematic representation of the laser measuring chamber

The count rate is derived from the number of particles divided by the volume flow rate. The particle size is proportional to the intensity of the detected scattered light signal. In addition to the particle size, the scattered light intensity is also influenced by the refraction index of the particle form and the orientation of the particle in the sensing volume. Positioning the detector in the 90° direction makes it possible to minimise the influence of the refraction index for the aerosol particles on the determination of the particle size. The large opening angle of the detector optics was chosen so that ambiguities in the scattered light intensity are compensated by resonances, which inevitably occur when monochromatic laser light is used.

This makes the clear assignment of the particle size to sufficiently narrow size classes possible. The 11-C uses 32 size channels. Capturing the particle concentration and particle size makes it possible to capture the size distribution of the aerosol particles, which in turn is the foundation for calculating the particle mass.

4.2 Calibration, physical background

Particle size detection is calibrated with mono-dispersive latex certified by the NIST (National Institute of Standards and Technology). The dust mass calculation is calibrated with dolomite dust in comparison to a reference device. All devices are delivered with a calibration certificate!

The condition of a spectrometer should be checked annually. Send the device to the manufacturer for this purpose, where it is inspected and calibrated with the help of a reference device. Alternatively the customer can perform the calibration directly. A calibration tower and reference device are required to do so. Two special training sessions are required for the correct operation of the calibration tower. The reference device must be inspected and certified annually by the manufacturer using mono-dispersive latex aerosol.

Each manufacturer uses a different method for the calibration of aerosol spectrometers. Such a method can be called a “house standard”. Why? Because there is no worldwide calibration standard for aerosol spectrometers, all manufacturers should use the same standard aerosol particles for size calibration, for example polystyrene-latex or PSL. The GRIMM “calibration house standard” is based on a comparison between a reference device calibrated with PSL and the spectrometer candidate.

A calibration characteristic curve with all relevant parameters of our spectrometer (laser wavelength, detector position, detector opening angle, PSL refraction index m = 1.60 +io etc.) has been calculated for the reference device. The reference device is supplied with various mono-dispersive PSL samples and the particle size measurements are validated for this standard material. As the master device, the first GRIMM reference device was in turn compared to the laser aerosol spectrometer model LAS-X from PMS, Boulder, Colorado as a reference device. We ensure correct particle size measurements in the specified channels with this procedure.

The particle size is calibrated with NIST traceable polystyrene latex from the company Duke Scientific.

This means the optical latex equivalent diameters are measured. The size channels refer to electronic thresholds. When a single particle passes through the laser beam, the incident laser light is scattered.

This scattered light is collected by a mirror and focused on the detector at a specified angle. The photons captured by the detector emit a “raw signal” which is amplified and classified into particle size channels. Therefore the number and size of the aerosol particles can be measured.

A spectrometer candidate is calibrated against a reference device with the help of a fully computer-controlled, automated “GRIMM calibration tower” using dolomite dust as the standard aerosol. Why dolomite dust? Dolomite dust is non-toxic, non-hygroscopic, poly-dispersive and very stable in storage. The dolomite dust covers the entire size range for all GRIMM spectrometers from approximately 0.22 µm to > 30 µm. Since both the reference device and the spectrometer candidate are manufactured the same way, the dolomite dust has to lead to identical results for the two spectrometers. The dolomite dust is blown into the top of the cylindrical calibration tower by a short blast of particle-free compressed air and homogenously distributed through the entire cross-section. A reference device and three or six candidates with identical aerosol intakes are installed on the lower section of the calibration tower. A return flow of particle-free compressed air from the bottom to the top guarantees a clearly defined and reproducible aerosol particle distribution during the entire calibration process.

During calibration, the number in each individual channel starting with the largest is compared simultaneously between the reference device and the spectrometer candidate. The calibration software can compare 32 size channels at the same time. The statistical comparison is based on a mean value formed from two cycles of two minutes and ten minutes. Depending on the measured particle concentration, the calibration software can electronically adjust the threshold of the candidate.

Lower threshold = more particles in the channel

Higher threshold = fewer particles in the channel

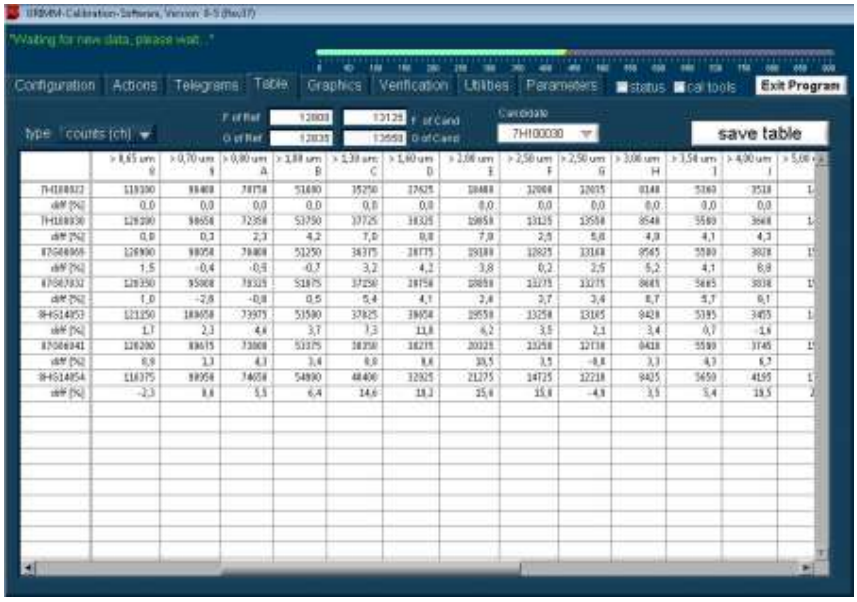


Figure 4-3: Screenshot of the GRIMM calibration software during the calibration process with a reference device and candidate (here GRIMM environmental dust monitor with 31 channels)

The table in the illustration shows a section of the calibration when there are at least 3 matches between the accumulated count values of the candidates and the reference device. The count values of the candidate compared to the reference device have to be within the allowable range with an accuracy of ± 2%. Since the particle diameter influences the particle size to the power of three, the certified accuracy for mass measuring mode is ± 5%. The calibration software checks all relevant parameters and the quantity of calibration dust to ensure that the concentrations lie above a certain minimum. All results are stored electronically and saved in the database for quality assurance purposes.

Calibration on the tower is followed by a comparison under indoor conditions:

In the room air comparison, the spectrometer candidate is compared to the same reference device to determine the agreement under indoor conditions. If the candidate keeps the particle concentration within a channel with a tolerance of ±3% compared to the reference device for a concentration of more than 500 particles per litre of air, it is considered successfully calibrated.

The following screenshot from the GRIMM calibration software CalSoft is provided for clarification. What is known as the “ramp” shows an example of the measured particle concentration for a candidate compared to the reference device, respectively after calibration.

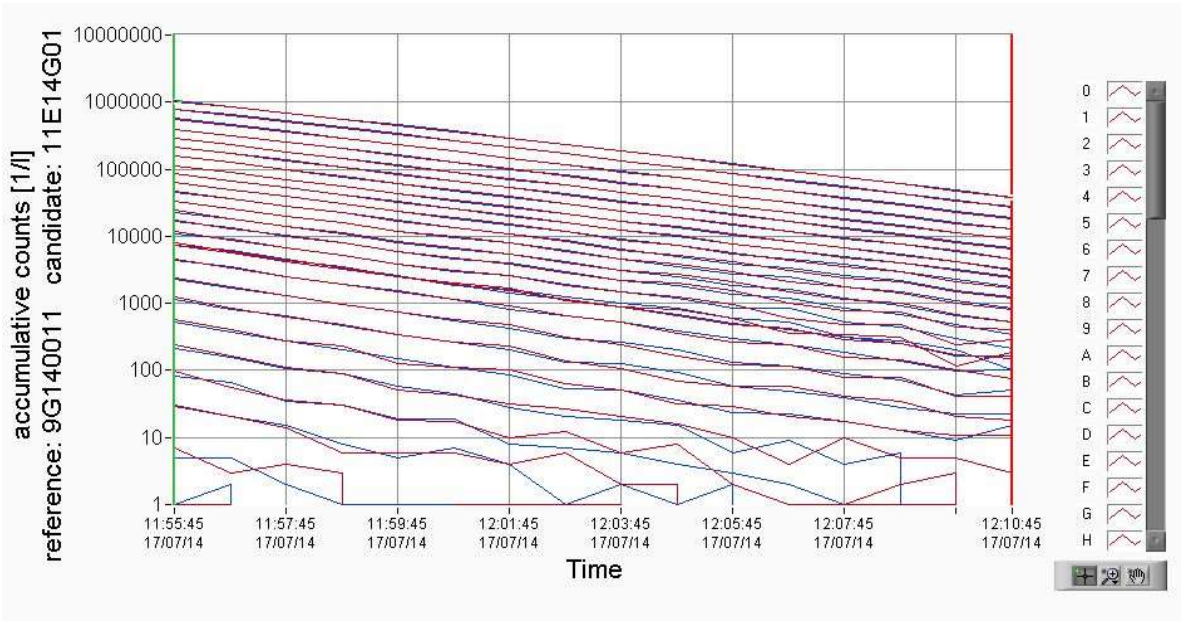


Figure 4-4: Calibration: Simultaneously measured particle concentration for all 32 size channels of the candidate (blue) and reference device (red) vs. time (test ramp with dolomite on calibration tower)

5 Measurements

5.1 Putting into operation

The measurement device can be operated as follows:

1. **Standalone operation** without a PC, with an SD memory card or USB stick, controlled using the membrane keyboard
2. RS232 communication using **HyperTerminal control commands** or the **GRIMM Windows Software 1178** with a connected PC
3. USB communication using **HyperTerminal control commands** or the **GRIMM Windows Software 1178** with a connected PC
4. Bluetooth communication using **HyperTerminal control commands** or the **GRIMM Windows Software 1178** with a connected PC, tablet PC, laptop or smart phone with Bluetooth-capable terminal app
5. LAN communication using **HyperTerminal control commands** or the **GRIMM Windows Software 1178** with a connected PC

Standalone operation without a PC is discussed in the following. Operation using **HyperTerminal** control commands is explained in Section 5.2 “Terminal software via RS-232 interface” and the sections that follow. All information for the **GRIMM Windows Software 1178** is found in Section 5.3.

“Standalone operation”

For properly putting the device into operation, follow the steps and information below.

Never operate the device without a PTFE or BQ filter and specimen holder! Only use the original GRIMM accessories.

Verify that the gravimetry filter (PTFE filter) is correctly inserted as shown in the illustration. For the gravimetric determination of the weight of the dust particles collected on the filter, see the detailed information in Section 5.5 “Gravimetric control of the dust mass”

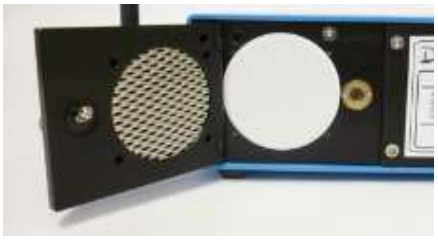


Figure 5-1: Open filter chamber

If the bio-measuring cell is installed, verify that it is properly inserted into the specimen holder as shown in the illustration.

Open the cover cap on the sample intake and connect the radially symmetrical sample collection head to the sample intake. Insert the storage medium (SD card or USB stick) into the corresponding slot. The storage medium is mandatory for standalone measurement and supports the storage of longer measurement series with small time increments.

Figure 5-2: Impactor chamber with specimen holder

Connect the power supply unit or insert a charged battery (as shown in the illustration to the right) into the compartment provided, pushing the lock button. The battery has to disappear entirely in the compartment and engage with a click. The device turns on automatically.

Removal should be performed as follows: Turn off the 11-C spectrometer without connected mains cable. When the lock button is pressed again, the battery comes partly out of the compartment and can be removed.

After starting the device with the **{ON/OFF}** button, the model designation and firmware version are shown on the display. Pressing the **{Standby}** button displays the serial number and hour of operation counter for the device. The pump and laser operating duration is counted as the operating time.

OPC MODEL 11-C **Vers: 12.40 E**

11-C: Version 12.40 E
The “E” after the version indicates the European format (date, time) DD.MM.YY. “US” after the version indicates that the American format YY.MM.DD is selected.

Date 18.11.14 Time 9:31:15

The entire cycle takes about 10 seconds and can be terminated with the **{+}**- or **{-}** button. Then the filter query is displayed.

filter changed? **press +: yes -: no**

Now the device asks if the gravimetric filter has been replaced. Confirming with the **{+}** button resets the calculated filter weight and the corresponding sample volume to zero. This display is only shown for about 10 seconds. If the **{+}** or **{-}** button is not pressed, the measurement device automatically switches to standby mode. If the **{+}** or **{-}** button is pressed, the measurement device starts the self-test over.

Ser. No. 11C14P01 **Run-Time: 12345h**

In the filter query, the serial number and hours of operation can be read as well: **{Standby}**.

Weight x, xx µg **Volume x, xxx m³**

If **{Mean/Weight}** is now pressed, the theoretical filter weight and corresponding sample volume since inserting the filter are displayed.

Self Test

If the **{-}** button is pressed, the device continues to accumulate the dust mass and sample volume data. This process is confirmed by an audible beep. Now the system begins with a self-test and ZERO calibration check.

Standby Mode **Press 2nd Key**

This process takes about 30 seconds. If you want to modify any operating parameters during this time, you have to put the device into standby mode again: **{Standby}**.

5.2 Measurement

Every measurement is initiated by an automatic self-test immediately upon returning to measuring mode . This flushes the measuring cell with clean air. Several different measurements are taken simultaneously, allowing conclusions to be drawn about the device status. If the device is intact, the following message is shown on the display: "**Self Test OK**"

The self-test is repeated in case of a fault. If the self-test is not successful after several attempts, the following message appears: "**Fatal Error**"
"**Please Check**"

There appears to be a device error that has to be corrected. Possible causes are:

- A foreign object in the measuring cell interrupting the laser beam
- Laser failure
- A different hardware defect

First attempt to correct the fault by thoroughly cleaning the sample intake. See Section 6.1.2 "Cleaning the measuring chamber". Otherwise the device must be sent for service. If there is no fault, the actual dust measurement begins after the self-test. The measurement is updated on the display every 6 seconds. After a minute the measurement should have stabilised, since the rolling average for the last minute is always used to make the display more consistent (i.e. the last 10 measurements).

5.3 Measuring mode and measurement display

In dust mass measuring mode, the unit ***µg/m³*** is shown on the right edge of the display. If the device is in particle concentration measuring mode, the unit **/l** for particles per litre appears on the right edge.

Note that the data for the chosen measuring mode as shown on the display are of the same type as the data recorded on the memory card or USB stick, or for operation with HyperTerminal or the GRIMM Windows Software 1178, sent over the respective interface. That means either mass or particle concentrations can be displayed and recorded.

Additional analyses are possible using the GRIMM Windows Software 1178. These are:

- For occupational medicine, the three dust mass fractions according to EN 481, inhalable, thoracic and respirable in µg/m³
- *Immissions*: The three dust mass fractions PM10, PM2.5 and PM1 in µg/m³

- **Measurements that can be determined:**
- Particle counts in 32 count channels, in particles per litre
- Particle mass in 32 mass channels in µg/m³

5.4 Mode switching particle count/particle mass

Via terminal software: **{N}** to switch to normal mode (mass)
{C} to switch to count mode

The filter weight and sample volume are reset to 0 with each version change.

5.5 Gravimetric control of the dust mass and determining the gravimetry factor (C-factor)

Due to the fact that the measurement device does not determine the dust mass directly but indirectly by means of optical scattered light measurement, the results have to be corrected for the respective measuring location with a gravimetry factor known as the C-factor. The C-factor can be determined with the gravimetry filter installed in the device.

The C-factor depends on the particle density, form and refraction index of the particles. Therefore it has to be determined for each type of dust. This is essential for workplace measurements in particular, since very different types of dust are often found here.

If the C-factor is not known, measuring is performed with the value 1 and the gravimetry is carried out after the measurement.

Gravimetry requires a micro-scale with a high resolution and precision. For a given resolution of 10 µg, a total mass of approximately 1 mg should be present on the filter so that the weighing error is kept small enough to be disregarded. The required collection period is determined from the existing dust concentration and the sample volume flow.

Please carry out the following steps to determine the gravimetry factor:

- Open the filter chamber and take the old filter out of the filter chamber. Clean the filter chamber as described under 6.2 “Replacing the PTFE filter”. Also clean the sample collection air path as described in Section 6.1.2 “Cleaning the measuring chamber”.
- Weigh a new filter (at least 3 times) and note the average weight you determine.
- Centre the new, weighed filter on the large O-ring in the filter chamber and close the filter chamber.
- Turn the dust monitor on and answer the question “Filter changed?” with yes **{+}** so the calculated filter weight is set to zero.
- Conduct your dust measurements at a characteristic location. Operate the dust monitor in a horizontal position with the display facing up.

Please note that, if the measurement series was interrupted, the filter question when turning on the device always has to be answered with no **{-}**.

- You can display the current calculated filter weight during the filter query by pressing the **{Mean/Weight}** button or using the control command **{W}** in HyperTerminal.
- If the filter weight is sufficiently large (at least 1 mg dust mass), you can turn the device off and remove the filter.
- Avoid shocks during transportation.
- If possible, remove the filter so that no collected material is lost. Weigh the loaded filter at least 3 times for greater accuracy. The difference to the empty filter weight is the dust mass actually collected.
- Calculate the gravimetry factor according to the equation below.
- The gravimetry factor that is determined can be changed with the **{*G*}** command in HyperTerminal.

$$C - factor = \frac{Dust\ weight\ on\ the\ filter}{Calculated\ dust\ weight}$$

To improve the measuring accuracy, you should determine the factor several times. The value should not deviate from the basic value by more than approximately ± 30%. However, higher values are possible with dust that contains metal.

Now the calculated C-factor can be entered into the dust monitor. All dust mass concentration values as well as their mean values are multiplied by this factor and the output on the display is corrected accordingly. This calculation affects all measurements in version 7.80 only. On the other hand, the measurements on the memory card and output over the RS-232 interface are not corrected. The gravimetry factor appears in the P-line.

6 Analysis software

6.1 Connecting the 11-C to the PC

As described in Section 2, the 11-C has various connections to operate the device with analysis software. These connections are described in this section.

6.2 Terminal software via RS-232 interface

Every GRIMM spectrometer can be operated using the corresponding control commands with terminal software and a GRIMM USB/RS-232 cable (1141A). Terminal software is usually a text-based communication program included with the Windows operating system since Windows 2.0. Windows no longer includes a terminal program since Windows Vista, but this can be downloaded from the pages of the company Hilgraeve as a billable or free download. Alternative providers are:

HyperTerminal Private Edition: http://hyperterminal.soft-ware.net/download.asp

or

Putty: http://the.earth.li/~sgtatham/putty/latest/x86/puttytel.exe.

Other terminal programs should not be used since they do not fully communicate with the device firmware. The steps that follow will be explained using HyperTerminal.

6.2.1 Transmission protocol

The following connection settings should be configured for HyperTerminal to work properly:

Bits per second:	9600
Data bits:	8
Parity:	none
Stop bits:	1
Flow control:	Xon/Xoff

6.2.2 Establishing a HyperTerminal connection

Connect the dust monitor to the PC with a GRIMM USB/RS232 cable (1141A) and turn the device on. After installing the terminal program under Windows 7, you will find it under:

START->All programs ->Accessories ->HyperTerminal

Figure 6-1: HyperTerminal properties

1.) Select a serial connection and specify the interface used to connect the spectrometer. Confirm your selection with OK.

2.) Configuring the transmission parameters

Figure 6-2: Transmission parameters

The connection settings are shown in the illustration. Accept these settings and confirm with OK.

If there is no communication between the 11-C and your terminal software, check the settings.

Check the connection by pressing **{v}**. Now the version of your device has to be displayed. By sending a **{?}**, you obtain a table with all possible commands. Also see Section 5.2.4 “RS-232 commands”.

Once you have established a connection, you can change settings on the measurement device with corresponding commands, start and end measurements or also record data. For the latter, select TRANSFER and RECORD TEXT in the HyperTerminal menu.

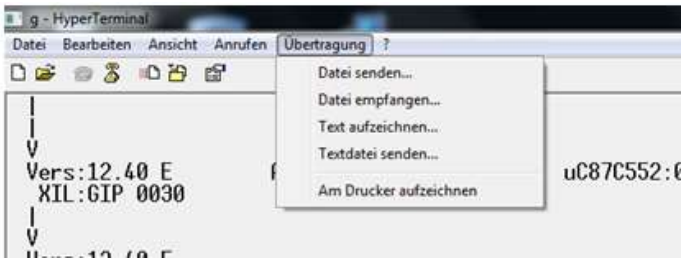


Figure 6-3: Capturing text

3.) Now enter the desired file name with the file extension *.TXT!

Figure 6-4: Saving a text file

4.) Start the measurement with the **{S}** command in HyperTerminal or the **{STANDBY}** button.

At the end of data recording, go again to TRANSFER -> RECORD TEXT -> END.

6.2.3 Terminal software via TCP/IP connection

Figure 6-5: Establishing a TCP/IP connection

Alternatively, select a TCP/IP connection if you want to use a network cable between the 11-C and PC. Enter the IP address of the 11-C in the terminal software. See Section 2.12 for information on how to determine the IP address of the device.

Once again, check the connection by pressing **{v}**. Now the version of your device has to be displayed. By sending a **{?}**, you obtain a table with all possible commands. Also see Section 5.2.4 “RS-232 commands”.

Once you have established a connection, you can change settings on the measurement device with corresponding commands, start and end measurements or also record data. For the latter, select TRANSFER and RECORD TEXT in the HyperTerminal menu.

6.2.4 RS-232 commands

The text-based commands are sent to the dust monitor over the RS-232 interface. The dust monitor will confirm receipt with an echo. Uppercase or lowercase letters can be used for the commands. Numeric values such as alarm values, all of which can only be changed in standby mode, have to be followed by the enter key (return or enter, ASCII 13). A period is used as the decimal separator.

You can use any terminal program for testing, as long as it supports the Xon/Xoff software protocol. The explanations and examples in this manual refer to the HyperTerminal program. The corresponding settings for the interface parameters have to be configured before starting.

Commands

? Help screen with an overview of all commands

```
###################### Help for Dust Monitor ############################
|  A  Alarm                          |  B  Battery                        |
|  E  Error                          |  F  Fast-Mode    (Output a 6 Sec) |
|  G  Gravimetry C-Factor            |  H  Runtime hours                  |
|  I  Interval                       |  J  Output Channels                |
|  T  Time Set             [Standby]| ^T  Timer Set            [Standby]|
|  L  Location Code      [1...99, +]| ^L  Land (for Date)      [Standby]|
|  M  Mean Value                     |  Z  Zero Clear Mean                |
|  R  Run Measurement                |  S  Standby Modus                  |
|  U  Unlock/Lock Keys     [Standby]|  @  Serial-No.                     |
|  V  Version                        |  W  Weight                         |
|  $  User Strings (Analog Inputs)   |  *  User Factors (Analog Inputs)   |
|  _  Output User Strings + Factors  |  !  Output Model + Rev + Version   |
|  #  Fast P ON/OFF   (Interval=6)   |  \  IP-Address                     |
|  ;  Autocal                        |  :  Gesytec              [Standby]|
|  '  Commentary until CR            |  "  Commentary until CR            |
| ^D  Disable Output                 | ^E  Enable Output; no Fast         |
| ^Y  Power OFF                      |  Long Break: Power ON              |
|  C  Count Mode           [Standby]|  N  Normal Dust Mode     [Standby]|
|  <  only Count_Channel 1...16      |  >  only Count_Channel 16...32     |
#########################################################################
```

^ All commands with these characters use the key combination **{Ctrl}+{letter}**.

A Output of the current alarm value. In standby mode, it can be changed by entering a corresponding value.

```
A
Alarm :       0 /l  :500
```

B Output of the battery charge level (with the power supply is connected, the value is always 130%)

```
B
Battery Power :  11%
```

C Turn on count mode/turn off mass display

E Output error code (ERROR)

Error Code:	OLED display	Meaning
"128"	NEW SELFTEST	Self-test error
"32"	CHECK NOZZLE	Check sample collection intake
"16"	NO OPERATION	Battery charge level = 0%
"8"	PLEASE RECHARGE	Battery charge level < 10%
"4"	PUMP CURRENT TOO HIGH	Motor current I_{mot} > 100%
"3"	FLOW-ERROR	Volume flow control outside the control range
"2"	CHECK FILTER	I_{mot} < 20%
"1"	CHECK FILTER	I_{mot} > 60%

^E Request for mass value transfer/turn off fast mode

G Output gravimetry factor. Can be changed in standby mode in the range from 0.10 to 2.50, increment 0.01.

H Output hours of operation

I Interval for the normal output and storage on the memory card. Can be changed in standby mode.

0	=	1	minute
1	=	5	minutes
2	=	10	minutes
3	=	15	minutes
4	=	30	minutes
5	=	60	minutes
6	=	6	seconds

J Output of the channel sizes in µm for version 12.40

```
Jc:    0.22    0.25    0.28    0.30    0.35    0.40    0.45    0.50
Jc;    0.58    0.65    0.70    0.80    1.00    1.30    1.60    2.00
jc:     2.5     3.0     3.5     4.0     5.0     6.5     7.5     8.5
jc;    10.0    12.5    15.0    17.5    20.0    25.0    30.0    32.0
```

L Output measuring location pre-selection (location number) and change in standby mode

^L Country setting (E or U) for date output on the dust monitor (standby mode only).
E = Europe
U = USA

M Output mean value and sample volume (count mode in the example that follows)

```
M
Mc:   65542    44025    30325    21600    15500    10975     8150     6900
Mc;    4225     2725     1900     1000      725      425      300      200
mc:     100       50       20       15        5        0        0        0
mc;       0        0        0        0        0        0        0        0
V:    0.0002 m3
```

N Turn on mass display, turn off count mode

R Run measurement. Start the measurement from standby mode.

S Stop. Activate standby mode

T Time output. The clock can be set in standby mode. If the minutes are changed, the seconds are set to zero.

^T Timer operation for turning the dust monitor on and off automatically.
In this operating mode, turning the 11-C on and off can be programmed with the following input:
- Month (Mon)
- Day
- Hour
- Minute (Min)

U Keyboard lock
U
U=0 Keyboard unlocked
U=1 Unable to go to standby mode
U=2 No keyboard operation possible

V Output version number of the device software
```
V
Vers:12.40 E
```

W Output filter weight and corresponding sample volume (weight)
```
W
Weight :     38.7 ug     Volume :    0.892 m3
```

^Y Power off: Turn off the dust monitor

Z Output and subsequent reset of the mean values and volume (zero).

@ Output of the serial number and, if connected, the serial number of the sensor
```
@
Ser.No. 11C15025  Sensor: FHE90012
```

! Output of the device model and version number
```
OPC Model 11-C
Vers: 12.40 E   E
Rev.: U
```

$ Select or change the configuration of the connected analogue sensors to show on the display (only in standby mode). Special characters via ASCII codes cannot be input. The '°' character (ASCII 248) for example is output as '_' (underscore).

Preconfigured texts can be selected with the tab key and confirmed with the enter key. They can also be overwritten with any texts. Numeric output is always five digits and begins at the 9th place. An audible warning is emitted if characters are entered here, except a decimal point. The multiplication factor that refers to 1 volt can then be entered after the text. However, it can also be changed with the asterisk '*'.

Example 1:

Temperature sensor:	0°C = 3.0 volts and 50°C = 8.0 volts
User text :	Temp. : . °C
User factor:	10.0 [°C/volt]
Offset:	3.00 volt

The sensor data can be read from an EEPROM. Transferring the data from the EEPROM, including the "user" text, only takes place if the "user" factors in the device are set to 1.0 and the offset values to 0.0. Recalibration by the user therefore continues to be possible (positive offset values are not possible).

***** Change user factors (only in standby mode). Changes the multiplication factor referenced to 1 volt.

_ (underscore) Output of all "user" texts and analogue input factors (only in standby mode).

Example 2:

```
_
$(1..4):Temp.:     .   C|Humidity   . %rH|Input 3:  .   V |Temp.:     .   C|
*(1..4): 10.189998 | 10.6 | 0 | 0 |`  2.775 V |  0.022 V |  0.000 V |  0.000 V |
```

The four "user" texts are output in the first line. The second line first shows the for user factors for the analogue voltages and then the offset values. Analogue 4 is reserved for a permanently installed sensor.

Long Break Turn the dust monitor on **{CTRL}+{PAUSE}**

; Autocal. The device stops during an ongoing measurements after the configured number of hours. The measurement begins again automatically after a self-test.

Example:

; 99 After an ongoing measurement over 99 hours, the device turns off and starts with a self-test.

6.2.5 Service mode – settings

Sending the character sequence **{ | }** and **{Tab}** key or **{ASCII character 124}** and **{ASCII character 009}** switches the dust monitor to service mode 0. With data output over the RS-232 interface, additional data and explanatory texts are output. Several additional control commands are available, such as reading the last service with **{~}** (Last Service) or reading the volume flow with **{^F}** (Flow Adjust). See the list of the displayed commands above.

Example 1:
Pressing **{V}** in user mode displays the short software version number:

```
V
Vers:12.40 E
```

Example 2:
Pressing **{V}** in service mode 0 displays the long software version number:

```
V
Vers:12.40 E        ASM:DM191U 27.5.2015    uC87C552:011   DM191U 27.05.2015 0
  XIL:GIP 0030
```

To return to measuring mode, press **{ | }** and **{Space Bar}** **{ASCII character 124}** and **{ASCII character 032}**. You will find the **{ | }** character on the relational operator key of your keyboard.

Example 3:
Normal data presentation in measuring mode 12.40:

```
P   14   10   13   15   59    5  100    0  130   35    6    4    0   65   85   6          5
190   51.9   20.6
C0:   31919    14509     6595     2960     1210      510      250      170
C0;      90       60       40       40       30       25       15       15
c0:       9        4        2        2        2        1        1        1
c0;       1        0        0        0        0        0        0        0
```

Data presentation in service mode with brief explanation of the P-line values:

```
   Year Mon   Day    Hr   Min   Loc    GF   Err Qbatt   Im   UeL   Ue4   Ue3   Ue2   Ue1   Iv   P_Weight
P_Vol{l}   rH_i Temp_i
P  _14   10   13   12   56    1    0    0  100   25   64    4    0    0    0   6        217
375   36.2   33.6
C_:  132940    77350    48435    22270     9325     4610     3210     1795
C_;    1305     1050      765      575      385      280      195      131
c_:     131       82       68       49       33       20       13       10
c_;       7        4        2        1        1        0        0        0
```

The 11-C can operate in mass or count mode.

Mode switching is done with **{N}** for mass mode or **{C}** for count mode

In mass mode the mass distribution of the aerosol in the 32 size channels is shown.

In count mode the particle distribution in the 32 size channels is shown.

6.2.6 P-line

There are three data strings for measurement transmission. The actual measurements as counts or mass, the P-line with lead data and the K-line with calibration data.

The K-line appears once after ending the self-test at the start of every measurement and contains information about the state of the laser diode and optical measuring cell. A detailed description is provided in Section 6.4.

The P-line is marked with a “P” and contains the lead data such as the date, time, sensor values and some service values. The P-line is output via the terminal and stored on the USB stick/memory card.

According to the configured interval, the P-line appears once or for instance after each dataset in what

is known as fast P-mode. It is structured as follows:

```
P 14 9 23 12 56  1  0  0 100 25 64 4 0 0  0 6  217  375  36.2   33.6
```

The data in the P-line are designated as follows:

```
Year Mon  Day Hr Min Loc GF Err Qbatt Im UeL Ue4 Ue3 Ue2 Ue1 Iv P_Weight P_Vol[l] rH_i Temp_i
```

The meanings of the individual values are explained below using sample values (in bold).

P **14 9 23 12 56** 1 0 0 100 25 64 4 0 0 0 6 217 375 36.2 33.6
The measuring time with year, month, day, hour and minute is stored in the first five places.

P 14 9 23 12 56 **1 0** 0 100 25 64 4 0 0 0 6 217 375 36.2 33.6
This is followed by the measuring location, which can be chosen from 1 to 99, and the gravimetry factor. For measurements in count mode, the gravimetry factor is not considered. The gravimetry factor can be configured in mass mode. The factory default setting is 1.

P 14 9 23 12 56 1 0 **0** 100 25 64 4 0 0 0 6 217 375 36.2 33.6
Error codes are stored in the eighth place. The error codes are encoded as bit values. For the meanings of the error codes, see the table under control command E in Section 5.2.4. A value of 0 means there is no error.

P 14 9 23 12 56 1 0 0 **100 25** 64 4 0 0 0 6 217 375 36.2 33.6
The battery charge level is stored in the ninth place, followed by the motor current input of the internal sample air pump. Both values are given in percent. A value of 130 for the battery charge level indicates that the spectrometer is operated on the power supply. Typical values for the motor current input are between 10 and 40%.

P 14 9 23 12 56 1 0 0 100 25 **64 4 0 0 0** 6 217 375 36.2 33.6

The next five values contain the measurements from optional sensors, for example the temperature, relative humidity and flow rate. Please contact the nearest GRIMM sales office or dealer for further information.

P 14 9 23 12 56 1 0 0 100 25 64 4 0 0 0 **6** 217 375 36.2 33.6

Iv indicates the current measuring interval.

P 14 9 23 12 56 1 0 0 100 25 64 4 0 0 0 6 **217 375** 36.2 33.6

p_weight indicates the dust weight that has passed the measuring cell since the last service/reset. p_vol indicates how many litres of air have passed the measuring cell since the last service/reset.

P 14 9 23 12 56 1 0 0 100 25 64 4 0 0 0 6 217 375 **36.2 33.6**

The current relative humidity and the current temperature of the sample air from the internal sensor are output in the following two values.

6.2.7 11-C, version 12.40, particle number measuring mode (counts)

In the following, the transmission of measurements with HyperTerminal control commands is shown for the 11-C as an example. Measurements shown in HyperTerminal are always cumulative. There are however differences in the unit. The measurements in the Counts measuring mode are all shown as intervals greater than or equal to 1 Min (Iv= 0...5) in the unit of particles per litre. If the measurements are output in interval 6 = 6 seconds or faster, the unit is particles per 0.1 litres.
In particle mass measuring mode, designated as normal mode in HyperTerminal, the unit is always µg/m³.

1 min interval: 32 channels >0.22µm to >32µm in P/l

```
Run_No.:030232
Data online from: 11C14009  Sensor:
Vers:12.40 E
Jc:    0.22     0.25     0.28     0.30     0.35     0.40     0.45     0.50
Jc;    0.58     0.65     0.70     0.80     1.00     1.30     1.60     2.00
jc:     2.5      3.0      3.5      4.0      5.0      6.5      7.5      8.5
jc;    10.0     12.5     15.0     17.5     20.0     25.0     30.0     32.0
P  _14   10   28   11    7    3    0    0   89   21   64    4    0    0    0   0
29      1310
K    750  1370  2276     5     0    53   108
P   14   10   28   11    8    3  100    0   87   51   64    4    0    0    0   0
29      1311
C_:  349060   158664    72120    34725    14740     5255     2285     1205
C_;     615      415      300      270      195      175      160      135
c_:     103       60       45       33       23       14       12       10
c_;       6        4        2        1        1        1        0        0
```

6 sec. interval: 32 channels >0.22µm to >32µm in P/100ml

```
K .  199   694   934     0     0    55    94
P   15    9    8   12   50    1  100    0  130   27  117    4   78   52   26   6
        24       590   38.7   31.0
C0:    8624     5100     3190     2155     1380      965      665      595
C0;     365      205      145       80       65       50       25       20
c0:      16       15       10        3        1        1        1        1
c0;       0        0        0        0        0        0        0        0
```

6.2.8 Model 11-C version 12.40 measuring mode channel masses in µg/m³

```
M
Mn:    35.7     34.1     32.9     32.2     31.7     31.3     31.2     31.1
Mn;    31.0     31.0     30.9     30.9     30.9     30.8     30.6     30.4
mn:    29.9     28.6     28.3     27.7     27.3     27.3     27.3     25.0
mn;    25.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
V:    0.0002 m3
```

6.3 GRIMM Windows Software 1178 (including installation instructions)

The fully revised 1178 software was introduced in 2010 and is compatible with the 32 and 64-bit operating systems starting with Windows XP. For more detailed information, consult or request the GRIMM Windows Software 1178 manual.

Data are shown numerically or graphically in the following formats:

Number distribution: Particle number concentration in all channels as particles/litre

Environmental protection: Three mass fractions (PM10, PM2.5 and PM1) in the unit µg/m³. The values are calculated with a uniform density factor for all size channels and specific weight factors (not public) based on the measured number distribution, incorporating relevant standards. The results were not validated for the 11-C in open-air tests according to official PM equivalence tests, e.g. US EPA or EN 12341 for PM10.

External sensors: Depending on type, for example temperature, relative humidity, flow rate.

Service data: Pump flow, battery charge level, operating errors etc.

Statistics: Various statistical performance figures for the measurements as well as presentation of mean values and box plots for PM values.

The GRIMM Windows Software 1178 supports online statistical data analysis, the analysis of the device functions and a complete system diagnosis.

Installation of the 1178 software:

The software is provided to you with the order on the supplied USB stick. The installation instructions refer to installation from the USB stick.

1. First install the runtime and Visa from the folder “Schritt_1_Runtime_+_VISA”
2. Open “Schritt_2_Spektrometer-Software” and copy the folder “1178_VX-X” to your hard drive **For example** C:\Program Files\GRIMM
3. Copy the license file from the folder “Schritt_3_Lizenzdatei-für-Software” to the folder “1178_Vx-x” on your hard drive

   For demo measurements – **user code**: **“Demo”**

Alternatively you can download the installation instructions for the Labview software from the homepage of GRIMM Aerosol Technik GmbH & Co. KG. Under www.grimm-aerososl.com, go to the pull-down “Products” → and select “Software”.

Screenshots of the software

Figure 6-6: Home screen of the 1178 software

This is a view of the home screen after the software has recognised the connected spectrometer.

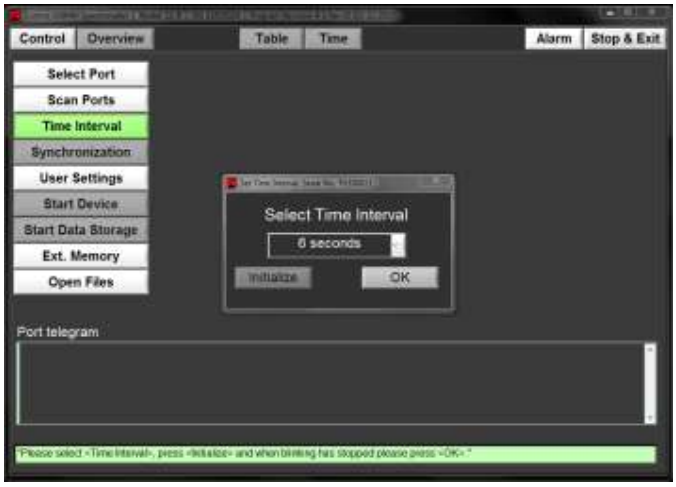


Figure 6-7: Setting the measuring interval

Window to select the measuring interval

The device has a highly precise internal clock. Synchronisation is only required about every three months or after changing time zones.

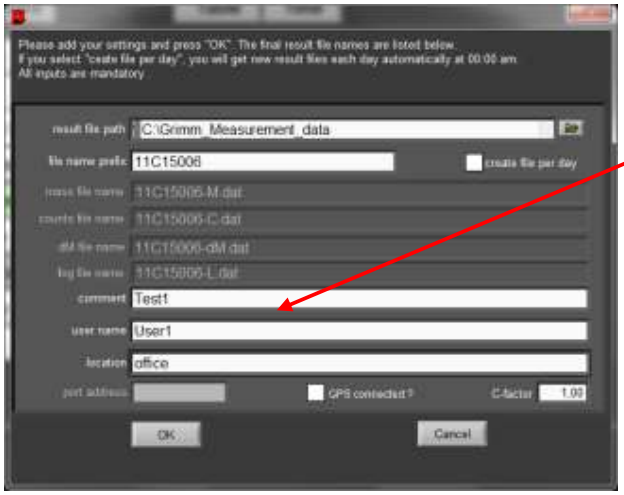


Figure 6-9*: Selecting the file name and storage location*

You can enter the following for easier use of the data:

- A comment
- The user
- Information

about the measuring location These data are included in the header when exporting to MS Excel.

Figure 6-10: Overview of the values for an ongoing

Overview of the determined values:

The window to the left displays the mass values in addition to the count values in selected ranges.

The window on the right displays the count values across all channels.

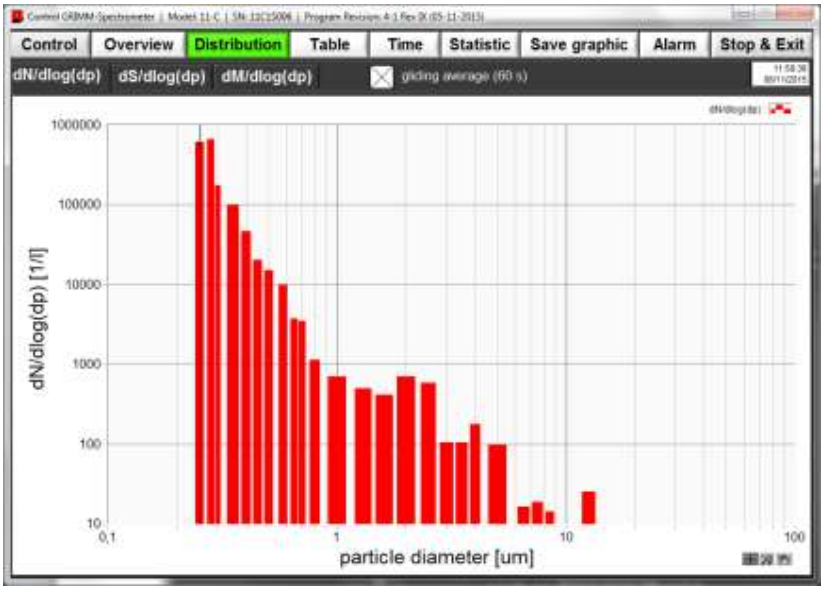


Figure 6-11: Particle count distribution

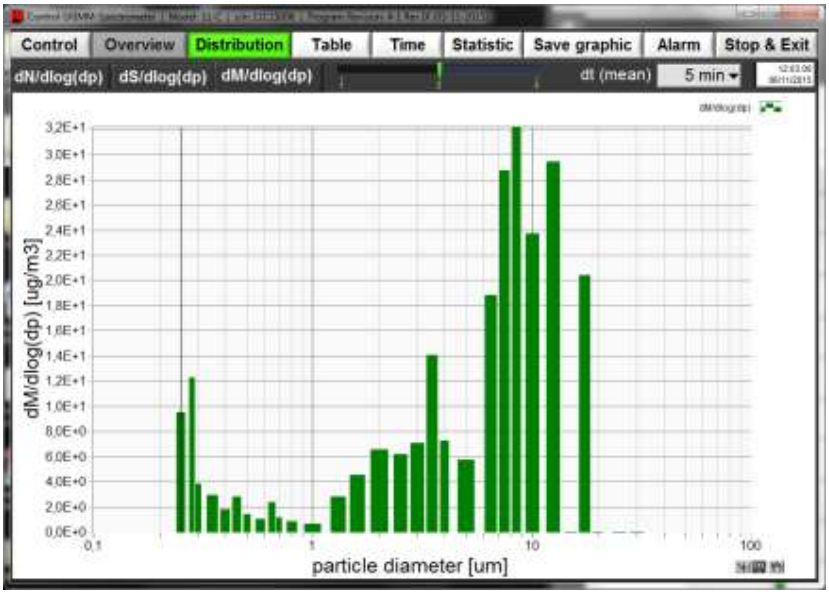


Figure 6-12: Particle mass distribution

Further analyses of the counts, for example regarding the particle diameters, number of particles in table form and other characteristics, are possible with the GRIMM Windows Software 1178. Further information is found in the manual for the GRIMM Windows Software 1178.

6.4 Troubleshooting (display messages and status indicators)

Error messages on the display	Meanings
FATAL ERROR PLEASE CHECK	Possible causes for this message are: Contamination in the measuring cell A laser failure or other hardware defect Information on the cause of the error is output through HyperTerminal after the self-test fails 5 times Clean the measuring chamber as described in Section 6.1.2.
CHECK NOZZLE	Check sample collection intake Clean the measuring chamber as described in Section 6.1.2.
NO OPERATION	Battery charge level = 0% Charge the battery by connecting the power supply
PLEASE RECHARGE	Battery charge level < 10% Charge the battery by connecting the power supply
PUMP CURRENT TOO HIGH	Motor current Imot > 100% Check the sample intake and sample discharge for contamination and plugging. Please contact our Service department
FLOW-ERROR	Volume flow control outside the control range, for instance in case of overpressure on the device intake Please contact our Service department
CHECK FILTER	Imot < 20% Please replace the PTFE or BQ filter and insert it correctly in the filter chamber; the same applies to the specimen holder
CHECK FILTER	Imot > 60% Please replace the PTFE or BQ filter and insert it correctly in the filter chamber; the same applies to the specimen holder

Additional function of the LED 2 charge level indicator:

LED 2 lights up yellow when the charger is connected	The battery cannot be charged through the device. Contact service but do not open the device.

7 Maintenance and cleaning

7.1 Maintenance and cleaning by the customer

Some maintenance on the 11-C can be carried out by the customer. This maintenance work is described in this section. Other maintenance work, such as internal filter replacement, must be carried out by authorised service technicians. If you are not sure or need the support of a service technician, please contact the dealer nearest you or the contact person at GRIMM Aerosol Technik GmbH & Co. KG.

Completing the following points at least once a year is recommended!

7.1.1 Cleaning the measuring chamber

The filter chamber has to be cleaned with a lint-free cloth or soft brush each time the filter is replaced. Tough dirt can also be removed with special cleaning cloths for IT equipment.

Figure 7-1: Cleaning the filter chamber

7.1.2 Impactor chamber

The impactor chamber has to be cleaned with a cotton swab or lint-free cloth each time the specimen holderis replaced. Tough dirt can also be removed with special cleaning cloths for IT equipment.

7.1.3 Changing the specimen holder

Turn the device off. Loosen the screw in the impactor chamber cover. The screw has a mechanism to prevent it from falling out. Carefully open the impactor chamber cover. Now remove the used specimen holder. Make sure that the dust collected on the specimen holder does not get into the instrument, since this would get the measuring cell dirty.

Figure 7-2: Opening the impactor chamber

Cleaning the impactor chamber

Conventional paper towel or a soft brush are best for cleaning the impactor chamber.

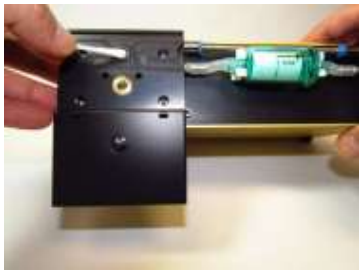


Figure 7-3: Cleaning the impactor chamber with a brush

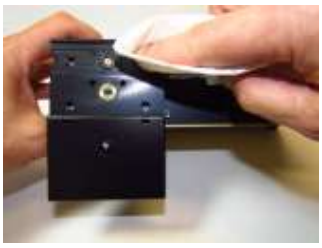


Figure 7-4: Cleaning the impactor chamber with paper towel

Now insert a new specimen holder in the impactor chamber. The specimen holder should touch the small O-ring. Now close the cover so that the specimen holder does not shift, and turn the screw to a perceptible stop (not too tight).

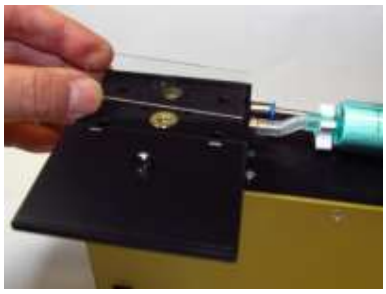


Figure 7-5: Inserting the specimen holder

7.1.4 Cleaning the measuring chamber

Turn off the device to clean the measuring chamber. Open the filter chamber and take out the gravimeter filter. Use clean, oil-free compressed air to blow out the air intake on the front of the device with a maximum pressure of 3 bar, always in the airflow direction. Since the aerosol channel goes straight through the measuring chamber, you must be able to look through it.

If the intake nozzle is plugged, clean it from the filter chamber side with a wood or plastic rod (do not use harder materials or the nozzle may be damaged!).

Figure 7-6: Cleaning the measuring chamber

Do not pull anything (such as cloths etc.) through the intake nozzle, nor disassemble it!

7.1.5 Housing

The dust monitor is enclosed by a housing that protects it against mechanical impacts and electromagnetic fields. The membrane keyboard and display must be protected against severe mechanical impacts. A dry cloth should be used to clean the housing, or moist cleaning cloths for IT equipment in case of tough dirt.

Protect the device against contact with liquids!

7.1.6 Replacing the PTFE filter

Filter replacement

Turn the device off and disconnect the power supply. Loosen the bayonet closure on the filter chamber cover. This closure has a mechanism to prevent it from falling out. Carefully open the filter chamber cover. Now remove the used filter with suitable tweezers. Make sure that the dust collected on the filter does not get into the instrument, since this would get the measuring cell dirty. If needed, turn the device with the opened filter chamber cover so the bottom faces down and remove the PTFE filter.

Figure 7-7: Filter removal

Conventional paper towel or a soft brush are best for cleaning the filter chamber.

Figure 7-8: Cleaning the filter chamber

Now use the tweezers to centre a new filter on the large O-ring in the filter chamber. Do not let the filter touch the small O-ring. Note Section 4.5 for gravimetric analysis. Now close the cover so that the filter does not shift, and turn the bayonet closure to a perceptible stop.

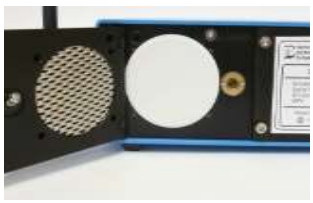


Figure 7-9: Inserting a new filter

The maximum runtime on battery and the service life of the p . contamination increases. Make sure to replace the filter in a timely manner for this reason, no later than when the corresponding warning is displayed. A filter load over 20 mg should be avoided if possible.

7.1.7 Replacement of consumables

The impactor chamber has to be cleaned every time the specimen holder is changed. In order to do so, set the 11-C upright with the rear facing you. Open the impactor chamber and carefully take out the specimen holder.

7.2 General service by GRIMM Aerosol Technik GmbH & Co. KG

GRIMM Aerosol Technik GmbH & Co. KG maintains a service department at its production site. For all questions about the device, first contact the dealer nearest you. Some dealers have their own local service technician.

In case of a serious error, the service technician will contact the service department.

The dealer nearest you and its service technician, where applicable, are available to you for regular calibration combined with an inspection of the device. Some regional dealers maintain their own calibration laboratory at their site. If this is not the case for your dealer, please contact us for an offer and to coordinate the process:

GRIMM Aerosol Technik GmbH & Co. KG.
Dorfstraße 9
83404 Ainring
Germany
Website: www.grimm-aerosol.com
E-mail: info@grimm-aerosol.com
Tel.: +49 8654-578-0
Fax: +49 8654-578-35

Internal purge air filter

To protect the laser optics against dirt and for the device self-test, an integrated fine particle filter produces particle-free air. Its service life is several years, even with continuous operation. Should the message

“CHECK NOZZLE

AND AIR INLET”

appear several times even though the sample intake is clear and there is no unallowable overpressure on the sample intake, this indicates a problem with the purge air supply. The problem can usually be corrected by replacing the filter, but this has to be carried out by trained service personnel. Please contact the nearest customer service department in this case or ask your dealer.

7.3 K-line, function test of the optical measuring cell, laser diode and photo diode

The condition of the optical measuring cell and the function of the optics, photo diode in the optical measuring cell and laser diode are determined during the self-test. These values appear in what is called the K-line in case of data output using HyperTerminal. The individual values in the K-line are explained in the following.

	DC/V	DC_D	DC_H	C0_H	C0_D	LA_I	LA_H
K	**665**	1292	1654	0	0	59	105

The value DC/v shows the DC voltage of the pre-amplifier without bias voltage (offset value). This serves as a reference value and has no meaning for the customer.

	DC/V	**DC_D**	**DC_H**	C0_H	C0_D	LA_I	LA_H
K	665	**1292**	**1654**	0	0	59	105

The photo diode generates an open-circuit voltage when the laser diode is off. This open-circuit voltage is called DC_d where d stands for “dark”. A value of 1292 in the K-line for example corresponds to a voltage of 129.2 mV.

When the laser is turned on, the voltage of the photo diode in the example shown above increases to 165.4 mV. The h in DC_h stands for “high”. The increase in the DC voltage results from the residual light of the laser, e.g. due to reflection in the measuring cell. Most of the laser light is normally absorbed by the light trap.

The DC_d and DC_h values are variable, for example depending on the temperature. However, the difference between DC_h and DC_d should always remain nearly constant. Approximately 36 mV in the example above (165.4 mV – 129.2 mV). Therefore the difference is a good indicator for the condition of the measuring cell.

If the difference between DC_d and DC_h changes a lot, the optics have to be cleaned or repaired by a service technician. The nominal difference between DC_d and DC_h can be obtained for each device from the most recent service record, or for new equipment from the acceptance record.

If the state of the measuring cell changes, e.g. because of dirt, this difference increases rapidly. For example, lint caught in the aerosol intake nozzle and projecting into the laser beam can cause the DC_h value to increase to more than 65000. In this case it is even possible that 0 is displayed for DC_h. A difference near zero, e.g. 2.3 mV is typical for a defective laser diode. A defective laser diode only emits weak light similar to a red LED.

	DC/V	DC_D	DC_H	**C0_H**	**C0_D**	LA_I	LA_H
K	665	1292	1654	**0**	**0**	59	105

The values C0_h and C0_d always have to be 0.

C0_h stands for counts without particles or zero counts with the laser turned on, and h therefore means “high”. Particle-free purge air flows through the measuring cell during the self-test. Therefore no particles can get into the measuring cell and the value has to be 0. A value not equal to zero indicates unwanted particles in the measuring cell, e.g. due to a leak in the sample air path.

C0_d is determined with the laser turned off and d therefore stands for “dark”. If a value not equal to zero is listed under C0_d, this indicates a problem with the signal amplifier. Since no scattered light can be produced without laser light, this has to be caused by electronic interference.

	DC/V	DC_D	DC_H	C0_H	C0_D	LA_I	LA_H
K	665	1292	1654	0	0	59	105

The laser diode in a GRIMM aerosol spectrometer is operated with two alternating laser outputs in what is known as multiplex mode. La_l “low” means low laser current in mA and La_h “high” means high laser current. If the La_h current increases to values greater than 180 mA, the laser diode is probably defective.

All devices include a quality assurance acceptance record containing the K-line values from factory calibration by the manufacturer for comparative purposes.

7.4 Repairs

Knowing that defective or inactive devices are costly for the customer, the GRIMM policy is to resolve customer problems as quickly as possible. When a device stops working, please contact the nearest GRIMM sales office or dealer as soon as possible.

Please contact the GRIMM service department by e-mail before you send one of our devices back for service:

service@grimm-aerosol.com

Kindly provide the following information:

- Device model number
- Serial number and year of manufacture (on the type plate, underside of the device)
- Order date and your order number (except for warranty cases)
- Your billing address
- Your shipping address

Prior to shipment, make sure each device is free of any contamination that could be hazardous to health.

8 Technical specification

8.1 Pneumatics

The illustration shows the pneumatics of the 11-X series. The sample volume flow of 1.2 litres per minute is controlled and so is the internal purge air circuit. Filters optimised for low pressure loss are used so that power can be supplied by the battery as long as possible.

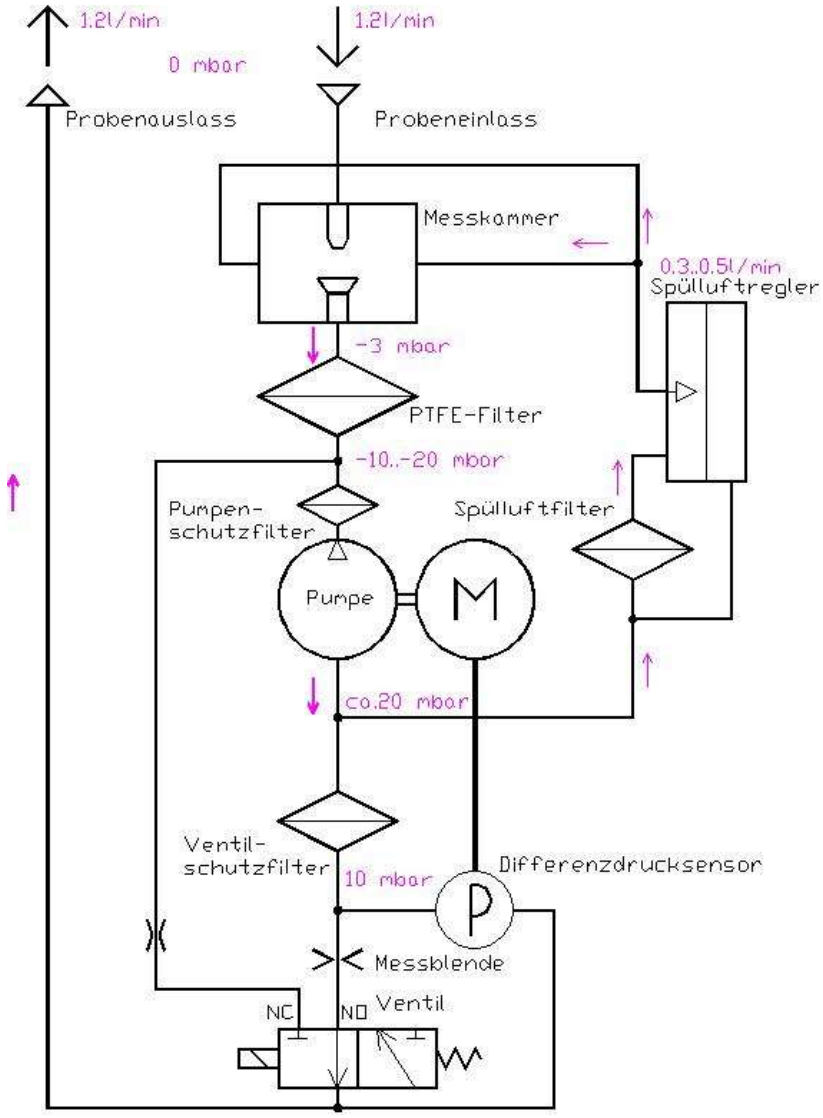


Figure 8-1: Pneumatics schema of the 11-C

A purge air circuit to protect the optical components passes through the measuring chamber in measuring mode. The measuring chamber can also be fully purged with particle-free air. This happens during the self-test to check the optics assemblies and after measuring to minimise contamination.

8.2 Technical data

8.2.1 Nominal rating of the 11-C model series

Electricity supply:	-Battery: 11.1VDC/4.4Ah, fully charged for 4-8 hours of continuous operation, depending on the operating conditions -18VDC power supply (U_{out}): 1112C, 100-240VAC (U_{in}) , 47-63Hz, 2.5 A (output)
Maximum current 11-C:	Battery discharged: 1.2 A Battery fully charged: 0.45 A
Fields of application:	For outdoor environmental measurements
Maximum elevation:	1000 m. 2000 m with individual readjustment of the volume flow adjustable per terminal program with the help of a volume measuring device such as Dry cal or Gillibrator
Temperature range (in operation):	+4 to +40 °C, relative humidity < 95 % (non-condensing)
Temperature range (storage and transportation):	-20 to +50 °C, relative humidity < 90% (non-condensing)
Maximum relative humidity (in operation):	Relative humidity < 95% (non-condensing)
Maximum relative humidity (storage and transportation):	Relative humidity < 90% (non-condensing)
Temperature of the sample air:	+4 to +40 °C, relative humidity < 95%, no corrosive or explosive gases
Pressure range of the sample air:	At normal pressure the volume flow is set to 1.2 litres per minute. For sites more than 1000m above sea level, the volume flow should be readjusted; 0 to -50 hPa (short term). At overpressure (max. +100 hPa) and for extended measurements with higher underpressure (max. -100 hPa), the sample air return has to be used.
Sample air discharge/sample air return	Present, discharge on the left side of the device

8.2.2 Technical data for the 11-C model series

Laser:	Wavelength: λ = 660 nm Output: P_{max} = 40mW P_{nom} = 0, 5/32mW CW (multiplex);
Size channels:	The specified channel thresholds [µm] apply for a counting efficiency of 50% with mono-dispersive latex aerosol 32 channels of the optical aerosol spectrometer, lower channel limits: 0.22/ 0.25/ 0.28/ 0.3/ 0.35/ 0.4/ 0.45/ 0.5/ 0.58/ 0.65/ 0.7/ 0.8/ 1.0/ 1.3/ 1.6/ 2/ 2.5/ 3/ 3.5/ 4/ 5/ 6.5/ 7.5/ 8.5/ 10/ 12.5/ 15/ 17.5/ 20/ 25/ 30/ 32 [µm]
Particle concentration:	1 to 2,000,000 particles per litre
Particle mass:	0.1 to 100,000 µg/m³
Reproducibility:	±3% across the entire measuring range
Sample volume flow:	1.2 l/min, ±5% constantly controlled
Purge air volume flow:	0.3 l/min, constantly controlled Automatic follow-up cleaning in standby mode
Sample collector:	47 mm PTFE round filter (no supporting material) GRIMM order no.: 1113A or 76 x 26 x 1 mm glass specimen holder
Operation:	With membrane keyboard or via PC with interfaces (RS-232, USB, Ethernet, Bluetooth) using Windows software or HyperTerminal program and control commands
Display:	2 x 16 alphanumeric characters, light-emitting (OLED)
Self-test:	Automatically on start-up
Measuring time intervals:	Configurable: 6 sec, 1 min, 5 min, 10 min, 15 min, 30 min, 60 min via membrane keyboard, through Windows software or HyperTerminal
Storage interval:	Configurable: 6 sec, 1 min, 5 min, 10 min, 15 min, 30 min, 60 min via membrane keyboard, through Windows software or HyperTerminal
Communication:	Via PC and RS-232 interface, also USB, Bluetooth or Ethernet
Display data output:	Dust measurements or particle concentration as rolling average for one minute or mean values with corresponding sample volumes. Alarm values, battery charge level, gravimetric factor, measuring location number, date and time, measurements of the optional accessories (sensors)
Data output:	Via PC and interfaces (RS-232, USB, Ethernet, Bluetooth)

Analogue inputs:	3 x (0-10V), resolution 10-bit (approx. 10 mV). Display with calibration factors that can be changed and editable texts
Data interface:	ASCII: RS-232 (9600 baud, 8-bit, no parity, 1 stop bit, software protocol: Xon/Xoff)
Data storage SD card:	4 GB, for storing measurements and the following data: Date, time, measuring location number, gravimetry factor, error code, battery charge level, motor current, GPS data, relative humidity and temperature of the sample air as well as the analogue values of the external sensors (1 through 3)
USB stick data storage:	4 GB
Dimensions LxWxH:	32 x 18 x 7 [cm]
Weight:	1.7 kg + 0.7kg Li-Ion battery
Memory functions:	The measuring mode last selected in standby mode is saved in the device In case of power loss during a measurement, all mean values with the corresponding sample volumes are saved so that the measurement is automatically continued when power is restored.

8.3 Accessories

Required and recommended accessories

	Product no.	Description
1	**1141A**	Special GRIMM RS-232 on USB data transfer cable (with larger buffer)
2	**1112C**	Power supply/charger 220/110 V
3	**1113A**	PTFE filters (25)
4	**1111**	Radially symmetrical sample collection head
5	**1119**	Straight connection tube, length 3 cm
6	**1142.SD4GB**	SD memory card 4 GB
7	**1148**	Mini-filter for zero test
8	**1178**	32/64-bit LabView software for aerosol spectrometer
9	**1110L-E**	Li-Ion battery
-	**1118A**	Printed user manual

Figure 8-2: Required and recommended accessories for the 11-C

Additional accessories depending on the application

1117A	Small replacement part set containing: Two O-rings 41x2 NBR, two O-rings 4x2 N70, 20cm PVC hose, mini filter for zero test, 1 straight connection tube length 3cm and PTFE filters (25)
1151A	Clean room sample collection heads 0.5; 1; 2 and 4 m/s with stand
1152	Isokinetic duct probe with 4 intake nozzles for wind speeds of 2-25 m/s
1158-EE	Temperature and relative humidity sensor
1154	Temperature, humidity and air speed sensor

Sources of supply

Accessories and consumables are available from

GRIMM Aerosol Technik GmbH & Co. KG

Dorfstraße 9

83404 Ainring

Tel.: +49 (0) 8654-578-0

8.4 Sample collector

To minimise the measuring error during sample collection, make sure the difference between the speed of the aerosol being measured and the speed of the aerosol at the intake of the measurement device is as close to zero as possible. This sample collection for particle measurement is called **isokinetic** partial flow sampling.

Since the dust and particle measuring devices are equipped with volume flow control (1.2 l/min or 72 l/h), the suction speed can be determined exactly by the geometry of the sample collector.

A suitable sample collector should therefore be used according to the application. GRIMM offers the following models:

8.4.1 Radially symmetrical sample collection head (model 1111)

APPLICATION: Indoor measurements (IAQ) and outdoor air measurements up to air movement of approx. 2.5 m/s from various directions. The radially symmetrical sample collection head complies with Directive EN 481 for workplace measurements and guarantees a suction speed of 1.25 m/s at the opening.

Figure 8-3: Sample collection head

Removing the sample collection head from the sample intake

To remove the sample collection head, push on the blue sealing lip using a finger or small tool and pull the sample collection head out of the sample intake.

Figure 8-5: Removing the sample collection head from the sample intake

8.4.2 Clean room sample collection heads with stand (model 1151A)

APPLICATION: For measurements in the flow range up to 4 m/s where the air is flowing at a relatively constant speed and in a defined direction, for example downstream from filter systems or in laminar flow boxes.

Representative sample collection for particle measurements requires isokinetic partial flow sampling. This state is only given when the main and partial stream have the same speed. The sample collector has four different nozzles suitable for speeds of 0.5, 1, 2 and 4 m/s. Select the suitable nozzle after measuring the air speed at the measuring point. The sample collection opening always has to face frontally into the airflow. Either insert the sample collector directly into the sample intake on the measurement device, or mount it on the stand in a corresponding location. In the latter case, the sample collector is connected to the measurement device with a hose that is as short as possible to keep particle losses due to sedimentation to a minimum.

The following intake nozzles are available according to the air discharge speed:

-Red nozzle:	up to 0.5 m/s
-Gold nozzle:	0.5 to 1.0 m/s
-Green nozzle:	1.0 to 2.0 m/s
-Blue nozzle:	2.0 to 4.0 m/s

Separate installation instructions are provided for this application.

8.4.3 Isokinetic duct probe for 2 to 25 m/s (model 1152)

APPLICATION: Sample collection for particle measurements from air shafts or ventilation ducts, before or after filters, in supply and exhaust air systems.

This duct probe was developed especially for dust measurements in ventilation ducts. It can also be used with over or underpressure up to **100 mbar** thanks to the sample air return. The duct must be equipped with an assembly opening that is **35 mm in diameter**. With the scale on the sample collector tube, measurements according to Association of German Engineers (VDI) 2066 can be taken quickly and easily. If measurements are not taken at normal pressure, the sample volume may have to be converted to standard cubic metres. Then the measurements have to be corrected accordingly.

The probe consists of the following components:

(2) Four incoming flow nozzles for the speed ranges 2-4, 4-8, 8-16 and 16-25 m/s. The nozzle with the smallest opening is used for the highest speed.

(3) 90° probe elbow

(4) Opening for sample air return discharge

(7) Duct holder

(8) Probe extension 250 mm

(9) Connecting piece for connection to the measurement device and air return 0.5 m hose 3*6 mm

(10) Banjo fitting to connect the air return; wrench 8/10 for nozzle replacement and attaching the banjo fitting on the left side of the device.

(1) Ventilation duct

(5) Sample air to measurement device

(6) Exhaust air return

Figure 8-4: Duct probe

Figure 8-5: Duct probe components

The numbering refers to the sketch on the next page "Functional principle of the isokinetic duct probe"

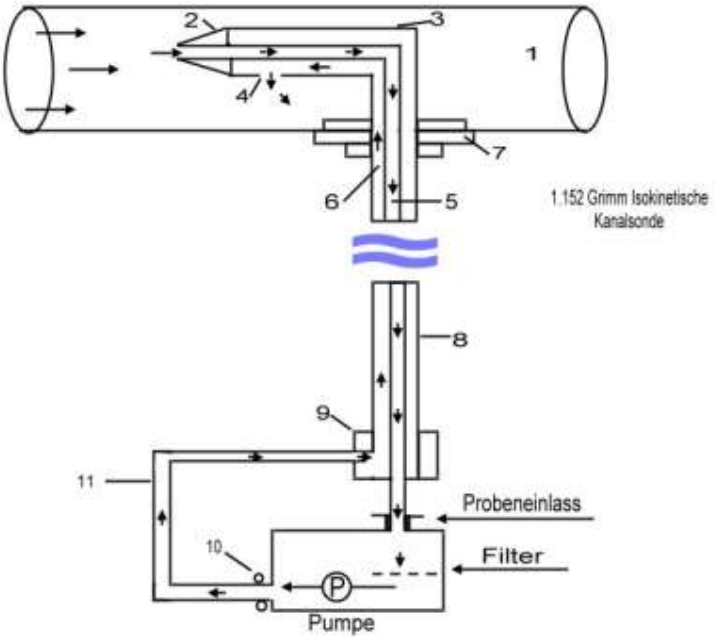


Figure 8-6: Functional principle of the isokinetic duct probe

8.4.4 Installation of the duct probe 1152

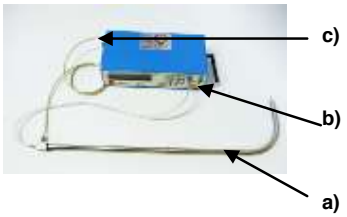


Figure 8-7: Installation of the duct probe

Installation of the duct probe

The duct probe for the measurement device is supplied with separate installation instructions.

To establish the connection, insert the isokinetic duct probe **a)** into the sample intake on the 11-C or use the transparent silicone tube **b)** as a flexible extension with a 4 mm connection tube to the sample intake.

The grey PVC hose **c)** conducts the sample air back and is connected to the sample discharge on the 11-C without tools.

Figure 8-8: Connecting the sample air return

Note: To avoid particle losses due to sedimentation in the silicone tube as far as possible, the distance between the duct probe and the sample intake on the dust monitor should be as short and straight as possible or vertical. Ideally the duct probe would be connected directly to the dust monitor!

8.5 Mini-filter for zero test (model 1148)

This filter is used to test the dust monitor for interference in the signal electronics and leaks in the suction system. When the filter is connected to the air intake on the dust monitor, the concentration measurements on the display have to go to zero after a minute due to averaging or immediately in case of online measurement. The increase in the pump motor current up to 60%, which may be accompanied by a warning, is normal here.

Figure 8-9: Mini-filter for zero test 1148

8.6 Sensor for temperature and humidity (model 1158-EE)

This sensor due to its low power input is ideal as an accessory for all dust monitors. The sensor values can be shown online on the display, via HyperTerminal or in the sensor window of the GRIMM Windows Software 1178. Knowledge of the relative humidity is fundamental for the interpretation and analysis of aerosol measurement data.

- A climate sensor or at least a sensor simulator (X11HSIM0%) is required to operate the 11-C.

Technical data:

Dimensions:	∅ = 12 mm, length = 83 mm, cable: approx. 1.5m
Connection:	6-pin
Electricity supply:	10V ±5%, < 5 mA
Temperature range:	-40 to + 60 °C
Resolution:	0.1 K
Accuracy:	Typically 0.2 K
Humidity range:	0 to 100% relative humidity
Resolution:	0.1%
Accuracy:	Typically 2%
Temperature dependency:	Typically 0.03% relative humidity/K

Figure 8-10: Sensor 1158-EE

8.7 Temperature, humidity and air speed sensor (model 1154)

This sensor also has an integrated anemometer for air speed. The compact design of the sensor was optimised for use in combination with the isokinetic duct probe and the direct determination of the air speed in air ducts. Another application is monitoring the air speed in a preferred direction during a particle measurement, e.g. for source studies or ventilation testing.

Technical data:

Dimensions:	∅ = 15 mm, length = 130 mm, cable: approx. 3m
Connection:	6-pin
Electricity supply:	10V ±5%, < 5 mA
Temperature range:	0.3 to +80 °C
Resolution:	0.1 K
Accuracy:	Typically 0.3 K
Humidity range:	0 to 100% relative humidity
Resolution:	0.1%
Accuracy:	Typically 3.5%
Wind speed:	0.4 to 20 m/s
Resolution:	0.1 m/s
Accuracy:	Typically ±1% of the final value/±1.5% of the measurement

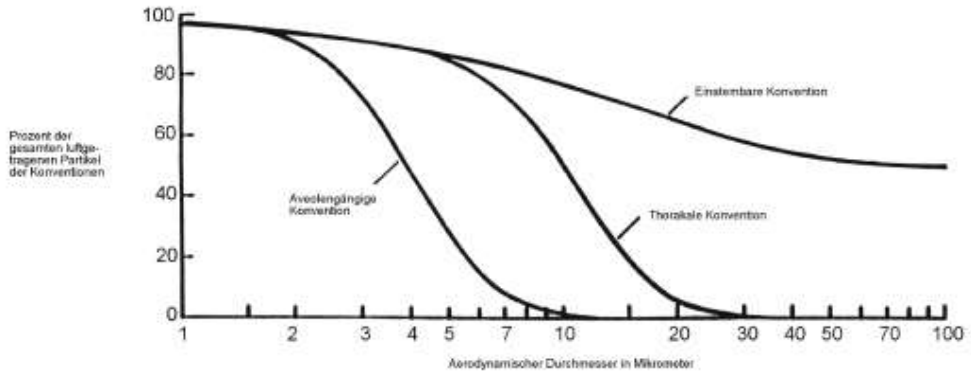
Figure 8-11: Sensor 1154

9 Appendix

Table 2: Numeric values of the conventions for total airborne particles

Aerodynamic diameter in µm	Inhalable (%)	Thoracic (%)	Respirable (%)	PM-10 (%)	PM-2.5 (%)
0.0	100	100	100	100	100
1.0	97.1	97.1	97.1	100	99.5
2.0	94.3	94.3	91.4	94.2	85.5
2.5					48.0
3.0	91.7	91.7	73.9	92.2	6.7
4.0	89.3	89.0	50.0	89.3	0
5.0	87.0	85.4	30.0	85.7	-
6.0	84.9	80.5	16.8	81.2	-
7.0	82.9	74.2	9.0	75.9	-
8.0	80.9	66.6	4.8	69.7	-
9.0	79.1	58.3	2.5	62.8	-
10.0	77.4	50.0	1.3	55.1	-
11.0	75.8	42.1	0.7	46.5	-
12.0	74.3	34.9	0.4	37.1	-
13.0	72.9	28.6	0.2	26.9	-
14.0	71.6	23.6	0.2	15.9	-
15.0	70.3	18.7	0.1	4.1	-
16.0	69.1	15.0	0	0	-
18.0	67.0	9.5	-	-	-
20.0	65.1	5.9	-	-	-
25.0	61.2	1.8	-	-	-
30.0	58.3	0.6	-	-	-
35.0	56.1	0.1	-	-	-
40.0	54.5	0.1	-	-	-
50.0	52.4	0	-	-	-
60.0	51.4	-	-	-	-
80.0	50.4	-	-	-	-
100.0	50.1				

Graphical presentation



Illustration, appendix: Size distribution of dust particles according to EN 481 Dust in the Workplace

10 Frequently asked questions – FAQ

Frequently asked questions known at the time of printing are answered below, with no claim of completeness. To view the current FAQ, visit the GRIMM Aerosol Technik GmbH & Co. KG website at www.grimm-aerosol.com.

What is IAQ?

IAQ is the abbreviation for **i**ndoor **a**ir **q**uality. It applies to all aspects of substances in room air as well as its toxicological, physical and physiological characteristics.

What particles are relevant for IAQ?

Number and size distribution

Indoor air quality refers to the quantity and quality of particles in the air, indoors and in public places such as classrooms, libraries or restaurants. These data are relevant for human health and wellbeing in everyday life. There are three important values for the quantity of aerosols: The number, size and mass of the particles in the air. Additional aspects are relevant for quality: volatile, semi-volatile, liquid and solid particles, and their toxicological effects.

How does the measurement work?

The sample air is suctioned directly into the measuring cell with negative pressure through the sample collection path or other sample collection systems. The particles in the sample air pass through a laser beam that is captured by a light trap. The laser light reflected by each individual particle is counted as a pulse and the intensity of its signal is classified as a certain particle size.

Why do I need a GRIMM model 11-C spectrometer when I already have a nephelometer?

While optical systems have been used for many years already, most of them are just nephelometers. These systems are low-priced but unable to measure the aerosol distribution in order to calculate the derived particle mass accurately. Only multi-channel spectrometers have the ability to calculate the dust mass concentration.

Can I validate the calculated MASS?

Gravimetric filter systems worldwide serve as reference devices. That is why GRIMM introduced a filter chamber where a filter collects the dust in the aerosol spectrometer. The collected sample can be weighted and a relationship between the calculated mass and weighed sample can be derived. This is achieved with the help of the C-factor as the aerosol mass correction factor.

Was this method OFFICIALLY approved?

This method was first tested in Europe and therefore closely follows the European EN 481 standard. In addition to the standard filter for gravimetric sample collection, these portable measurement devices also feature real-time measurement that is output as:

a) Sizes and distribution of results in 32 different classes, or
b) Mass distribution in 32 different classes, or
c) Three IAQ values simultaneously in one device

Is this device actually portable?

All GRIMM IAQ monitors can operate for up to 8 hours on a RECHARGEABLE BATTERY. They can also be operated on ALTERNATE CURRENT from 100 VAC to 230 VAC with a connected power supply unit. All measured data are shown on the display, stored on the memory card or USB storage medium, and output to a computer and monitoring software over a data cable.

How can the device state be monitored?

All GRIMM spectrometers go through a self-test before the measurement starts. During the self-test, all components such as the laser, pump and so on are checked and the results are output to the memory card or USB storage medium in the P or K-line. Furthermore, important service values are monitored continuously and an alarm is output in case of deviations.

How much maintenance do GRIMM devices require when the dust monitors are used in the field?

Very little maintenance! All spectrometers are optical instruments and do not require special service. However, an annual inspection of the instrument by GRIMM Aerosol Technik is recommended. This way you can be certain that your spectrometer is always operational.

How does GRIMM collect and transmit all monitored DATA?

All devices have a memory card that can store the measurement data over a very long period, depending on the measuring interval. They also have various interfaces for data output via USB, LAN, Bluetooth or the classic RS232 interface. This means the measurement results cannot only be stored for a limited time in the dust monitor but also output to central data collection systems over the existing interfaces.

How does the SOFTWARE display the measured data?

All GRIMM spectrometers have at least an RS-232 interface for data transfer to any PC in real time. Other interfaces are optional. With the powerful and user-friendly LABVIEW software, the transmitted DATA from multiple devices can be displayed simultaneously in real time.

Can ATMOSPHERICE values be determined in addition to the IAQ values?

All GRIMM IAQ monitors can record data from up to three optional sensors, for instance the wind speed, relative humidity and temperature. These data are also transmitted.

What is a P-line?

The P-line is an important characteristic curve marked with a “P” and contains information about the device measurements during the measuring process. The P-line is output according to the chosen interval but at least once a minute, for shorter intervals every minute. This line is described in detail in your manual.

What is a K-line?

The K-line is another important characteristic curve. It is displayed after every self-test and each time a measuring cycle starts. The K-line contains information about the status of the laser diode and the measuring cell. Some information, found in Section 6.4, indicates the status of the laser diode that has a significant influence on device performance.

What is the flow rate tolerance?

The flow rate at the sample intake has a tolerance of ± 5%.

How can the flow rate at the sample intake be checked?

To check the flow rate, install a flow meter at the sample intake and test it. Separate, illustrated instructions can be obtained from the Sales department at GRIMM Aerosol Technik GmbH & Co. KG.

How can the flow rate be adjusted?

The flow rate (for example at high altitudes) is regulated with the help of a differential pressure sensor. A restriction that needs to be emphasised is that the spectrometer may also be outside the tolerance if the measurement device is used at a low or high ambient pressure.

In principle the flow rate can be changed as follows:

- Measure the flow rate at the sample intake on your spectrometer with a flow meter.
- Connect your spectrometer to a computer with an existing HyperTerminal connection and set service mode 0 or 1 on the spectrometer:
- Send the command **{Ctrl} + {F}** to change the flow rate in HyperTerminal. Send **{+}** (increase the flow rate) or **{-}** (decrease the flow rate). Confirm the input with **{Enter}**.

The flow rate is correct when it is set to 1.2 L/min.

How can the status of the sample pump be determined?

The status of the sample pump can be monitored with the “Im” value in the P-line. The “Im” value is given in “Percent of actual power input of the pump”. Typically the value is in the range of 20 – 40%. A warning is shown on the display “Check dust filter & air passage” for values of 60% or higher but the pump continues working up to a value of 99.9%. If the “Im” value exceeds 99.9%, the error message “AIR PUMP CURRENT TOO HIGH” is displayed and the spectrometer is stopped immediately.

What can cause the pump current to be too high?

The most common reason for a high “Im” value is a plugged sample collection path. Cleaning the sample collection path as described in your manual should be carried out to solve the problem. Other possible reasons for a high “Im” value are a defective pump or plugged PTFE filter. A leak in the pneumatic circuit may also cause the pump current to be too high. Such a leak can be due to defective O-rings or porous hoses because of age or damage. If the high pump current cannot be reduced by cleaning the sample collection path and/or changing the PTFE filter, you should contact Service.

How can the sample intake and measuring cell be cleaned?

Turn the device over. Open the filter chamber and take out the gravimetric filter. First try to look through the sample collection path from the sample intake to the filter chamber. The aerosol duct in the optical chamber is straight and one can look through it.

Then clean the instrument with oil-free compressed air (max. 3 bar). This may only be performed in the flow direction; from the sample collection intake at the front of the device to the filter chamber.

Material plugging the aerosol nozzle in the optical chamber should be removed with a wood or plastic rod. To avoid damaging the nozzle, do not use hard materials!

How can information about the state of the laser diode be obtained?

The La_h value in the K-line gives you information about the state of the laser diode. La_h displays the laser current in mA when the laser works at high output. The laser diode has a monitoring diode in order to keep the optical laser output constant. As the laser diode ages, a higher current is required for the same optical output. Typical values for La_h are around 100 + /- 25 mA. La_h values higher than 180 indicate a defective laser diode. In this case the spectrometer has to be sent for service.

How can information about the state of the measuring cell be obtained?

The value DC_diff, which indicates the difference between DC_h and DC_d in the K-line, is a good indicator for the status of the measuring cell. Every spectrometer is supplied with a "QC protocol" that contains the DC_diff value for production. This value should remain constant. If the value changes, this indicates that the measuring cell is dirty and needs to be cleaned. See the question **"How can the sample intake and measuring cell be cleaned?"**.

What is the best measuring interval?

The measuring interval can be set between 6 seconds and 60 minutes. Use the GRIMM Windows Software 1178, HyperTerminal or the membrane keyboard to change the measuring interval. A good measuring interval can be determined from the ratio between the measurement duration and the expected number of datasets.

Example: Measurement duration 1 day

Measuring interval: 1 hour

Number of datasets = 24

Measurement duration 1 day

Measuring interval: 1 minute

Number of datasets = 60 x 24 = 1440

The larger the number of datasets, the higher the accuracy of your measurement data. With the degree of accuracy, the amount of storage space and time required for evaluation increase as well.

How can I deal with the error codes?

The error codes can help you diagnose problems with the spectrometer. Section 5.2.4 (RS-232 commands) and Section 5.4 (Troubleshooting) list the error codes.

"CHECK NOZZLE AND AIR INLET" (error code 32) is shown on the display. What has to be done?

To protect the laser optics and for the self-test, the device is purged with particle-free air produced by a fine filter. This fine filter has a service life of several years. If the message shown above is displayed, check whether the sample collection path is clear. If cleaning does not correct the problem, this is a clear indication of a fault in the internal purge air supply. A trained service technician should replace the filter. Contact your local dealer, the manufacturer or the Service department in this case. Service department contact information is found in the section "General service".

Example: You want to put your 11-C into operation. Even though the battery is installed and the mains cable is connected, the device does not start. What has to be done?

1. Check the LED 2 status on the battery display: What colour is the LED?

Green: The device is running on battery and the battery charge level is sufficient.

Red: The device is running on mains voltage and the battery is being charged.

Yellow: The device is running on mains voltage but the battery cannot be charged.

2. Check the sample collection path:

Open the filter chamber and take out the PTFE filter.

Open the sample intake.

Look through the sample collection path. If you see any contamination, the sample collection path has to be cleaned.

3. Clean the sample collection path:

Consult the section “Maintenance and cleaning” and clean the sample collection path as described there.

If you cannot eliminate the problem, contact Service as described in the section “General service”.

11 Index

BORREGO WATER DISTRICT

BOARD OF DIRECTORS MEETING – APRIL 17, 2018

AGENDA BILL 2.D

April 11, 2018

TO: Board of Directors, Borrego Water District

FROM: Geoff Poole, GM and Director Ehrlich

SUBJECT: Raftelis Spare Capacity Lease Analysis Proposal – L Brecht

RECOMMENDED ACTION:

Discuss and direct staff as deemed appropriate

ITEM EXPLANATION

As part of the discussions Long Term Cooperation Agreement with Rams Hill, a request has been made by T2 for BWD to consider allowing Rams Hill to use some of BWD's Spare Capacity in the distribution to transport water to their development. State law mandates BWD to offer space capacity (if available) and Staff is requesting a Board discussion on this topic. In addition, Staff would like to discuss the timing of requesting Raftelis to work on the calculation.

FISCAL IMPACT

TBD

ATTACHMENTS

None

BORREGO WATER DISTRICT

BOARD OF DIRECTORS MEETING – APRIL 17, 2018

AGENDA BILL 3. A, B, C

April 11, 2018

TO: Board of Directors, Borrego Water District

FROM: Geoff Poole, General Manager

SUBJECT: A. 2018-19 BWD Budget Review – K Pittman
B. Role of Borrego Water Coalition in GSP Development Process – Core Team
C. GSP Advisory Committee SDAC Ad Hoc Committee Update – Core Team

RECOMMENDED ACTION:

Discuss both issues with the Core Team

ITEM EXPLANATION

A. Kim has completed the development of the Draft Budget for 2018-19 and the O and I Committee reviewed on 4-11. The comments received have been included in the attachment. Staff is requesting full Board review of the document. ***BUDGET ATTACHED***
B. Some questions have been raised recently about the role of the Borrego Water Coalition in the GSP process. The Core Team would like to discuss this issue with the full Board.
C. The GSP Advisory Committee has recently created an ad-Hoc Committee to help with SDAC outreach efforts being funded by the latest Proposition One Grant for GSP implementation. Staff has been working with Le Sar, Diane Johnson and Rebecca Falk (AC members) on the roles and responsibilities and structure of the Committee, and another meeting is planned for April 13th. Staff would like to update the Board on the results of these discussions and receive direction.

FISCAL IMPACT

N/A

ATTACHMENTS

A. 2018-19 Budget

	C	S	W	AC	AD	AE
1	**BWD**	5/23/2017				4/17/2018
2	**CASH FLOW BUDGET**	ADOPTED	Actual YTD		Projected Budget	PROJECTED
3	**2018-2019**	BUDGET	and Projected	Rate Adjustment	W/rate increase	BUDGET
4		FY 2018	2017-2018	FY 2019	2018-2019	2018-2019
5						
6	REVENUE			(6% increase 4% revenue)		
7	WATER REVENUE					
8	Residential Water Sales	949,885	914,417	36,577	950,994	914,417
9	Commercial Water Sales	302,856	401,812	16,072	417,885	401,812
10	Irrigation Water Sales	210,597	227,944	9,118	237,061	227,944
11	GWM Surcharge	160,274	174,759	6,990	181,749	174,759
12	Water Sales Power Portion	457,206	494,910	19,796	514,706	494,910
13	**TOTAL WATER COMMODITY REVENUE:**	2,080,818	2,213,841	88,554	2,302,395	2,213,841
14				(6% increase)		
15	Readiness Water Charge	1,114,240	1,084,596	65,376	1,154,976	1,089,600
18	Meter Install/Reconnect Fees	1,360	51,085			20,680
19	Backflow Testing/installation	7,000	7,400			5,100
20	Bulk Water Sales	600	21,233			1,200
21	Penalty & Interest Water Collection	19,000	43,846			40,000
22	**TOTAL WATER REVENUE:**	3,223,018	3,451,921	153,930	3,554,271	3,400,341
23						
24	PROPERTY ASSESSMENTS/AVAILABILITY CHARGES					
25	641500 1% Property Assessments	62,303	63,661		64,351	64,351
26	641502 Property Assess wtr/swr/fld	106,212	106,630		106,212	106,212
28	641501 Water avail Standby	82,445	86,421		82,376	82,376
30	641504 ID 3 Water Standby (La Casa)	33,722	33,841		33,647	33,647
31	641503 Pest standby	17,882	16,796		17,870	17,870
32	**TOTAL PROPERTY ASSES/AVAIL CHARGES:**	302,563	307,350		304,455	304,455
33						
34	SEWER SERVICE CHARGES			(4% increase)		
35	Town Center Sewer Holder fees	226,391	221,077	9,023	234,593	225,570
36	Town Center Sewer User Fees	85,015	84,191	3,411	88,695	85,284
37	Sewer user Fees	267,460	270,642	10,704	278,304	267,600
39	Penalty Interest-Sewer	3,000	1,270	48	1,248	1,200
40	Sewer Capacity Fees	0	-	0	0	0
41					0	
42	**TOTAL SEWER SERVICE CHARGES:**	581,866	577,180	23,186	602,840	579,654
43						
44	OTHER INCOME					
53	Interest Income	6,600	19,337		6,000	6,000
54	**TOTAL OTHER INCOME:**	6,600	97,231		6,000	6,000
55						
56	**TOTAL INCOME:**	4,114,047	4,433,681	177,116	4,467,566	4,290,450

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4		FY 2018	2017-2018	FY 2019	2018-2019	2018-2019
66	**EXPENSES**					
67						
68	MAINTENANCE EXPENSE					
69	R & M Buildings & Equipment	185,000	182,272			200,000
70	R & M - WWTP	185,000	106,512			185,000
71	Telemetry	8,000	10,941			10,000
72	Trash Removal	4,200	7,375			4,200
73	Vehicle Expense	18,000	13,874			18,000
74	Fuel & Oil	23,000	25,656			30,000
75	**TOTAL MAINTENANCE EXPENSE:**	423,200	346,630			447,200
76						
77	PROFESSIONAL SERVICES EXPENSE					
78	Tax Accounting (Taussig)	3,000	3,115			3,000
79	Administrative Services (ADP)	3,000	3,095			3,000
80	Audit Fees (Squarmilner)	15,995	15,996			16,995
81	Computer billing (Accela/Parker)	13,500	15,521			25,000
82	Financial/Technical Consulting (Raftelis) (Fieldman) (Holt Group)	41,000	38,465			80,000
83	Engineering (Dynamic/Dudek)	50,000	60,704			60,000
84	District Legal Services (Downey Brand/BBK)	20,000	82,418			120,000
85	Testing/lab work (Babcock Lab)	8,400	9,420			12,000
86	Regulatory Permit Fees (SWRB/DEH/Dig alerts/APCD)	27,160	21,237			25,000
87	**TOTAL PROFESSIONAL SERVICES EXPENSE:**	182,055	249,971			344,994
88						
89	INSURANCE EXPENSE					
90	ACWA/JPIA Program Insurance	57,000	54,682			57,000
91	ACWA/JPIA Workers Comp	16,000	15,679			17,600
92	**TOTAL INSURANCE EXPENSE:**	73,000	70,361			74,600
93						
94	DEBT EXPENSE					
95	Citizens Bank-COP 2008 Debt Payment	251,475	202,425			254,500
96	BBVA-Viking Ranch Debt Payment	143,312	192,324			143,312
97	**TOTAL DEBT EXPENSE:**	394,787	394,749			397,812

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98	**EXPENSES**					
99	PERSONNEL EXPENSE					
100	Board Meeting Expense (board stipend/board secretary)	22,000	23,047			25,000
101	Salaries & Wages (gross)	826,000	807,205			956,000
102	Salaries & Wages offset account (board stipends/staff project salaries)	(55,000)	(85,526)			(60,000)
103	Consulting services/Contract Labor	24,000	16,339			15,000
104	Taxes on Payroll	22,000	22,882			22,300
105	Medical Insurance Benefits	220,100	218,871			236,000
106	Calpers Retirement Benefits	179,200	153,579			173,000
107	Conference/Conventions/Training/Seminars	8,000	18,367			17,000
108	**TOTAL PERSONNEL EXPENSE:**	1,246,300	1,174,763			1,384,299
109						
110	OFFICE EXPENSE					
111	Office Supplies	18,000	20,609			20,000
112	Office Equipment/ Rental/Maintenance Agreements	35,000	44,239			35,000
113	Postage & Freight	15,000	13,112			15,000
114	Taxes on Property	2,331	2,334			2,334
115	Telephone/Answering Service/Cell	19,000	19,087			24,000
116	Dues & Subscriptions (ACWA/CSDA)	21,526	20,663			21,000
117	Printing, Publications & Notices	3,000	2,175			2,500
118	Uniforms	5,400	6,124			6,500
119	OSHA Requirements/Emergency preparedness	4,000	3,121			4,000
120	**TOTAL OFFICE EXPENSE:**	123,257	131,466			130,333
121						
122	UTILITIES EXPENSE					
123	Pumping-Electricity	300,000	311,135			308,000
124	Office/Shop Utilities	20,000	12,723			1,200
126	**TOTAL UTILITIES EXPENSE:**	320,000	323,858			311,392
127						
128	GROUNDWATER MANAGEMENT EXPENSE					
129	GWM -legal/Misc.-prop 1 grant/USGS	120,000	185,519			120,000
130	Conservation incentive program	30,000	9,996			30,000
131	District portion of GSP	120,000	30,000			120,000
132	**TOTAL GWM EXPENSE:**	270,000	225,515			271,145
133						
134	**TOTAL EXPENSES:**	3,032,600	2,917,313		3,361,776	3,361,776
143						
144	**NET CASH FLOW (O&M)**	1,081,447	1,483,877		1,105,790	928,674

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146	**CIP PROJECTS**					
147	**Water**					
152	New well: Phase I = Exploration/Test Well (Possible Grant) & Phase II = Drill Well					265,000
153	Transmission line to convey well 16 water directly to ID1 900 Reservoir (Pipeline 1)					112,000
154	Frying Pan Road, north and south from T Anchor Drive (Pipeline 8)					165,000
155	Pipeline for Santiago and ID5 (Pipeline 11)					110,000
156	Rehab ID 5-5					110,000
157	Rehab Twin Tanks					600,000
158	10" Bypass at ID 1 Booster Station 2	15,000	16,140			15,000
159	Emergency water pipeline repairs	25,000	15,000			25,000
160	ID1-8, 125 Hp					60,000
161	Backhoe					200,000
162	Crew Truck					35,000
189						
190	**TOTAL WATER CIP:**	2,001,000	1,829,507		1,697,000	1,697,000
191	**Sewer**					
199	Force main replacement at La Casa					150,000
200	TSC-La Casa Bypass					100,000
214						
215	**TOTAL SEWER CIP:**	218,500	218,500		250,000	250,000
249						
250	**TOTAL CIP EXPENSES:**	2,219,500	2,048,007		1,947,000	1,947,000
251						
252	**CASH RECAP**					
253	Cash beginning of period	4,589,663	4,149,656		3,585,526	3,585,526
254	Net Cash Flow (O&M)	1,081,447	1,483,877		1,105,790	928,674
255	Total Non O&M Expenses	(2,219,500)	(2,048,007)		(1,947,000)	(1,947,000)
256	**CASH AT END OF PERIOD**	3,451,611	3,585,526		2,744,316	2,567,200
257						
258	**RESERVES**					
259	Working Capital-Water (4 months)	(1,000,000)	(1,000,000)		(1,000,000)	(1,000,000)
260	R & R Reserves	(532,000)	(532,000)		(532,000)	(532,000)
261	Contingency Reserves (8 % O&M)	(240,000)	(240,000)		(240,000)	(240,000)
262	Rate Stabilization Reserves	(800,000)	(800,000)		(800,000)	(800,000)
263	Available for Emergency Reserves	1,411,611	1,013,526		172,316	(4,800)
264	**Target Emergency Reserves**	2,000,000	2,000,000		2,000,000	2,000,000
265	**Emergency Reserves Deficit**	(588,389)	(986,474)		(1,827,684)	(2,004,800)