Surface Water Storage and Sedimentation

- **What does this dashboard relate to: general description of Surface Water Storage and Sedimentation Information?**

  The Surface Water Storage dashboard indicates volume of water stored in Dams. The storage can be influenced by the sedimentation that reduces the storage volumes The aggregated Surface Water Storage can be viewed per:

  - Water Management Area (WMA)
  - Water Management Area 2012
  - Province
  - Catchment

  The map shows a bar chart representing the percentage storage, total percentile value of storage in highlighted colours and the selected areas or individual dam depending on zoom level as well as a sedimentation indicator.

  The Right hand panel shows overview of the amount of water stored in each WMA, province or Catchment, as well as the national total. The table shows a list of all dams in a selected area with dam names, full supply capacity, current storage, date and sedimentation.

  FSC = Full Supply Capacity
  Sed= Sedimentation
  Mm3 = Million Cubic Meters
  1m3 = 1000 Litres
  1Mm3 = 1 000 000 000 Litres

- **Surface Water Storage**

  With reference to the Table, the % FSC is calculated from the value of water level in Dams (say X) per Total Full Supply Capacity (say Y) times 100%.

  X/Y x 100% = % Full Supply Capacity

  The colours represent the percentile range of the current level of storage,
  where the level is:

Below or equal to 10th percentile	Very Low
Above 10th and below or equal to 25th percentile	Low

Above 25th and below or equal to 40th percentile	Moderately Low
Above 40th and below or equal to 60th percentile	Normal
Above 60th and below or equal to 75th percentile	Moderately High
Above 75th percentile	High

Percentile

Percentile represents the statistical history of dam levels in the same month e.g. a percentile of 40% means that 40% of the values in the same month over the lifetime of the dam, the dam level was at or below that value

For the a specific dam for a specific month, the percentiles values are calculated from the dataset, consisting of daily water in dam level values of the specific month, plus daily dam level values of the same month in all of the previous years. The water in dam level of the specific dam for the specific month is then compared to the values of the 10th, 25th, 40th, 60th and 75th percentiles. The reason for using percentiles is to compare the current level of a dam to historic levels of the dam at the same time of the year.

If the water in dam level is less that the value of the 10th percentile for the current month it is categorised as Very Low (Red).
If the water in dam level is higher than the value of the 10th percentile but less than or equal to the value of the 25th percentile of the current month it is classified as Low (Orange).
If the water in dam level is higher than the value of the 25th percentile but less than or equal to the value of the 40th percentile of the current month it is categorised as Moderately Low (Yellow).
If the water in dam level is higher than the value of the 40th percentile but less than or equal to the value of the 60th percentiles of the current month it is categorised as Normal (Green).
If the water in dam level is higher than the value of the 60th percentile but less than or equal to the value of the 75th percentile of the current month it is categorised as Moderately High (Light Blue).

If the water in dam level is higher than the value of the 75th percentile of the current month it is categorised as High (Dark Blue).

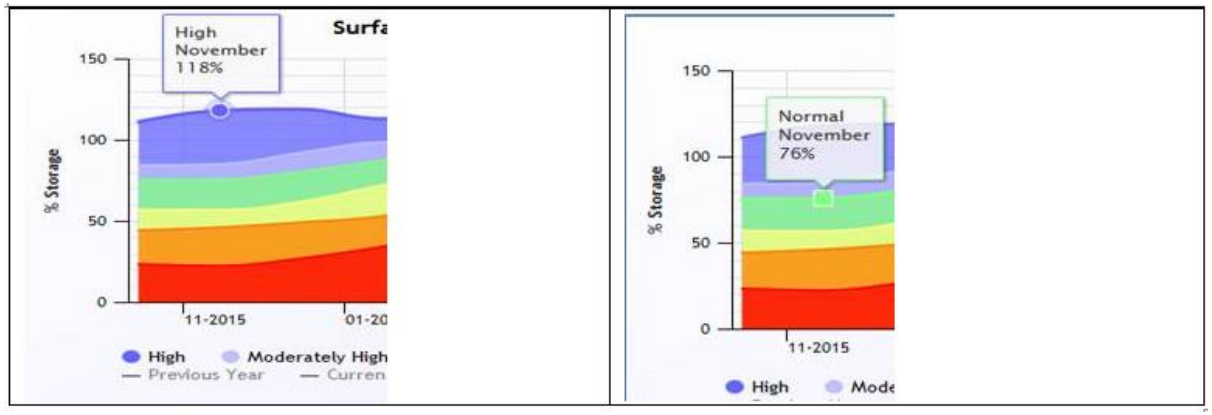
For a specific area such as a water management area, the daily water in dam levels of all the dams in the WMA are added together, for a specific month of all the previous years and the categorisation is then performed on the total dataset in the same way as described above.

The correct interpretation of:
• the blue (high) colour is: A dam will be coloured Blue when the level or %FSC is above the 75th percentile for current month
• the green (Normal) colour is: A dam will be coloured Green when the level or %FSC is between the 40th and the 60th percentile for current month

Definition of Percentile:

The 40th percentile indicates that 40% of all the historic levels for that month is on or below that level
The 100th percentile indicates that all the historic levels for that month is on or below that level

e.g. Vaal dam for November:
All the historic levels is on or below 118% FSC
And 60% of historic levels is on or below 76% FSC



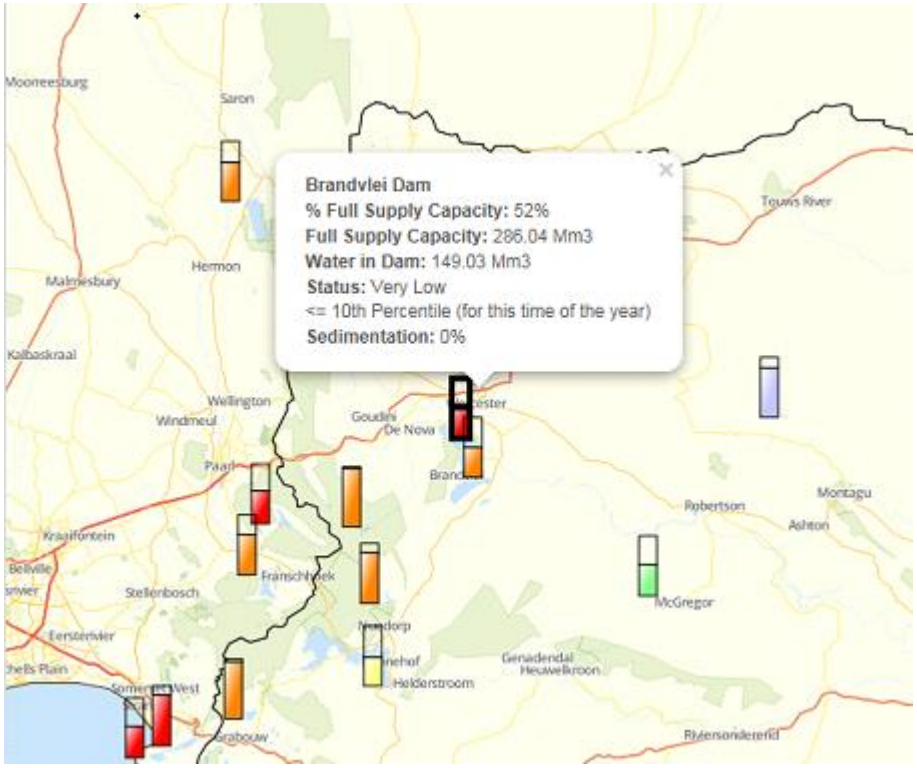
Why do we use Percentile and not Percentage:

Dam 1's normal operating level might be kept at e.g. 70% FSC for the following reasons
• Dam Safety: the dam wall might be compromised if the level is above 80% for an extended period
• Floods: to ensure that a flood is prevented downs stream
• Evaporation: to minimise on water loss
• Others
in this case the 75th Percentile might be 68% FSC

Dam 2's normal operating level might be kept at e.g. 110% FSC for the following reasons
• It's a small dam
• There is a low risk of floods

• Small surface area thus low evaporation
• Others
in this case the 75th Percentile might be 105% FSC

Description of Indicator on Dam Points



As per the indicator shown in the image above, it is notable that the popup seen when a user clicks on a dam icon, the user will be able to see details specific to the selected dam point. These details include the Dam name, the % Full Supply Capacity, the Full Supply Capacity and the Water in Dam values in cubic millimetres, the Status and the Sedimentation as a percentage value. The status shows which percentile is applicable to the selected dam point.

- **Sedimentation**

Hydrographic surveys is aimed at measuring the volume of a reservoir, one of the data outputs during this process of determining the capacity is a sedimentation value expressed in percentage. the monitoring programme is not fixed and it is compiled on an annual basis. every dam has its own unique rate of sedimentation. this rate determines the repeat period for surveys. during droughts and after floods, there are requests to deviate from the said program and prioritise surveys on certain dams immediately. some privately owned dams are surveyed on special request.

The main responsibility of hydrographical surveys is to measure and determine the capacity of a reservoir. the types of reservoir include large dams, smaller dams, farm dams, weirs and segments of rivers. once the capacity of the reservoir is known, it can be compared to previous surveys and the amount of sediment can thus be determined. the information supplied by hydrographical surveys is used by the department of water and sanitation to manage available water storage, floods and future planning.

- **What type/s of questions does this information aim to answer?**

  The Sedimentation Surveys seek to address questions of new capacity, monitor available or loss of water storage, floods impacts, siltation rate and amount deposited into the reservoirs. As a monitoring system, Sedimentation Surveys also rely on historical data and information to answer the timeframes of when, where and how much silt has been deposited into various reservoirs.

- **Data / Information discussion:**
  - Data used to generate the information:
    - What data is used?

      Sedimentation data is extracted from Hydrographic Survey database. Directorate: Hydrology (use the area / capacity table to calculate values to correspond with the gauge plate readings).

      Surveyors collect spatial data such as ancillary data, y, x locations and z elevations of the cross sections along the reservoir.

    - How is it extracted and from where?

      Dam Safety Office extract capacity tables and as built surveys of the dams, while Hydraulic laboratory services extract surveys of models and test results. Educational institutions such as Universities supply/receive data for research studies, municipalities' supply data and do surveys on request for planning purposes; Consultants supply data and do surveys on request. Regional Survey offices assist in data capturing of Hydrographical data and pre-processing, while final calculations and further analysis done at Spatial and Land Information Management (S&LIM)in Head Office, Pretoria.

    - How often is it extracted?

      The monitoring programme is not fixed and it is compiled on an annual basis. Every dam has its own unique rate of sedimentation. This rate determines the repeat period for surveys. During droughts and after floods, there are requests to deviate from the said program and survey certain dams immediately. Some privately owned dams are surveyed on special request.

- Business processes related to the data

  The resources required are a team of Surveyors and Survey assistants. A skills transfer programme is in place, including training of Graduate Trainees as this is a one of the scarce skills in the country. There are very few private companies that can perform this service.

  The shortage of human capacity is increased by the use of personnel from the regional survey offices, but they have limited manpower. Most of the regions now have their own dam survey equipment. Training is being given on a skills transfer and on a rotational basis.

- The algorithms / equations used to convert data into information
  How do we determine the capacity of a reservoir?
  Two types of surveys are performed to determine the capacity:

  1. Full contour survey of the reservoirs is done. The areas of the reservoirs that are not covered by water are surveyed as per set standards using Totalstations or RTK GPS, GNSS or combination of both. The scale of maps needed as well as accuracy of the capacity will determine the density of the spot shots.

     The area of the reservoir that is covered by water is surveyed by using various sizes of boats equipped with GPS receivers for position determination and Echo sounders for measuring of depth. Once again will the scale and accuracy determine the density of the underwater shots.

     Software suites like Hypack, Microstation and Modelmaker is then used to produce contour maps and area capacity tables for the reservoir. Cross sections at various points can also be generated. Once the area capacity table is known, it can be compared to previous surveys and sedimentation can be determined.

     The full contour survey is only used to determine the capacity of small to medium reservoirs. The amount of data generated during such a survey is huge and the existing software cannot cope with large dams.
  2. The second method to determine capacity of a reservoir is by means of taking cross sections of the reservoir at selected intervals. All large dams are surveyed this way. The cross sections are run at constant intervals over the length of the reservoir. The cross sections are run between two fixed beacons. The data are collected by Hypack software. The capacity of the reservoirs is then determined with sediment software that runs on the end areas principal.

     This type of survey produces results much quicker that the full contour survey method. For sedimentation determination the cross sections are run at a certain time frequency and once again the amount of sediment in the reservoir is determined by comparing the new capacity with the previous one.

Because the cross sections are run between fixed survey beacons, information such as build up of sediment as well as where the sediment is concentrated, is available immediately.

- Key assumptions made

Hydrographical surveys are now also beginning to get involved with the latest multi-beam Echo Sounder technology. If this technology is used to survey a reservoir, a multi-beam echo sounder is used to survey a dense cloud of spot shots on the floor as well as sides of reservoirs. This type of survey uses sophisticated Echo sounders as well as roll, pitch and tilt sensors to produce photo like images of the underwater environment.

- **Links to other sources of related information**

  www.water.co.za

- **Contacts details of persons who championed this dashboard:**
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- **Enquiries:**
  - For all dashboard enquiries click **HERE** to go to the Contact Us page.

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