DATE: October 19, 2017

TO: SJVUAPCD Governing Board

FROM: Seyed Sadredin, Executive Director/APCO
Project Coordinator: Sheraz Gill

RE: **ITEM NUMBER 12: DISTRICT INITIATIVE TO FACILITATE GOOD CITIZEN SCIENCE FOR UTILIZING PERSONAL AIR SENSORS IN THE SAN JOAQUIN VALLEY**

RECOMMENDATIONS:

1. Review and approve the following action plan to facilitate good citizen science for utilizing personal air sensors in the San Joaquin Valley:

   a. Work in partnership with other agencies to test the accuracy of various sensor technologies available to the general public
   b. Collocate personal air quality sensors at various District air monitoring sites to compare accuracy
   c. Define and share with the public the information that can reliably be ascertained from personal air quality sensors. For instance, for some sensors, the information may only be probative in establishing relative trends in air quality versus providing an accurate absolute measurement of air pollutant concentrations.
   d. Develop educational materials and guidance documents on the proper placement of monitoring equipment, considering the air quality area of interest
   e. Provide guidance for how data should be interpreted and used, making clear that collected data will not be used in the framework of regulatory monitoring
   f. Engage in partnerships and oversight with community groups and businesses who wish to use personal air monitoring sensors for monitoring projects
   g. Provide public education and training disseminating above information to the public through web-based tools and/or public meetings

BACKGROUND:

As the use of low cost air monitoring sensors by individuals becomes more prevalent, it is important for the District to engage Valley residents interested in using such devices. This engagement can be helpful in assisting Valley residents with proper installation, operation, and interpretation of the data obtained.

CURRENT EFFORTS BY THE DISTRICT TO ADDRESS PUBLIC DEMAND FOR REAL-TIME LOCALIZED AIR QUALITY DATA:

The general public's interest in using these personal low cost sensors is rapidly growing throughout the nation. In response to the public's interest in more real-time and localized air quality data, the District has already invested significant resources over the last several years to provide Valley residents with such information. First, in 2010, the District created the Real-Time Air Advisory Network (RAAN) to provide the residents of the Valley access to hour-by-hour local air quality conditions. With this new risk-management tool, RAAN made it possible for schools, parents, and others to make informed decisions about when outdoor activities should be limited, and for whom. RAAN revolutionized the way local air quality conditions are communicated on a real-time basis. However, RAAN relies on data from air quality monitors that are typically sited at locations which measure worst case concentrations. Given the large geographical area that is covered by the District's air monitoring network, this method, although providing the worst case air quality measurements, may not accurately reflect the actual air quality conditions at the neighborhood level.

To provide Valley residents with more localized air quality information, the District then invested significant resources to develop a new air quality information system that provides hour-by-hour data at the neighborhood level. Upon the completion and rollout of the Neighborhood RAAN system, planned for early 2018, Valley residents will be able to enter their exact address into the RAAN system to receive location specific air quality updates throughout the day. At this time, with the Neighborhood RAAN system, Valley residents are uniquely positioned to have available current air quality data for their neighborhood – no other region has this capability. While the District's Neighborhood RAAN system is expected to meet the needs of most Valley residents for real-time localized air quality information, it is reasonable to anticipate that the use of low cost personal monitors will be significant and will continue to grow.

Although these low cost sensors provide a number of options for citizens to become more involved in measuring localized air quality, there are a number of important aspects that must be considered when operating these sensors, as well as how to interpret and use the data that they collect.

CURRENT STATE OF LOW COST SENSOR TECHNOLOGY:

Air monitoring sensor technology has been developing at a rapid pace over recent years, increasing the number of analyzers that the general public can use to measure ozone, particulate matter, or other pollutants at their own home or business. In addition, these sensor technologies are becoming more affordable, making them more accessible to Valley citizens who wish to conduct personal air monitoring. Many of the latest sensors cost less than $500, with some costing as low as $200, making them even more practical for use by Valley residents. As a result, the industry for air monitoring sensor technology has been increasing at a rapid pace, where there are now more options for personal air monitoring equipment than ever before.

Current options for air monitoring sensors include measuring gas parameters (ozone, NO2, CO, SO2) as well as particulate matter of varying diameters (PM10, PM2.5, PM1.0). Some sensors also have the ability to measure meteorological parameters like temperature and humidity. Some of these sensors are weatherproof, can be solar powered, and can report their data online through cellular networks or Wi-Fi. As a result, these sensor technologies have the ability to act as a compact and portable air monitoring site, usable for a variety of purposes. The following are examples of current sensor technologies, many of which are handheld, easily attachable to a surface, or wearable.

Figure 1 Examples of Low Cost Gas and PM Sensor Technology

Figure 2 Examples of Wearable Sensor Technology

ASSISTING VALLEY RESIDENTS WITH THE USE OF PERSONAL AIR MONITORING SENSORS:

Anticipating that the use of personal air monitoring sensor technology will continue to grow over the coming years, and since the District has extensive experience with siting, operating, and maintaining high level air monitoring equipment, the District is in a position to provide valuable education and guidance to citizens and community groups who are interested in using these sensor technologies.

Although the technology for low cost sensors has improved in recent years, the technology, the manner by which these sensors are utilized, and lack of training poses certain limitations. However, with public education, these limitations can be minimized if combined with proper means to communicate the air quality information that these sensors can reliably provide.

Accuracy of the collected data from many low cost sensors has been determined to be very poor and can result in readings that are not representative of true conditions. For instance, through its Air Quality Sensor Performance Evaluation Center (AQ-SPEC), the South Coast Air Quality Management District (South Coast) has conducted extensive testing of low cost air monitoring sensors and has concluded that the correlation between the data collected from a number of low cost sensors and data collected from high precision regulatory monitors can be quite poor. Low cost sensors that measure gas parameters, like ozone, have been shown to perform worse compared to sensors that measure particulate matter.

In contrast, under the District's air monitoring program, significant effort is made to ensure that the data collected is of high quality and is defendable when being compared against federal air quality standards. To ensure this high level of data quality, the District follows strict federal guidelines for regularly scheduled maintenance, calibrations, and certifications, and undergoes regular independent audits by the California Air Resources Board (ARB) and the federal EPA. Additionally, District staff

who maintain, operate, and calibrate our high precision monitoring equipment have received extensive training and have gained the necessary level of expertise needed to properly manage the District's expansive air monitoring network. Since low cost sensor technologies do not follow these strict and costly maintenance and calibration guidelines, over time the data accuracy can diminish and drift from known performance standards.

Another factor that impacts the accuracy and the validity of air quality data collected relates to the placement of the sensors. It is important to place sensors in a manner that ensures measurements are reflective of ambient air quality conditions to which individuals are actually exposed. For instance, sensors located near obstructions may lead to artificial mixing and overly concentrating pollutants that are not reflective of actual ambient conditions. Furthermore, if the purpose of the sensors is to measure area-wide exposure in a large community, similar to the District's air monitoring network designed for regulatory purposes under the Clean Air Act, the siting, maintenance, data integrity and quality assurance, and instrument quality must adhere to the strict requirements established in federal law.

Since the District's air monitoring equipment consists of higher precision components and EPA approved pollutant measurement methodologies, they are designated by the EPA as either Federal Reference Method (FRM) or Federal Equivalent Method (FEM). Due to this, the data that the District's analyzers collect is considered regulatory and can be compared against the federal standards and used to determine whether the Valley is in attainment. Since low cost sensors are equipped with lower quality components and uncertified measurement methodologies, they do not have the EPA FRM/FEM designation, and therefore their data is not of the high quality necessary to be comparable to the federal air quality standards.

Without accurate and correct interpretation of the data collected by these sensors, it is possible to mislead the public when communicating public health risk resulting from the measured concentrations. The information communicated can be misleading if the averaging time of the measured concentrations is ignored or improperly applied. For instance, many of the current air sensors imply an Air Quality Index (AQI) measurement based on instantaneous or very short-term readings, when the official EPA AQI is based on federal standard averaging times of 8-hours for ozone and 24-hours for particulate matter. Furthermore, some individuals even go further and compare an instantaneous reading with an annual ambient air quality standard, which is based on the average readings for an entire year. As the use of these monitors becomes more prevalent, the District will engage in additional public education to inform the users of the appropriate interpretation of the measured data relative to applicable standards.

If approved by your Board, the District will undertake the following actions:

- Work in partnership with other agencies to test the accuracy of various sensor technologies available to the general public
- Collocate personal air quality sensors at various District air monitoring sites to compare accuracy
- Define and share with the public the information that can reliably be ascertained from personal air quality sensors. For instance, for some sensors, the information may only be probative in establishing relative trends in air quality versus providing an accurate absolute measurement of air pollutant concentrations.
- Develop educational materials and guidance documents on the proper placement of monitoring equipment, considering the air quality area of interest
- Provide guidance for how data should be interpreted and used, making clear that collected data will not be used in the framework of regulatory monitoring
- Engage in partnerships and oversight with community groups and businesses who wish to use personal air monitoring sensors for monitoring projects
- Provide public education and training disseminating above information to the public through web-based tools and/or public meetings

FISCAL IMPACT:

The District's 2017-18 Budget contains sufficient appropriations to implement this initiative.