Small Unmanned Aerial Systems (sUAS) for Stormwater Control Measures (SCMs) Inspection

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Drones in MassDOT Stormwater Program

Stormwater Control Measures (SCMs)

- Previously known as Best Management Practices (BMPs)
- Typically surface features such as infiltration basins, water quality swales, or other systems using physical and biological processes to manage stormwater.
MassDOT’s Goals

Assuring these facilities remain effective:

- Maintain assets in a state of good repair
- Meet MassDOT program objectives and facilitate permit compliance
Advantages of Drones

- Reduce costs for inspection of surface stormwater facilities
- Enable access to remote facilities
- Reduce worker safety risks
- Fast acquisition of accurate, repeatable data (e.g., contour/elevations)
- Inspection-to-inspection consistency for comparison purposes
MassDOT Aeronautics Coordination

Stormwater Unit coordinated with Aeronautics in developing protocols for consultant drone operations in the following areas:

- Applicability of drone use (e.g., BMP Inspection)
- Site evaluations
- Operator training and currency
- Flight operations: pre-flight planning through post-flight
- Data management and security
- Accident response
- Consultant certification/pre-qualification
Route 190 Corridor

55 SCMs Identified

- Towns: Lancaster, Leominster, Sterling, West Boylston, Holden
Route 395 Corridor

17 SCMs Identified

- Town: Oxford
Route 290 Corridor

8 SCMs Identified

- Town: Auburn
Constraints

- **Site Specific Constraints**
  - Airspace restrictions- controlled airspace
  - Safety
    - Secure launch/landing location
    - Traffic conditions and distracted driving
    - Pedestrian or other public access to the site
  - Prevalence and thickness of undergrowth
  - Maintaining visual line of sight
  - Signal interference
    - Cellular towers
    - Large metal structures (e.g., water tanks) to avoid compass errors
Data Management

• **Storage Constraints**
  • Routine inspection of 40 SCMs data: 5.4 GB total
  • Enhanced inspection of 10 SCMs data: 21.1 GB total
  • Post-processed imagery ➔
    • with Near Infrared (NIR) = ~6 GB per site
    • without NIR = ~4.6 GB per site
  • Video data: ~400 MB per SCM

• **Privacy Concerns**
  • No private vehicle license plates or property features were captured, as recording occurs only at the SCM. Data collection is within MassDOT policy parameters, not sensitive in nature, and does not require editing for release to the public.
Accessibility - Good
Sediment Level - Moderate
Trash - Low
Erosion Level - No
Vegetation Health - Fair
Spillway Condition - Poor
Overall Condition - Poor

SCM 644
I-395 at Lowes Pond
Stormwater Wetland
Accessibility - Good
Sediment Level - High
Trash - No
Erosion Level - No
Vegetation Health - Fair
Spillway Condition - Failing
Overall Condition - Failing

SCM 961
I-190 at Gates Brook
Sediment basin w/ sand filter
Study Findings

Desktop Analysis and Field Verification

• Constraints matrix $\rightarrow$ 83% success in identifying drone inspectable sites
  • 40 of 48 sites successfully inspected by CEI via drone

• Launching flights from the shoulder of the road was more feasible than originally assumed from desktop screening

Orthomosaic of SCM 640 overlaid with 6-inch contours
Study Findings

Data Capture and Methodology

• Routine field inspections: averaged 15 minutes per site
• Site time to obtain enhanced data due to setting of Ground Control Points (GCPs) 1 hour per site
• Measure of success for the sample set inspected:
  • Site access 85%
  • Quantification of sediment levels 97.5%
  • Identification of erosion issues 95%
  • Outlet spillway condition 72.5% (27.5% not identifiable*)

* “Not Identifiable” designations were mainly due to vegetation overgrowth
Study Findings

Data Capture and Methodology (cont.)

• Enhanced inspections (CAD files contour/elevation data): 5-6 hours of in-office post-processing

• Provided more data than necessary for completion of inspection forms
  • Normalized Difference Vegetation Index (NDVI) camera can be used to assess vegetative health → provides ongoing monitoring that can be compared to historical imagery
  • Contour/elevation data developed can be used in hydraulic models, maintenance estimates, volume loss due to erosion, etc.

• Installation of permanent Ground Control Points (GCP’s) at BMPs could eliminate need to access same structure for recurring topographical surveys
Thank You!

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