

SMART FLOOD-SENSING LED DELINEATOR

Flood-Sensing LED Delineator

Proposal for Road Authorities

A roadside delineator next to a storm drain or manhole senses flooding, warns on site with a red flash, and alerts the control center in real time.

Concept Design · Sept. 2026



At a Glance

AT A GLANCE

Problem — local roadside flooding causes accidents when nobody can see it

Invisible at night / in heavy rain
Drain backflow floods the road edge first, but drivers and pedestrians cannot judge the depth

Late situational awareness
Staff learn of it late via complaints or patrols — submerged drains are hard even to locate, delaying drainage and repair

Dedicated gauges are costly
Level gauges and CCTV need power/comms works and high install cost — impractical for every flood-prone spot

Solution — turn the delineator that is already there into a flood sensor

Built on the existing **one-bolt nut-anchored delineator**, with a water-level sensor, solar power and LTE-M radio inside — when the base floods, the **LED flashes red** and **control center and duty staff are alerted instantly**. Replaced in place in 3 minutes — no power or communication works.

Four Key Points

01

On-site warning
Watch · Warning · Alarm (default 3/10/15 cm)
Admin picks heights from 5 electrodes · red flash for instant recognition

02

Real-time monitoring
Map dashboard + SMS / messenger alerts
Automatic log of flood time and duration

03

Drain location marker
Post shows where the drain is even when submerged
Blocked drains cleared quickly

04

No-construction rollout
Same installation method · solar self-powered
Airtime ≈ US\$1–2 per post per month

Rollout — pilot first, then scale



Contents

- 1

Cover · At a Glance
- 2

System Concept (Site → Network → Cloud → Control)
- 3

Product Structure · Operation
- 4

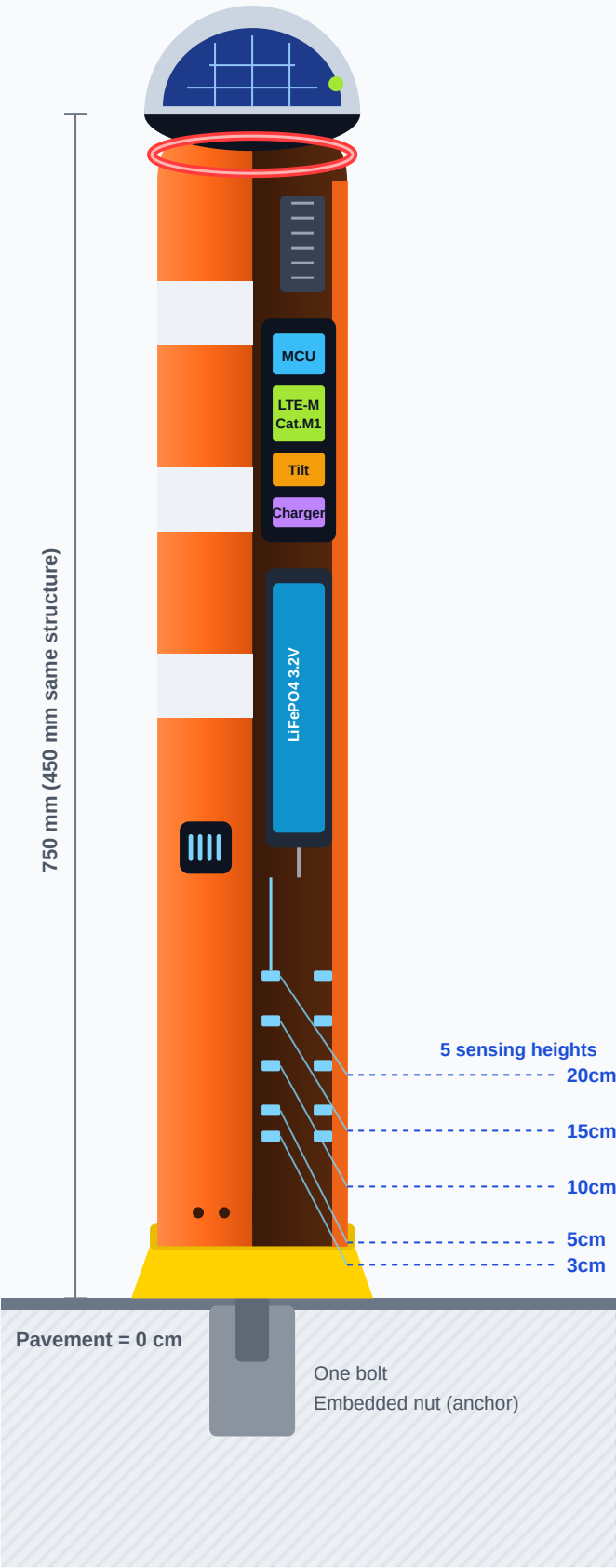
Dashboard · Communication Options
- 5

Rollout · Specification · Benefits

Product Structure · Operation Scenario

A Post internals (cross-section)

Based on the 750 mm nut-anchored delineator · right half cut away · heights measured from pavement



① **Solar cell + light sensor**
Curved top PV · auto-on at night · charge compensation on cloudy days

② **360° LED ring**
Amber (normal) / orange flash (warning) / high-intensity red flash (alarm)
Visible all round · 600 m at night

③ **Antenna · electronics (IP68)**
MCU · LTE-M (Cat.M1) module · tilt/impact sensor · charger IC
Mounted high in the post so the radio keeps working when flooded

④ **LiFePO4 battery**
3.2 V 6 Ah · -20 to 60 °C · 2,000+ cycles
20% emergency reserve locked → 12 h+ of alarm with no sun

⑤ **5 capacitive electrodes**
Stainless electrodes, non-contact sensing through the wall
3·5·10·15·20 cm above pavement — admin selects Watch/Warning/Alarm heights

⑥ **Drain-marker pictogram**
Pictogram on the body + map icon → locate the drain when flooded

⑦ **One-bolt nut-anchored base**
Same ROADEX installation method · drain holes · 3-minute swap

Operation Scenario — Detail

Stage	Trigger (default)	On-site LED	Network · Control	Staff action
Normal	No electrode wet	Steady amber (delineation)	6-hour heartbeat — battery, signal, tilt	—
Watch	3 cm electrode for 30 s	Unchanged (avoids confusing drivers)	Sent immediately · map shows "drainage delay / drain possibly blocked"	Admin app alert → crew dispatched to clear / inspect
Warning	10 cm electrode for 30 s	Orange flash 1 Hz	Sent immediately · warning event · update every 5 min	One SMS / messenger alert → site check, start pumps
Alarm	15 cm electrode for 30 s	High-intensity red flash 2 Hz	Repeated alerts · EOC API · VMS message	Close the road · dispatch patrol · detour guidance
Clear	Electrode dry for 5 min	Step down one stage → back to amber	Recovery notice · log start / duration / peak level	Confirm outcome · record drain clearing

Decision Logic · Reliability

30-second persistence
Ignores splashes from vehicles and waves

Clear hysteresis
Clears after 5 min dry — no alert chatter at threshold

Remote configuration
Stage heights (5 points), persistence and alert channels set per post or group; changes logged

Autonomous when offline
LED warning continues on last settings · events uploaded after reconnect

Placement · Drain-Marker Operation

Placement
Kerb side right next to the drain / manhole, low-lying flood-prone spots first · replaces existing delineators

Marker registration
Installer app maps post ID — drain number — GPS · drain icon on the dashboard map

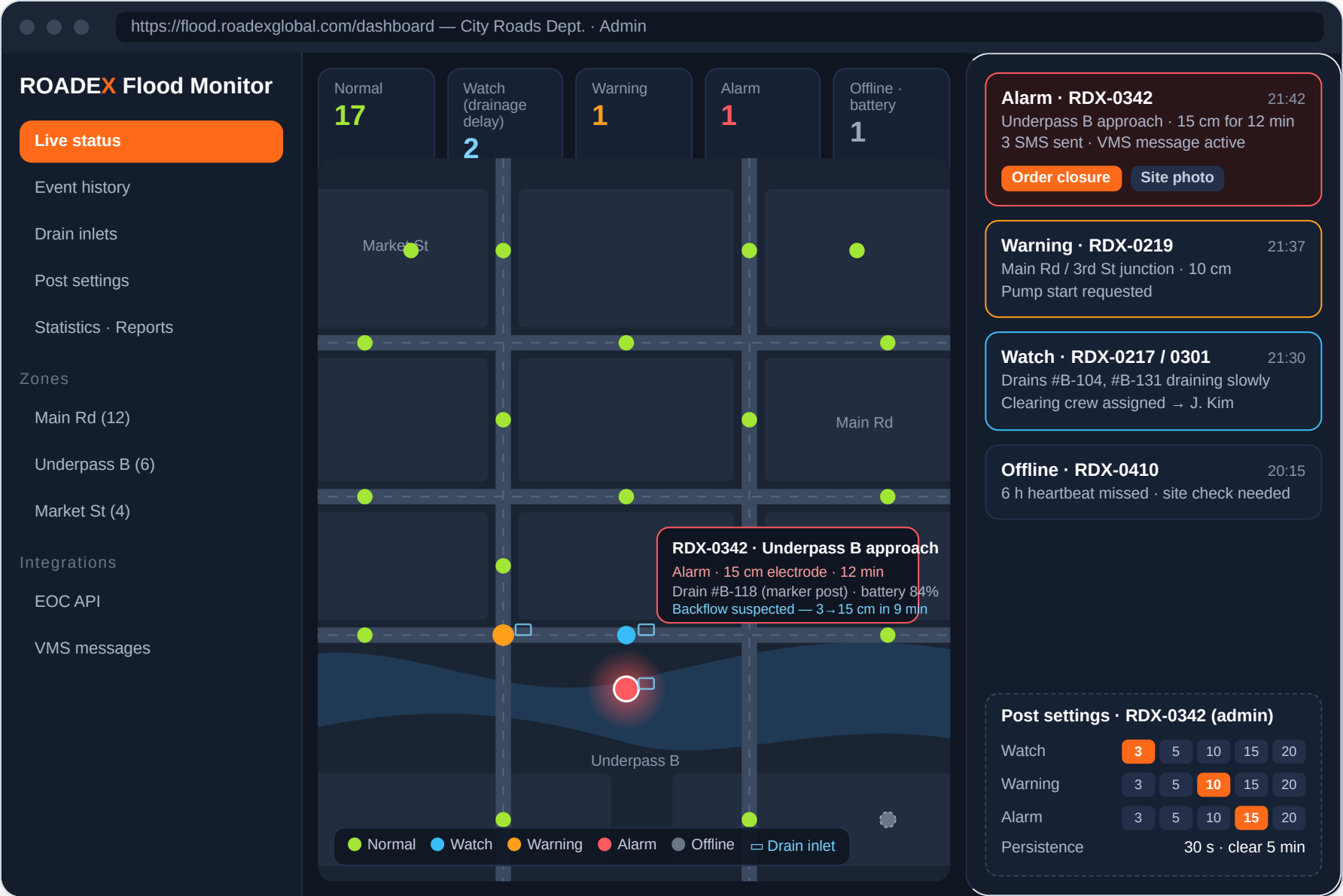
Maintenance use
Repeated Watch events = chronically blocked drain → automatic clearing priority list

Key Specifications (concept design)

Body	One-bolt nut-anchored 750 / 450 mm, recycled TPU	Radio	LTE-M (Cat.M1) built in · MQTT/TLS · modular (LoRa option)
Power	Solar PV + LiFePO4 3.2 V 6 Ah · 20% reserve locked	Level sensing	5 capacitive electrodes (3·5·10·15·20 cm) above pavement
LED	360° ring · amber / orange / red · flash 1 Hz / 2 Hz	Other sensors	Tilt / impact (knock-down, damage) · light
Protection	IP68 · -20 to 60 °C	Certification (planned)	Radio type approval (KC; CE/FCC per market) · battery safety · delineator test report

Monitoring Dashboard · Communication Options

Dashboard example (web · roads / emergency management staff)



Key Dashboard Functions

Live map

Post positions and status colors · drain-marker icons · zone filters · auto-zoom on alarm

Alerts · Response

SMS · messenger · e-mail · staff assignment · logged closure / pump / VMS orders

Remote configuration

Stage heights (5 points) · persistence · alert channels · per post / group · change log

History · Reports

Flood start / duration / peak · chronically blocked drains ranking · annual report · open API

Communication Options — LTE-M per post vs LoRa + gateway

Item	LTE-M (Cat.M1) in every post	LoRa (regional ISM band) + gateway
Added cost per post	Module + antenna + SIM ≈ US\$18–26	Module + antenna ≈ US\$7–11
Infrastructure	None (carrier network)	Outdoor gateway ≈ US\$450–600 per 1–2 km, needs power and a site
Monthly airtime	≈ US\$1–2 per line (IoT plan)	≈ US\$7 per gateway backhaul, posts free
20 posts · 3-year total	≈ US\$1,250 (HW 450 + airtime 800)	≈ US\$960 (HW 185 + GW 520 + airtime 265)
100 posts · 3-year total	≈ US\$6,200 (HW 2,200 + airtime 4,000)	≈ US\$3,250 (HW 925 + 3 GW 1,550 + airtime 800)
Coverage	Nationwide · independent — one post failing affects no other	1–2 km per GW (0.5–1 km urban) · GW failure = whole zone down
Power	High TX peaks · low average with PSM / eDRX	Low power · easier on the battery
Certification · Development	Pre-certified module · low development effort	Node and GW certified separately · LoRaWAN server to operate
Procurement view	Recurring airtime (solved by bundling 3 years)	No node airtime · GW maintenance and power line items
Best fit	Scattered sites · < 40 per zone · fast rollout	40–60+ posts clustered within 1–2 km

Alert Path · Latency Target

① Post → cloud Sent right after the 30 s decision · 5–10 s incl. LTE-M attach	② Rules · storage Rule engine < 1 s · time-series log	③ Alert delivery SMS / messenger 5–10 s · dashboard live · EOC API	Target Threshold reached → staff phone within 1 minute · on-site LED immediate
---	---	--	---

Recommendation — LTE-M for the pilot, modular radio for the future

A 10–20 unit pilot is **spread across many flood-prone sites**, so **LTE-M** — independent per-post connectivity with no gateway — wins on total cost, reliability and speed. Designing the radio as a **swappable module** lets dense clusters in the scale-up phase switch to **LoRa + gateway** to cut airtime fees.

Pilot (10–20 posts)

LTE-M built in · 3-year airtime bundled · no gateway or power works

Scale-up (100+)

LoRa GW for dense zones · LTE-M for scattered sites · mixed operation

Rollout · Specification · Expected Benefits

Rollout — pilot first, then phased scale-up



What we ask of the road authority

Pilot sites · installation

Flood-prone site data, road-occupancy and installation permits, approval to replace existing delineators

Responsible staff · alert recipients

Named roads / emergency contacts, SMS and messenger recipient list, agreed response procedures (closure, pumps, clearing)

Data · integration

Share flood history and drain inventory, agree EOC / VMS interfaces, jointly evaluate the pilot

Specification · Certification Plan

Body	One-bolt nut-anchored delineator 750 / 450 mm · recycled TPU · 3 reflective bands
Level sensing	5 capacitive electrodes (3·5·10·15·20 cm above pavement) · 30 s persistence · 5 min clear
Warning light	360° LED ring — steady amber / orange flash 1 Hz / high-intensity red flash 2 Hz
Power	Solar PV + LiFePO4 · 20% reserve locked · 12 h+ of alarm with no sun
Radio	LTE-M (Cat.M1) built in · MQTT over TLS · 6-hour heartbeat · modular radio
Other functions	Tilt / impact (knock-down, damage) · battery reporting · remote thresholds
Environment	IP68 · –20 to 60 °C · salt and UV resistant (as existing delineators)
Monitoring	Web dashboard · SMS / messenger / e-mail · open API (EOC, VMS, smart city)

Radio type approval (KC · CE / FCC per market)

Battery safety certification

Delineator test report (existing)

Flood-sensing function test (accredited lab)

IP68 ingress test

Expected Benefits

- Accident prevention — instant on-site warning**
Drivers and pedestrians see early flooding at once → prevents vehicle flooding and falls into drains / manholes
- Faster response**
From complaints and patrols → staff alerted within 1 minute; pumps, closures and clearing start early
- Efficient drain maintenance**
Posts mark submerged drains · chronically blocked drains listed automatically → clearing priorities
- Data-driven drainage upgrades**
Flood start, duration and peak history → evidence for upgrade priorities and budgets, annual report
- No construction · existing function kept**
Replaced in place with no power or comms works · normal delineation and night guidance unchanged
- Smart-city · emergency platform integration**
Open API links to EOC, VMS and smart-city platforms — an extensible road IoT layer

About ROADEX

Road safety products manufacturer, Korea. ROADEX designs and manufactures delineators (one-bolt nut-anchored 750/450 mm), lane separators, solar road studs and LED landscape lighting, with installations for municipalities and highway authorities across Korea. This proposal adds flood sensing and connectivity to the proven one-bolt delineator, delivered as a single package of manufacturing, installation and maintenance.

Head office & factory 37 Murim 4-gil, Yakmok-myeon, Chilgok-gun, Gyeongsangbuk-do, Korea
R&D center Rm 508, Business Incubation Center, 13-13 Hayang-ro, Hayang-eup, Gyeongsan-si, Korea
Overseas partner Sepang, Selangor, Malaysia
CEO Park Young-wook · Business Reg. No. 508-20-65581

ROADEX · Road Safety Products

Tel +82-53-761-2434 · Fax +82-53-964-0977 · rdxbiz0102@gmail.com · www.roadexglobal.com

This document is a concept design.
Specifications and schedule are subject to pilot results and mutual agreement.