TECHNICAL ANNEXE

Everything CARI-Pani does, in one place.

The reference behind the CARI-Pani brochure: every job, check and tool, what each reads, what to send to start, and the records behind each result.

Built for: water utilities, municipal networks and supply managers.

Preparing your records: page 6 · Looking up a check: pages 3 and 4 · The evidence: pages 8 and 9

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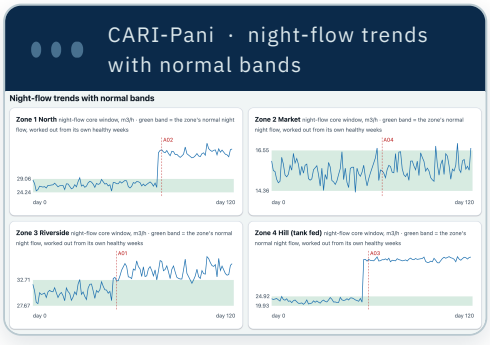
Words on the screen and where it runs page 10

CAPABILITIES, BY JOB

What CARI-Pani does, job by job.

Each job runs when its readings are there. A check that needs more readings names them in the report.

JOB	WHAT YOU GET
Zone water loss and night flow	Zones ranked by new water lost, the likely cause, what to check first, and whether the repair worked.
Bursts on big mains	A plain alarm for a sudden, lasting rise in flow on a main, with what to check.
Pumps wasting power	Pumps that stop early, run long or restart too soon; the pump giving less water; the electricity wasted, with its cost at your tariff and CO_2 using your grid factor.
Meters that are wrong	Meters stopped, stuck, jumped, backwards, in the wrong unit or with a wrong clock, listed for a visit; water not recorded in an area.
Tank and reservoir checks	Water missing from a reservoir or tank, fill by fill; when supply came and for how long; water left standing too long.
Pipes in replacement order	Pipes ranked from your own break records, a yearly plan within budget, expected breaks for groups of pipes, an inspection list.
Quality alerts	Breaches of IS 10500 or your own limits; “the water changed” told apart from “the sensor is wrong”.
Ranked work lists	One report across zones, pumps, tanks, meters and pipes, graded High, Medium or Low, with what to check first.
Reports and alerts	Reports in English, Hindi, Marathi and Gujarati; alerts by WhatsApp, SMS or e-mail from your own sender accounts.
Runs on your own PC	Your first report is run at our end; continuing monitoring runs on your own computer and only reads your records.



Built for: water utilities, municipal networks and supply managers. Start with one or two zones, a pumping station and the pipe list, or with your log sheets typed as a simple table.

CHECKS, PART 1

Zones, history and pressure.

Each check is a named alarm or notice raised on your own readings. What it reads is listed so a tag list can be matched before records are sent.

CHECK: WHAT IT TELLS YOU	WHAT IT READS
ZONE FLOWS AND NIGHT FLOW **A steady reading jumps to a new level**	any flow or level
Inlet and zone flows do not add up	inlet and zone meters
A zone uses a bigger share of its day in its lowest-use hours	zone inflow
Lowest-use flow up, against pressure and the day's flow	zone inflow; pressure
Lowest-use flow up, with zone details	zone inflow; customers, large users
Tank and source volumes do not close	tank level, source and outlet flows
ZONES AGAINST THEIR HISTORY AND NEIGHBOURS **Zone uses more than on comparable days**	zone inflow over weeks
Zone rose alone among its neighbours	inflow of several zones
Flow up while pressure is down	zone inflow and pressure
Zone water balance off, or its meters disagree	inlet, outlet and zone meters
PRESSURE, BURSTS AND MAINS **Sudden, lasting flow rise on a main**	main flow
Sudden loss at a reservoir	reservoir level and flows
Low pressure while pumping	pressure and pump state
Sudden pressure fall	pressure
Pressure swings	pressure
Pressure often too low for customers	pressure
Pressure after a valve creeping up	pressure downstream of a valve

How a check answers. A named alarm, with the readings behind it, the likely cause and what to check first. A check that needs more readings names them.

CHECKS, PART 2

Tanks, pumps, meters and water quality.

Reservoirs and tanks, pump patterns, the meters on your network and the quality of the water.

CHECK: WHAT IT TELLS YOU	WHAT IT READS
RESERVOIRS, TANKS AND PUMPS **Reservoir water balance**	level, inflow, outflow
Tank water balance, fill by fill	tank level and flows
Water stays too long in a tank	tank level and flows
Pump stops early or runs long	pump run state
Pump restarts too soon	pump run state
Pump duty: wear, or a pipe-side change	pump power, flow, run state
Pump vibration sensor dead	vibration reading
METERS **Meter stopped**	meter totals
Meter stuck	meter totals
Meter jumped	meter totals
Meter running backwards	meter totals
Meter scale or unit wrong	meter totals
Meter clock wrong	meter totals with time
Water not recorded in an area	bulk and customer meters
WATER QUALITY **Drinking-water limits, IS 10500 or your own**	quality readings
Quality sensor problem, not the water	quality readings
Water quality changed	quality readings
A slower change in one quality reading	quality readings
Chlorine lower than travel or tank time explains	chlorine; network file

Data-quality notes. Gaps, flat runs, jumps and clock errors in your records are noted in the report.

PLANNING AND ANALYSIS TOOLS

Plan before you dig or switch.

A tool is a pane where you give a file or settings and get a computed answer or plan. Most need your network file in the EPANET .inp format; we first check that it runs and tell you what is wrong in it.

TOOL	WHAT GOES IN	WHAT COMES OUT
OPERATIONS PLANNING		
Pump timetable	network file and settings	on-hours and cost for the day
Valve timetable	network file, zones	each zone's turn and share of water
Pump cost and CO_2	network file, hours, your tariff and grid factor	energy per pump; cost and CO_2
Tanker plan	network file; your tankers	a trip list for every tanker
Ward supply hours	inlet flow or levels with time	hours of water each ward got
NETWORK PLANNING		
Pressure-logger places	network file	best places for pressure loggers
Shut-off pieces	network file	which valves isolate each pipe
Contamination spread	network file, entry point, amount, timing	where it spreads, who is served, a map
Fire flow at hydrants	network file, up to 20 places	most water per hydrant; first place to lose pressure
Resilience and layout	network file, your minimum pressure	spare pressure, single-route pipes, layout scores
Simplify a big network	network file, pipe size limit	a smaller network file
Chlorine boosters	network file with chlorine, 1 to 3 stations	best booster places and doses
Chlorine and by-products	network file with chlorine	levels at the places you watch
PRESSURE SURGES		
Slow surge	network file, the event	pressure swings that follow
Water hammer	network file, pump stop or valve closing, air vessel	pressure swings, with air vessels
PIPE NETWORK		
Check my network	network file	does the file run, what is wrong in it
Compare with my meters	network file, meter readings	do the meters agree with the file
Where is the leak	network file, pressure readings	an area to search
What if	network file, a pipe or valve to close	the network with that change
QUALITY, PUMPS, PIPES AND LEAKS		
Check my sensors	quality readings	sensor problems told from water changes
Chlorine along the network	chlorine readings, network file	chlorine against travel and tank time
Pump energy	pump power, flow, run state	pump giving less, pipe resistance, wasted power
Pipe renewal plan	pipe list with breaks, budget, rates	pipes in order, a yearly plan
Remaining life of pipes	pipe list with breaks	a likely life range for groups of pipes
Rank listening loggers	logger levels	loggers worth a visit, with reasons
Explained leak spot	logger levels, network file	an area for the leak
Leak cost	water lost, your price	the money lost at your price

Timetables, plans and control rules are worked out on your file and settings.

WHAT TO SEND

Send what you have. Any column names.

Each check runs when its readings are there; "how much" is a guide, and your first report says which checks your records support.

FOR	YOUR RECORDS NEED	HOW MUCH
Zone water loss and repair check	Inflow to each zone, one row per time; pressure at the zone's far point helps	A few weeks or more
Zones against history and neighbours	Zone inflow for each zone, same time steps	Weeks, to cover comparable days
Burst watch	Main flow; pressure if you have it	A few weeks
Listening loggers	Logger levels; the network file for logger places	The logger's own nights
Reservoir and tank checks; supply hours	Level, inflow, outflow; or daily level and pump notes	Several fills
Pump run patterns	Pump run state; or a pump log of starts, stops, units, hours	Weeks
Pump energy	Pump power, flow, run state	Complete records, weeks
Meter checks	Customer or bulk meter totals with time	Months of readings
Water quality	Quality readings with time; an analyser export or a lab table	Weeks
Pipe ranking and yearly plan	Pipe list: year laid, material, length, breaks with dates; budget and rates	Several years of breaks
Network model and planning tools	Network file (EPANET .inp); meter readings with flow for the model check	One file
The money view	Your water and electricity prices; grid CO_2 factor for carbon	-
Alerts	Your WhatsApp, SMS and e-mail sender accounts; who receives alerts	-

FORMATS

CSV and Excel files; exports from any logger, meter, sensor or control room; typed log sheets as a simple table with one reading per row; a network file in EPANET .inp format.

HOW TO SEND

Any column names work; we map them with you. Send a table with one reading per row, with times and units; the report names the readings it used.

THE REPORT, THE LANGUAGES AND THE ALERTS

One report, four languages.

The same report for the manager who signs the work order and the engineer who walks the zone.

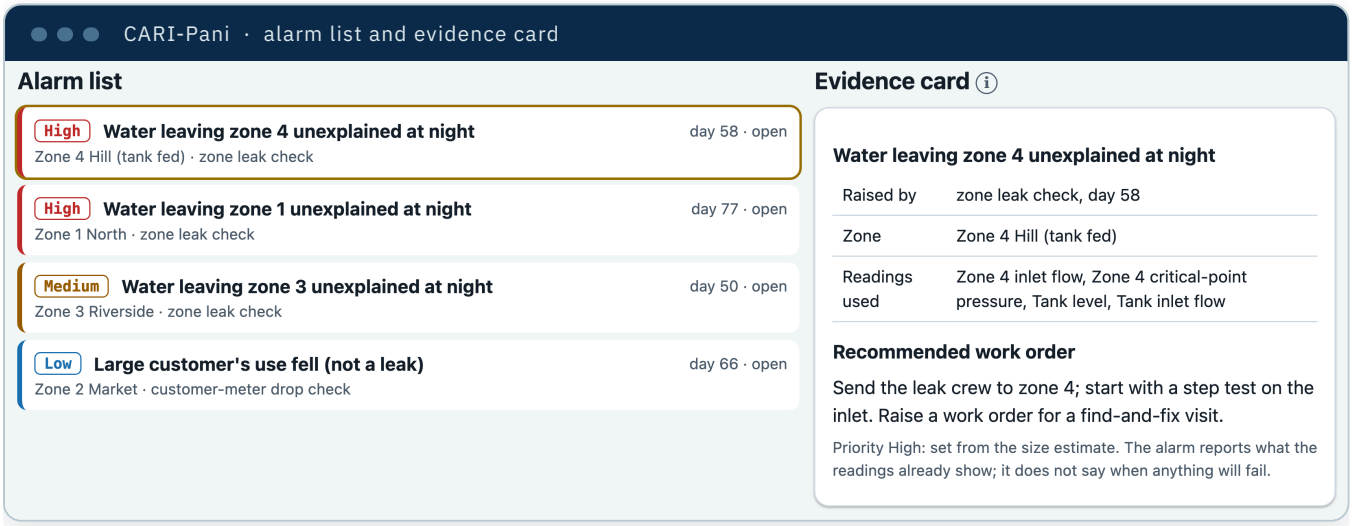
What every report holds

PART	HOLDS
Overall	One line for the network
Priorities	Zones and assets, most important first
Each alarm	What changed, the likely causes, what to check first, the readings behind it
Coverage	Data coverage and quality
Assumptions	Stated
Checks run	Which readings each used
Audit trail	Which file, which period, which checks

As PDF and CSV. Gaps, flat runs, jumps and clock errors in your records are noted in the report.

Languages and alerts

ITEM	DETAIL
Report languages	English, Hindi, Marathi, Gujarati
Alert channels	WhatsApp, SMS, e-mail
Sent from	Your own WhatsApp, SMS and e-mail sender accounts
Who receives	The people you name
E-mail	The report goes by e-mail as a PDF in your language



Real app screen, on the app's example network.

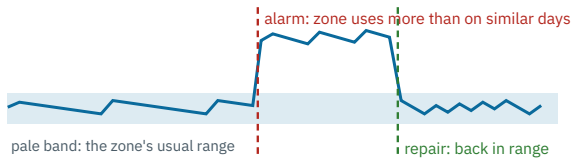
EVIDENCE, PART 1

Results on real records.

Openly published records from real water networks, each with its scope. Records used to score a check were ones it had not seen.

WHAT	RECORDS	RESULT	KIND
Zone water loss alarm	A leakage district, 15-minute inlet flow	Zone alarm six days before the leak was repaired, from the inlet flow alone	**Real records**
Pipe replacement order	A city's real main breaks and pipe register	About half of ten years of breaks in the top tenth of our list; about a third by material alone	**Real records**
Water-quality changes	Real drinking-water quality readings with labelled test changes	7 of 8 labelled changes caught, no false alarms	**Real, labelled test changes**
Pump failure days	A water-supply pumping station	Most logged failure days named, with few false flags	**Real records**
Network model	A real network: six block inlets, a month not seen	Matched measured pressure at all six inlets	**Real records**
Supply hours	Real records, three months not seen before	Read within a quarter of an hour on most days	**Real records**
Meters	Real smart-meter records	Large faults found; meters listed for a visit	**Real records**
Listening loggers	Real listening-logger records	Additional loggers flagged for a visit beyond the maker's own list; an area for the leak	**Real records**

A leakage district, day by day



Drawn example of the alarm and the repair check.

A city's main breaks, ten years

Our list — **about half**

By pipe material alone — **about a third**

The share that fell in the top tenth of each list; scored on breaks the ranking had not seen.

Every result lists the records it was scored on.

EVIDENCE, PART 2

Test networks, standard tools and added tests.

Known test changes and comparisons with standard tools. The standard tools are the open-source EPANET, WNTR, TSNet and EPANET-MSX.

WHAT	TEST NETWORKS	RESULT
Pump cost and energy	Standard and generated test networks	Agreed with a standard simulator in every test run
Chlorine and by-products	Two standard test networks	Matched the standard water-chemistry tool
Contamination spread	Fresh test cases	Matched the standard tool
Fire flow	Fresh networks, one gravity-fed and one pumped	Passed
Resilience and layout	Four example networks	Matched the standard tool
Simplify a big network	Standard test networks	Identical to the standard tool's result
Control rules	Standard and generated test networks	Most tests passed, including a valve holding a tank level
Burst watch	Generated bursts, and one real recorded burst	Raised on the generated bursts and on the one real recorded burst

Real records with known test changes added

WHAT	RECORDS	RESULT	KIND
Reservoir and tank balance	Real reservoir and tank records, with test losses added	Test losses found; no alarm on the untouched month	**Real, test added**
Zone leaks, added flow	Real district records, with known flows added	The larger added flows found	**Real, test added**
Pump energy	Real pump-station records	Larger added pump losses found on stations with complete records	**Real, test added**

How to read the evidence words

WORD	MEANING
Real records	Openly published records from real water networks, scored on records the check had not seen.
Real, test added	Real records with known faults or losses added, so the right answer is known.
Real, labelled test changes	Real quality readings with labelled test changes.
Test networks	Standard or generated networks, where the right answer is known.

Matched to standard tools. Planning calculations are compared with EPANET, WNTR, TSNet and EPANET-MSX on standard test networks.

WORDS ON THE SCREEN AND WHERE IT RUNS

The words on the screen.

CARI-Pani uses a small set of plain terms in the app and the report.

Terms used in the app and report

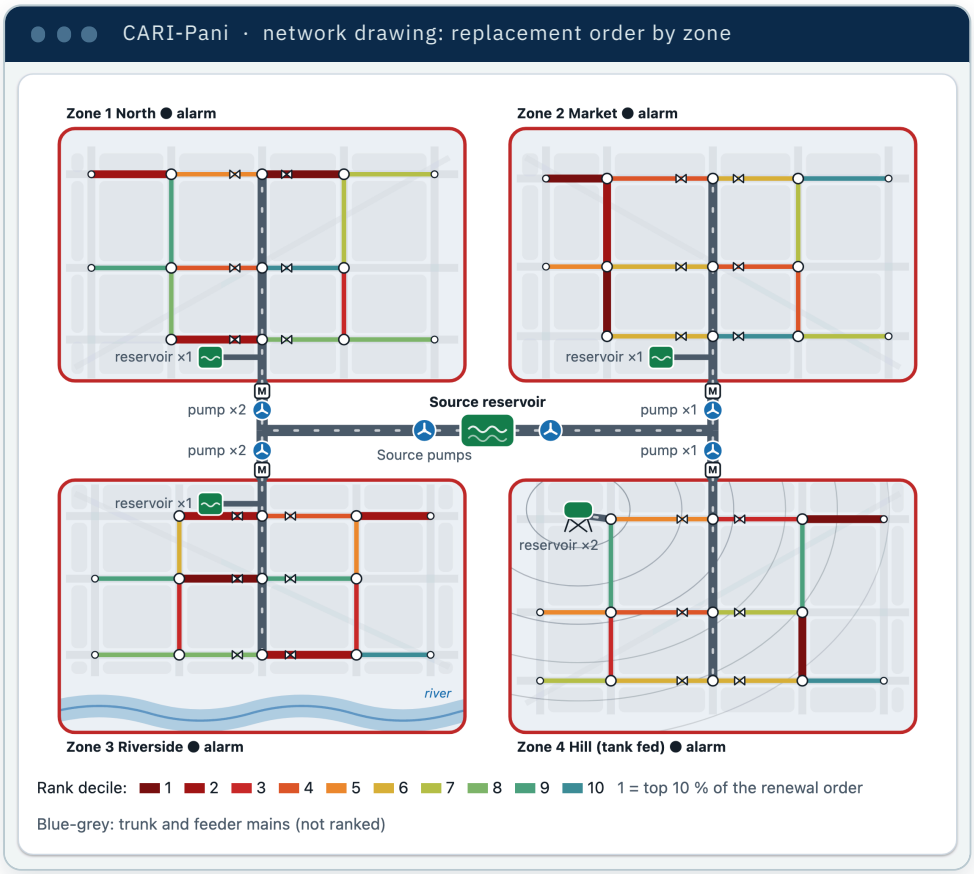
TERM	MEANING
High, Medium, Low	The grade beside an alarm. P1 act now, P2 plan this month, P3 note.
Check first	The first thing to look at on site, named on every alarm.
Not judged	A check that needs more readings says so, with the reason.
Usual range	The shaded band shown for a zone on its trend.
Repair check	After a repair, whether the zone is back inside its usual range.
Replacement order	Pipes ranked from your own break records; the top tenth is the first tenth of the list.

Where it runs

Your first report is run at our end from the files you send and e-mailed as a PDF. Continuing monitoring runs on your own computer. It reads records only and never changes a setting in your network.

Who it is for

SECTOR	EXAMPLES
Water utilities	City water boards, municipal corporations
Municipal networks	Zones, mains, reservoirs, customer meters
Supply managers	Supply hours, tanks, tankers



Pipes in replacement order on the network drawing, from the app's example network.

START WITH ONE ZONE

Send a few weeks of inflow readings from one zone for a first loss report. Your first report is run at our end from the files you send, ranked and in plain words, in your language.

WRITE TO US

contact@carimo.tech
carimotech.com