Grade 11 Geography — Resource Management Quiz

Duration: 45 minutes · Total: 75 marks
Mastery threads assessed: chronology and change; geography and resources; civic decision-making; perspective taking

Exam instructions (concise, printable)

- Read the community scenario and station data. The quiz simulates rotating inquiry stations (A, B, C); answer station-specific items where indicated.
- Show all calculations and cite station data or the scenario when requested. Use the provided peer-feedback rubric for Q9 (debate) — teacher will apply it in scoring.
- Write clearly in the spaces provided. Partial credit is awarded where indicated.
- Total questions: 15. Total marks: 75.

Community scenario — Harborview, CA (fictional)
Harborview is a coastal community in California (population 25,000). It sits above a shallow coastal aquifer, supports a small commercial fishery, has mixed agriculture in its hinterland, and attracts tourists. The town faces water shortages, pressure for new housing, seasonal fish stock declines, and interest in local renewable energy projects. Local stakeholders include municipal managers, farmers, fishers, tourism business owners, environmental NGOs, and youth civic groups.

Station Data (for Stations A, B, C)
Station A — Groundwater & Water Use (annual volumes)

- Population: 25,000
- Annual groundwater extraction (current)
  - Municipal (household + municipal services): 2,500,000 m3
  - Agriculture (local farms): 3,000,000 m3
  - Industry (small manufacturing & food processing): 1,000,000 m3
  - Other (parks, golf course, losses): 500,000 m3
  - Total extraction: 7,000,000 m3/year

- Natural aquifer recharge: 4,000,000 m3/year
- Estimated long-term safe yield for sustainability: 5,000,000 m3/year
- Aquifer active storage: 60,000,000 m3 (volume available for use before severe ecological impacts)

Station B — Energy, Land Use, and Infrastructure

- Current electricity mix (Harborview grid): natural gas 55%, imported hydro 20%, local renewables 15% (small solar + wind), other 10%
- Available sites: coastal ridge (good wind, 50 ha), south plain (solar potential, 80 ha), several brownfield sites near town center (for small-scale solar + storage)

- Land-use change timeline snapshot:
  - 1980: Agriculture 60% of hinterland, Natural habitat 30%, Urban 10%
  - 2000: Agriculture 45%, Natural habitat 25%, Urban 30%
  - 2020: Agriculture 35%, Natural habitat 20%, Urban 45%

- Tourism seasonality: peak May–September (doubles town population on some weekends)

Station C — Fisheries & Biodiversity

- Fisheries: Small fleet (15 vessels) targeting anchovy and nearshore rockfish; total catch declining 30% over 5 years
- Employment: 120 direct fishery jobs; 600 jobs in agriculture; 1,500 jobs in tourism/service sector
- Key biodiversity concerns: eelgrass beds declining near marina (habitat for juvenile fish)

Exam questions (15 items)

1. (3 marks) Identify two primary resource pressures facing Harborview that are evident in the scenario and station data. For each pressure, state one immediate physical effect on the local environment.

   - Marking: 1.5 marks per pressure (1 for correct pressure, 0.5 for linked effect).

2. (3 marks) Using Station B land-use timeline, calculate the percentage point change in urban coverage between 1980 and 2020. Show your calculation.

   - Marking: 3 marks (2 for correct arithmetic, 1 for clear statement).

3. (6 marks) Using Station A data:
   a) Calculate the annual groundwater deficit relative to natural recharge. (2 marks)
   b) Calculate the percent reduction in total extraction required to reach the estimated safe yield. Show steps. (4 marks)

   - Marking: full credit for correct numeric answers and method.

4. (6 marks) Compare two resource-management options for water: building a desalination plant near the coast versus a community-wide water-conservation program (including tiered pricing and leak repairs). For each option, list two benefits and two drawbacks that consider environmental, economic, and social factors. (3 marks per option; 1.5 marks per benefit/drawback pair)

5. (2 marks) Multiple choice: Which geographic principle best explains why Harborview’s aquifer recharge is less than extraction?

A. Spatial diffusion of innovation
B. Scale and spatial interaction
C. Carrying capacity and over-extraction
D. Cultural landscape change

- Marking: 2 marks for correct answer.

6. (5 marks) Perspective taking — You are a small-scale fisher from Harborview. Write a concise policy memo (120–150 words) to the municipal council arguing one specific management action to protect nearshore fish stocks while sustaining livelihoods. Include one measurable outcome you would want tracked.

   - Marking: 5 marks (2 for clear action, 1.5 for justification with local evidence, 1 for measurable outcome, deduction for off-topic).

7. (6 marks) Civic decision-making — Design a 3-step consultation process the town can use to decide on siting a new renewable-energy project (e.g., wind or solar). For each step, name the activity and the intended civic outcome (who participates, what decision is produced). Ensure the process supports equitable participation of at least two stakeholder groups from the scenario. (2 marks per step)

8. (4 marks) First-principles modelling — Describe a simple conceptual model (box-and-arrow description; text acceptable) that links groundwater extraction, recharge, and land-use change to the health of eelgrass beds. Identify one feedback loop in your model and state whether it is reinforcing or balancing. (3 marks for model description, 1 mark for feedback identification)

9. (6 marks) Debate simulation — The council is considering a municipal-scale desalination plant. Choose a side (For or Against) and provide:

   - Four evidence-based arguments supporting your side (one per bullet). (4 marks)
   - One practical civic action step the council should take next (1 mark)
   - Indicate which two stakeholder groups you prioritize and why (1 mark)
     Use the peer-feedback rubric on the next page for clarity of argument (teacher will score using rubric categories).
   - Marking: see rubric (total 6 marks).

10. (4 marks) Chronology and change — Given the land-use timeline in Station B, explain one long-term cause and one long-term effect of the urban expansion between 1980 and 2020 on local resource availability. Use specific evidence from the station data. (2 marks for cause, 2 marks for effect)

11. (5 marks) Quantitative allocation scenario — Suppose agriculture agrees to a 20% reduction in water use and industry a 10% reduction (from current extraction). Calculate:
    a) The new annual municipal water allocation available to the town while meeting the safe yield target. (3 marks)

b) The resulting per-capita daily municipal water volume in liters (assume population 25,000). Show calculations. (2 marks)

- Use Station A numbers.

12. (4 marks) Critical evaluation — A policy brief claims “Desalination solves Harborview’s water crisis with no trade-offs.” Identify two specific weaknesses or missing pieces of evidence in that claim, and explain why each weakens the argument. (2 marks per weakness)

13. (4 marks) Spatial justice — Briefly explain how the spatial distribution of resources and land use in Harborview (Station A & B) could create inequities among social groups. Provide one concrete policy measure that would reduce such inequities. (2 marks for explanation, 2 marks for policy measure)

14. (4 marks) Simulation metrics — If the town pilots a community energy-sharing co-op using rooftop solar and shared batteries, list four measurable indicators (one per bullet) the town should track over the first 3 years to evaluate success. Provide a one-sentence rationale for each indicator. (1 mark per indicator + rationale)

15. (13 marks) Synthesis recommendation — As an advisor to the Harborview citizens’ advisory panel, write a comprehensive recommendation (max 300 words) that balances environmental sustainability, economic viability, and community needs. Your recommendation must:

- Propose one integrated policy package (describe 3 coordinated actions). (6 marks)
- Explain how the package addresses at least two mastery threads: chronology and change; geography and resources; civic decision-making; perspective taking. (4 marks)
- List three measurable indicators (with target values where possible) to evaluate success within 5 years. (3 marks)
- Marking: allocate points as indicated; clarity, use of station data, and feasibility will be assessed.

Peer-feedback rubric (applies to Q9 debate clarity; teacher scoring will use rubric categories as guidance)

- Argument clarity (0–2): 2 = clear claims, each argument concise; 1 = generally clear; 0 = unclear
- Use of evidence (0–2): 2 = directly cites station data or logical evidence; 1 = general evidence; 0 = unsupported
- Consideration of counterarguments (0–1): 1 = acknowledges at least one counterpoint; 0 = none
- Civic feasibility (0–1): 1 = practical next step that includes stakeholders; 0 = impractical or no stakeholder mention
  Total rubric points = 6 (used to score Q9).

Answer key with detailed explanations and scoring guidance

General note on scoring: Partial credit awarded where calculations or reasoning are correct but incomplete. Answers below show model responses and point breakdown.

1. (3 marks) Model answer (examples)

- Pressure 1: Groundwater over-extraction (Station A shows extraction 7,000,000 m3 vs recharge 4,000,000 m3). Effect: falling water table, reduced baseflow to coastal habitats. (1.5 marks)
- Pressure 2: Declining fish stocks (Station C: 30% catch decline). Effect: reduced fish recruitment, loss of eelgrass nursery habitat. (1.5 marks)

2. (3 marks)

- Calculation: Urban 1980 = 10%; Urban 2020 = 45%; percentage point change = 45% − 10% = 35 percentage points.
- Scoring: 2 marks for correct arithmetic; 1 mark for statement: "Urban coverage increased by 35 percentage points between 1980 and 2020."

3. (6 marks)
   a) Annual groundwater deficit relative to recharge = extraction − recharge = 7,000,000 − 4,000,000 = 3,000,000 m3/year. (2 marks)
   b) Percent reduction required to meet safe yield:

- Current extraction = 7,000,000 m3; safe yield = 5,000,000 m3; required reduction = (7,000,000 − 5,000,000) = 2,000,000 m3.
- Percent reduction = 2,000,000 / 7,000,000 × 100% ≈ 28.57% -> 28.6% (4 marks: 2 for method, 2 for correct percent to at least one decimal or rounded appropriately)

4. (6 marks) Model comparative points

Desalination — Benefits

- Reliable drought-proof supply (reduces dependence on recharge). (0.75 marks)
- Can supply large volumes to support growth and tourism. (0.75 marks)
  Desalination — Drawbacks
- High energy use and greenhouse gas emissions if powered by fossil fuels; costly to run (capital + O&M). (0.75 marks)
- Brine disposal harms marine ecosystems near discharge sites; social opposition and high costs could raise water prices. (0.75 marks)

Conservation program — Benefits

- Low-cost per unit water saved; reduces demand pressure and supports long-term sustainability. (0.75 marks)
- Encourages behavioral change and can be designed progressively to protect vulnerable households. (0.75 marks)
  Conservation program — Drawbacks
- May not yield enough immediate volume to meet shortages in severe drought without strict curtailment. (0.75 marks)
- Requires administrative capacity and enforcement; may be politically contentious if pricing burdens fall unevenly. (0.75 marks)

Scoring: award per benefit/drawback pairs; credit given for sound reasoning and link to environmental/economic/social trade-offs.

5. (2 marks)

- Correct answer: C. Carrying capacity and over-extraction (2 marks)

6. (5 marks) Model memo (example; award partial credit for clearly argued alternatives)
   Example content (approx. 130 words):
   "As a small-scale fisher, I request the council implement a seasonal nearshore closure for spawning months and fund community-led eelgrass restoration. Evidence: fish catch declined 30% over five years (Station C), and eelgrass beds are shrinking near the marina. A seasonal closure (April–June) would protect juveniles and allow recovery while offering targeted compensation (temporary fisher subsidies) to offset income loss. Measurable outcome: maintain or increase juvenile fish abundance indices by 20% in three years (measured via standardized juvenile surveys). This action balances conservation with livelihoods through time-bound protection and local stewardship."

Scoring:

- 2 marks for a clear, actionable management action
- 1.5 marks for justification using station data
- 1 mark for measurable outcome
- Deduct up to 0.5 marks for lack of clarity or missing stakeholder consideration

7. (6 marks) Model 3-step consultation process

Step 1 — Stakeholder mapping + targeted outreach (2 marks)

- Activity: Identify and invite representatives (farmers, fishers, municipal managers, tourism reps, youth, NGOs) and hold accessible sessions (evening + online).
- Outcome: Representative advisory list and initial reporting of priorities.

Step 2 — Evidence-sharing inquiry stations & scenario workshops (2 marks)

- Activity: Rotate small groups through data stations (water, energy, fisheries) with facilitators; share mini-lessons on disciplinary thinking (e.g., trade-offs, scale).
- Outcome: Shared fact-base and documented trade-off options (e.g., desalination costs vs conservation yields).

Step 3 — Deliberative ballot + implementation monitoring plan (2 marks)

- Activity: Use facilitated deliberation culminating in a ranked-choice decision or citizen jury recommendation; agree on monitoring metrics and timelines.
- Outcome: Community-endorsed decision and monitoring plan; clear responsibilities.

Scoring: 2 marks per step for activity + clear civic outcome and inclusion of at least two stakeholder groups.

8. (4 marks) Model conceptual model (example)

- Boxes+arrows description:
  - Land-use change (urban expansion) -> increased impervious surface -> reduced recharge rate.
  - Groundwater extraction (pumping) □ increases with municipal/agricultural demand.
  - Reduced recharge + sustained extraction -> lower groundwater levels -> reduced freshwater input to coastal zone -> stress on eelgrass beds -> reduced juvenile fish recruitment -> lower fish catches.

- Feedback loop:
  - Reinforcing loop: Lower fish catches -> increased pressure on remaining fishing grounds -> potentially increased fuel/effort to maintain catches -> further ecosystem stress (Reinforcing).
    Scoring: 3 marks for model clarity and correct linkages; 1 mark for identifying reinforcing feedback.

9. (6 marks) Model responses (teacher will use peer-feedback rubric categories)
   Example — Against desalination (sample arguments)

- Argument 1: High energy use will increase emissions unless powered by renewables; current local renewable capacity is limited (Station B: local renewables 15%), making desalination carbon-intensive. (1 mark)
- Argument 2: Brine discharge risks further degradation of nearshore habitats, including eelgrass beds already in decline (Station C). (1 mark)
- Argument 3: Capital and operating costs likely to raise water rates, disproportionately affecting low-income households and tourism-dependent workers. (1 mark)
- Argument 4: Alternatives (demand reduction, brownfield solar + local storage) could deliver water and energy co-benefits at lower environmental cost. (1 mark)

- Civic action step: Commission a comparative environmental and social impact assessment and a cost-benefit analysis including community consultations within 6 months. (1 mark)
- Prioritized stakeholder groups: Small-scale fishers and low-income households (explain: fishers depend on healthy nearshore ecosystems; low-income households are most vulnerable to rate increases). (1 mark)

Scoring by rubric:

- Argument clarity (0–2): award based on clarity (e.g., 2).
- Use of evidence (0–2): award if station data cited (e.g., 2).
- Counterarguments (0–1): award 1 if one counterpoint acknowledged (e.g., "may provide reliable supply" noted and contested).
- Civic feasibility (0–1): award 1 for practical next step. Total = up to 6 marks.

10. (4 marks)

- Cause: Urban expansion (from 10% -> 45%) likely decreased permeable surfaces and increased water demand (cause — land-use change and population growth). (2 marks)
- Effect: Reduced recharge and increased extraction pressure, contributing to groundwater deficits and stresses on ecological resources (effect). Use Station A data: extraction 7M vs recharge 4M supports this effect. (2 marks)

11. (5 marks)
Given: Agriculture reduces 20% (3,000,000 -> 2,400,000 m3). Industry reduces 10% (1,000,000 -> 900,000 m3). Other remains 500,000.

a) New municipal allocation to meet safe yield:

- Non-municipal total = agriculture 2,400,000 + industry 900,000 + other 500,000 = 3,800,000 m3.
- Safe yield = 5,000,000 m3 -> municipal allowed = 5,000,000 − 3,800,000 = 1,200,000 m3/year. (3 marks: 2 for arithmetic, 1 for clear statement)

b) Per-capita daily municipal water volume:

- Annual per-capita = 1,200,000 m3 / 25,000 people = 48 m3/person/year = 48,000 liters/year.
- Daily per-capita = 48,000 liters / 365 ≈ 131.5 liters/person/day ≈ 132 L/day. (2 marks: 1 for conversion and arithmetic, 1 for final daily value with units)

12. (4 marks)
Two weaknesses (model answers)

- Weakness 1: Omits energy and emissions cost — desalination requires energy; Station B shows local renewables only 15% of current mix, so desalination would likely increase fossil fuel reliance unless paired with renewables. Explains why claim "no trade-offs" is false. (2 marks)

- Weakness 2: Ignores marine ecological impacts — brine disposal can harm eelgrass and nearshore fish nurseries (Station C indicates eelgrass decline), so environmental trade-offs are significant and need mitigation. (2 marks)

13. (4 marks)

- Explanation (2 marks): Spatial distribution — urban expansion concentrated in certain zones increases impervious surfaces and raises municipal demand concentrated in urban areas, while agricultural water access may be protected (or vice versa), producing unequal access; tourism peaks concentrate resource strain at certain times, exacerbating burdens on lower-income residents and seasonal workers.
- Policy measure (2 marks): Implement a progressive water tariff with lifeline allocation (basic water needs at low cost) and targeted subsidies for low-income households; pair with investment in leak repair in lower-income neighborhoods to reduce losses. Scoring based on specificity and equity focus.

14. (4 marks)
Four measurable indicators (each 1 mark with rationale)

- Indicator 1: % of locally generated electricity used within co-op monthly (rationale: measures self-reliance and reduced import dependence).
- Indicator 2: Peak load reduction (kW) during summer months (rationale: shows effect on grid stress and resilience).
- Indicator 3: Number of participating households and equitable participation (% low-income households included) (rationale: measures social inclusion).
- Indicator 4: System uptime/availability (%) and battery cycle degradation rate (rationale: tracks technical viability and maintenance needs).

15. (13 marks) Model synthesized recommendation (example up to 300 words)
Integrated policy package (6 marks: 2 marks per coordinated action)

- Action 1 — Demand management & equity protections: Institute a conservation program combining tiered pricing with lifeline allocations, prioritized leak repair, and subsidized low-flow fixtures for vulnerable households (reduces demand while protecting equity).
- Action 2 — Targeted supply diversification: Invest in distributed renewables (brownfield and rooftop solar + storage described in Station B) and a small-scale, emergency desalination unit with renewable power and strict brine mitigation only as last-resort supply for extreme droughts.
- Action 3 — Ecosystem-based fisheries & land stewardship: Establish seasonal nearshore closures for spawning, fund eelgrass restoration near the marina, and create water-sharing agreements with farmers tied to efficiency incentives (aligns resource health with livelihoods).

Addressing mastery threads (4 marks)

- Chronology and change: The package recognizes long-term land-use shifts (urban expansion

1980–2020) and prioritizes actions (leak repair, distributed renewables) that reverse trends causing reduced recharge.
- Civic decision-making & perspective taking: The plan includes targeted consultations, compensation mechanisms for fishers, and equitable lifeline allocations, ensuring decisions include multiple stakeholder perspectives and procedural fairness.

Three measurable indicators with targets (3 marks)

- Indicator 1: Annual groundwater extraction ≤ 5,000,000 m3 within 3 years (target = safe yield). (1 mark)
- Indicator 2: Increase local renewables share of local supply from 15% to 40% in 5 years (measure via local generation kWh). (1 mark)
- Indicator 3: Juvenile fish abundance index up by 20% in 3 years and eelgrass coverage stabilized or increased by 10% in 5 years (monitoring transects). (1 mark)

Scoring: 6 marks for three coherent, coordinated actions (2 each); 4 marks for explicit thread connections (2 threads × 2 marks each if well argued); 3 marks for three measurable indicators with realistic targets and alignment to actions.

End of exam.